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**EXECUTIVE SUMMARY****1. INTRODUCTION****1.1 GENERAL**

The Himachal Pradesh State Electricity Board (HPSEB) proposes to develop the Sainj hydro-electric project with a total installed capacity of 100 MW in the state of Himachal Pradesh. The project has been handed over to Himachal Power Corporation Limited (HPCL) under the control of Government of Himachal Pradesh. The project is located up-stream of the Parbati Stage –III (520 MW) project, which at present is under construction.

The proposed Sainj Hydro Electric project is located in Sainj Sub Tehsil of district Kullu at a distance of about 35 km from NH-21. The project is a runoff river scheme over river Sainj, a tributary of river Beas. The barrage site is proposed to be located near village Niharani of Godapur Panchayat. Likewise, power house is proposed near village Suind of Rohilla panchayat in Sainj sub-tehsil and Banjar main tehsil of Kullu district. The power house of the Sainj Hydro-electric project is located about 300 m upstream of proposed power house of the Parbati Stage-II. The barrage and power house sites are located at a distance of 58 km and 46 km from Kullu, (district headquarters) respectively. The project location has been shown in Figure-1.

**2. PROJECT DESCRIPTION**

The salient features of project are briefly described as below:

- 24.5 m high Diversion gated barrage at an elevation of  $\pm 1733$ m, downstream of village Niharni on river Sainj. The FRL and MDDL is proposed at an elevation of  $\pm 1752$  m and  $\pm 1738.50$  m respectively, to attain a live storage of  $\pm 38.41$  ham to meet up diurnal peaking requirement during lean months.
- Two underground disilting tanks (145mx15mx7.5m) to exclude all silt particles down to 0.2 mm Size.
- A Head Race Tunnel (HRT) on the right bank of river Sainj, of about  $\pm 6.3$  km long with 3.76 m diameter designed to carry a discharge of 28.70 cumec.
- Two intermediate adits 320 m and 430 m long and 4 m D-shaped proposed at RD 930 m and 4750 m respectively to facilitate construction of HRT.
- An underground restricted orifice surge shaft at the end of HRT - adit to top elevation  $\pm 1766.5$  m and another adit at Bottom Elevation +1672.37m is proposed to facilitate the construction of surge shaft
- An underground pressure shaft of  $\pm 2.75$  m diameter, 550 in long to carry discharge into power house.
- An underground power house to be located on right bank of river Sainj near confluence of Jiwa Nallah and Sainj river, which will have two units of 50 MW each to provided total installed capacity of 100MW.

- A tail race tunnel (TRT) of 400 m long and 4.8 m D-shaped, will constructed for discharging the water back into river Sainj.
- Infrastructure works like construction of approach roads, bridge, colony office complex, school and hospital.
- Energy generation of 399.57 GWh and 436.90 GWh at 90% and 50% dependable years are envisaged as a result of commissioning of the project.

The total land requirement for the project is 56.763 ha. The project is proposed to be completed in about 4.5 years. The project layout plan has been shown in Figure-2

### **3. ENVIRONMENTAL IMPACT ASSESSMENT STUDY**

The study area covered as a part of the EIA study is as below:

Upstream of the dam site	: 10 km on either side from the periphery of reservoir submergence
Downstream of the dam site	: 10 km on either side of the river
Catchment Area	: Catchment area intercepted at barrage site

The baseline status is described briefly in the following sections.

#### **3.1 PHYSIO-CHEMICAL ASPECTS**

##### **3.1.1 Meteorology**

The climate of the project area is characterized by cool and dry climate. Meteorologically, the year can be divided into three distinct seasons. Winter season sets in from the month of October and continues upto February, followed by summer season from March to June. The area receives rainfall under the influence of south-west monsoons over a period of three months from July to September. June is the hottest month of the year, with mean maximum and minimum monthly temperatures of the order of 32.9°C and 26.6°C respectively. January is the coldest month of the year. The annual average rainfall in the project area is 1459.2 mm. Majority of the annual rainfall is received under the influence of south-west monsoons. During the period from January to April, winter precipitation occurs in association with the passage of western disturbances. The winter precipitation accounts for nearly 40% of the annual rainfall. Relative humidity is maximum (91%) during the monsoon months, while it is minimum (50%) in the summer months of April-May.

##### **3.1.2 Geology**

The project area falling within the bandal gneissic complex of the Larji Rampur tectonic window. The various project appurtenances are proposed to be located along the right bank of the sainj river valley. The upstream of the project area is occupied by gneissic rocks of bandal gneissic complex comprising granitoid gneiss with zones of younger intrusive granitoids and amphibolites. The litho-sequence thrust over the massive quartzite of Manikaran formation, which in turn overlie the green phyllites of banjar volcanics-belonging to rampur group of rocks.

### 3.1.3 Seismology

The project area falls in under seismic zone-V, as per IS: 1894: 2002 i.e highest seismic zone in Western Himalayas. In the past, the region has been affected with a number of strong earthquakes.

### 3.1.4 Land Use Pattern

The land use pattern of the study area has been studied through digital satellite imagery data. The land-use pattern of the study area as per the satellite data is given in Table-1.

**TABLE- 1**  
**Land use pattern of the study area**

<b>Land use cover</b>	<b>Area (ha)</b>	<b>Percentage of Study Area (%)</b>
Dense vegetation	19,999	39.73
Open vegetation	21,199	42.10
Forest area	41,198	81.83
Agriculture land	1,670	03.32
Barren land /pasture land	4,854	09.64
Water body	1,187	02.36
Snow covered area	1,389	02.76
Built-up area/Exposed rock	54	00.11
<b>Total</b>	<b>50,352</b>	<b>100.00</b>

The major land use category in the study area is forest land, which accounts for almost 81.83% of the study area. The other major category is barren land accounting for about 9.64% of the study area. The agriculture land accounts for about 3.32% of the study area. The area under snow cover and water bodies account for about 2.76% and 2.36% respectively of the study area. The area under settlement / exposed rock is about 0.60% of the study area.

### 3.1.5 Soils

The soil in the study area is young like any other region of Himalayas. Soil on the slope above 30°, due to erosion and mass wasting processing, are generally shallow and usually have very thin surface horizons. As a part of field studies, soil samples from the catchment area were collected and analyzed for various physio-chemical parameters. The pH of soil at various sites lies within neutral range. The levels of NPK indicate moderate to high soil productivity. The sodium levels do not indicate any potential for soil salinization or adverse impacts on soil productivity.

### 3.1.6 Water Resources

River Sainj is the major tributary of the river Beas, originating from west of Rakti Dhar at an elevation of  $\pm 5500$  m. The total catchment area of river Sainj intercepted at the barrage site is 408 sq.km. of which 176 sq.km. is permanently under snow (above elevation of 4250 m). The minimum flow for 90% dependable year is observed as 4.82 cumec in the month of November.

As a part of the field studies, water samples were collected from various locations in the study area. The sampling was conducted from three seasons namely summer (April 2007), Monsoon (July 2007) and winter (December 2007). The total hardness in water samples ranged from 55-65 mg/l in summer, 47-60 mg/l in post-monsoon and 53-77 in winter seasons respectively. The low hardness level in the low calcium and magnesium levels are responsible for soft nature of water. The concentration of TDS level ranged from 124 to 145 mg/l, 109 to 139 mg/l and 126 to 140 mg/l in summer, monsoon and winter seasons respectively, which is much lower than the permissible limit of 500 mg/l specified for domestic use. This is also reflected by the fact that the concentration of most of the cations and anions are well within the permissible limit. The BOD and COD values are well within the permissible limits, which indicate the absence of pollution loading. It can be concluded that water quality of river Sainj can be considered as Class-A as per IS:2296 and can be used for meeting drinking water requirements after disinfection.

### **3.1.7 Ambient Air Quality**

Ambient air quality monitoring has been carried out with a frequency of two samples per week at three locations for three seasons. The monitoring was conducted for three seasons, viz., summer season (April - May 2007), post-monsoon season (October 2007) and winter (November - December 2007). The baseline parameters monitored were Suspended Particulate Matter (SPM), Respirable Particulate Matter (RSPM), Sulphur dioxide (SO<sub>2</sub>) and Oxides of Nitrogen (NO<sub>x</sub>). The values of these parameters were well below the permissible limits specified for residential, rural and other areas. The absence of industries, low vehicular traffic and low population density can be attributed for good ambient air quality in the project area.

### **3.1.8 Noise Environment**

Baseline noise data has been measured for three seasons. The day time equivalent noise level in summer and monsoon seasons at various sampling stations ranged from 32 to 45 dB(A), 34 to 46 dB(A). Likewise, day time equivalent noise level in winter season ranged from 37.5 to 39.6 at various sampling stations which were well within the permissible limit specified for residential area.

## **3.2 ECOLOGICAL ASPECTS**

### **3.2.1 Flora**

**Forest type:** The proposed project lies in the Sainj valley. The study area comes under Sainj, Forest Range and Jiwa Forest Range under the Great Himalayan National Park Conservation Area (GHNPCA). The forest types observed in the study area include, the Himalayan Chir Pine forest, Broad leaf forest, Conifer mixed with broad leaf forest, Secondary scrubs and Sub-tropical Riverine Forest.

**Floral Composition of the catchment area:** Chir Pine (*Pinus roxburghii*) is the dominant forest category in the catchment area. The coniferous tree species, e.g. *Cedrus deodara*, *Picea smithiana*, *Pinus wallichiana*, *Taxus wallichiana*, etc. form the top storey inter-mixed with species of *Acer*, *Prunus*, etc. In Sainj Valley, good forest can be seen on both sides of slopes. Sub-tropical forest of Chir Pine (*Pinus roxburghii*) can be seen in the lower reaches amidst orchards and agricultural lands as well.



**Endemic and monotypic species:** A number of monotypic genera distributed along the altitudinal cline were also reported in the Sainj Valley. Some of these taxa are *Asperugo procumbens* (Boraginaceae), *Boenmingausenia albiflora* (Rutaceae), *Hemiphragma heterophyllum* (Scrophulariaceae), *Parochetus communis*, *Ougeinea oogeinensis* (Fabaceae) and *Oxyria digyna* (Chinopodiaceae).

Some of the endemic Himalayan taxa are also reported from the Sainj Valley. These include *Aconitum chasmanthum* (mohra), *Atropa acuminata* (Jharka), *Codonopsis ovata* (Seerdandi), *Dioscorea deltoidea* (singli mingli) *Gentiana kurroo* (kurroo) *Meconopsis aculeate* (Poppy), *Nardostachys Jatamansi* (Jata masi), etc.

The project area lies in the vicinity of Great Himalayan National Park (GHNP) (Refer Figure-3). The tail end of the submergence is situated about 1.0 km from the boundary of GHNP and 1.5 km from the Sainj Wildlife sanctuary.

**Field Studies:** As a part of the EIA study, a detailed Ecological survey was conducted for three seasons namely summer, post-monsoon and winter. A total number of 115 plant species were recorded during the floristic survey in the study area. Species diversity of the study area is given in Table 2.

**TABLE - 2**  
**Species diversity of the project area**

Groups	No. of Species
Angiosperm and Gymnosperms	
• Trees	27
• Shrubs	18
• Herbs	39
• Grasses	8
Pteridophytes	8
Bryophytes	6
Lichens	3
Fungi	6
<b>Total</b>	<b>115</b>

**Dominance of various floral species:** Ecological analysis reveals that *Alnus nepalensis* (IVI: 57.543), *Juglans regia* (IVI 40.730), *Aesculus indica* (IVI:38.189) and *Cedrella toona* (IVI: 37.385) are the most dominant tree species in the area near the barrage site and submergence area. In the same area, shrubs were dominantly represented by the species of *Viburnum mullaha* (IVI:42.514) followed by *Sinarundinaria falcta* (IVI: 30.089) and *Desmodium gangeticum* (IVI: 27.334) and *Girardinia diversifolia* (IVI: 27.069). The dominant herbs, in the same area, were the species of *Impatiens bicolor* (IVI: 36.502), *Achyranthes asper* (IVI: 33.395) and *Poa pratensis* (IVI: 28.436).

The area between proposed power house & barrage site is dominated by the tree species of *Alnus nepalensis* (IVI:43.559), *Pinus roxburghii* (IVI: 33.290), *Juglans regia* (IVI: 30.087) and *Boehmeria regulosa* (IVI:28.150). Shrubs were dominated by *Viburnum mullaha* (IVI:50.449), *Sinarudinaria falcata* (IVI : 38.842), *Desmodium gangeticum* (IVI: 30.206) and *Chenopodium sp* (IVI:29.016). Herbs were dominantly represented by *Acyranthes asper* (IVI:47.458), *Impatiens bicolor* (IVI: 37.505) , *Tagetes erecta* (IVI: 33.608) and *Urtica dioica* (IVI: 25.267).



The area near the proposed power house area is dominated by the tree species of *Cedrella toona* (IVI: 49.096), *Ficus hispida* (IVI:48.556), *Populus ciliata* (IVI: 46.367) and *Pinus wallichiana* (IVI:44.409). Shrubs at the same location were dominated by *Zanthoxylum armatum* (IVI: 42.691), *Desmodium gangeticum* (IVI: 30.958), *Chenopodium* sp (IVI: 28.632) and *Clematis* sp (IVI:28.375). Herbs were dominantly represented by *Acyranthes asper* (IVI:43.176), *Ipomea nil* (IVI:34.938) and *Cynodon dactylon* (IVI:33.126).

**Threatened Status of Flora:** Of the trees species observed in the study area, *Betula alnoides*, which is rare species, was reported during survey. This tree species is of economic importance. Amongst shrubs, *Desmodium gangeticum* and *Sorbus acuparia* belong to rare category. Two species of herbs (*Bistorta macrophylla* and *polygonatum verticiltum*) are also of rare category observed in the study area.

### **3.2.2 Fauna**

The proposed project lies in the vicinity of the Great Himalayan National Park (GHNP). During field study, effort was made for siting of fauna. The primates are represented by rhesus macaque (*Macaca mulatta*) and common langur (*Presbytis entellus*) and are found to occur between 1440 m and 3420 m. The most frequently encountered mammal in the area is goral (*Nemorhaedus goral*) which occupies a wide range of habitat from temperate to sub-alpine forests.

The commonly observed reptiles in the area are Agama (*Agama tuberculata*), Gecko (*Cyrtodactylus lawderanus*), Himalayan pit viper (*Agkistrodon himalayanus*), Russell's viper (*Vipera russelli*), Skink (*Mabuya* sp.) and Indian rat snake (*Ptyas mucosus*), etc.

The avi-faunal diversity mainly comprises of a number of species of Babblers, Barbets, Blackbirds, Bulbuls, Bullfinches, Buntings, Chats, Cuckoos, Dippers, Doves, Drongos, Eagles, Finches, Flycatchers, Forktails, Goldcrests, Hawks, Kestrels, Kites, Martins, Minivets, Mynas, Nightjars, Niltavas, Nutcrackers, Nuthatches, Owls, Parakeets, Partridges, Peafowl, Pheasants Pigeons, Pipits, Redstarts, Rosefinches, Shrikes, Sparrows, etc.

Some of the important breeding migrants in this area are Ashy drongo (*Dicrurus leucophaeus*). Dark-Sided flycatcher (*Muscicapa sibirica gulmergi*). Asian brown flycatcher (*M.dauurica*), white-tailed rubythroat (*Luscinia pectoralis*), Barn swallow (*Hirundo rustica rustica*), Tickell's leaf warbler (*P. affinis affinis*), Greenish warbler (*P. trochiloides trochiloides*) and Golden-spectacled warbler (*Seicercus burkii whistleri*). A number of these breeding migrants come far away from warm plains and also from foothills to these habitats for breeding.

Insects in general are suited for monitoring landscape changes because of these abundance, species richness ubiquitous occurrence and importance in the function of the natural ecosystem. Insect are the major component of the bio-diversity by virtue of their vast numbers of both species and individual they are vital determinants of terrestrial ecological processes. GHNP due to its strategic location and large altitudinal variation provides a diverse habitat of fauna and flora. A total 37 families of different group of insects representing 108 genera and 125 species has been reported from GHNP. The order lepidoptera (butterfly and moth) represents higher diversity in terms of 55 genera and 61 species.

**Threatened Status of Fauna:** The following rare and endangered species have been reported sited in the study area.

Name	Status
<b>Mammals</b>	
<i>Canis lupus</i>	Endangered
<i>Ursus arctos</i>	Endangered
<i>Panthera pardus</i>	Endangered
<b>Birds</b>	
<i>Tragopan melanocephalus</i>	Endangered
<i>Catreus walichii</i>	Endangered

The barrage site is located close to the Great Himalayan National Park (GHNP). A map showing location of the project layout vis-à-vis Great Himalayan National Park is enclosed as Figure-3.

### 3.2.3 Aquatic Ecology And Fisheries

#### (A) Aquatic Ecology

The aquatic ecological survey for summer post-monsoon and winter seasons was conducted in the months of April 2007 and October 2007 respectively.

**Periphyton and Phytoplankton:** Dominance of periphyton was observed in the rapids, while, few phytoplankton were present in the pools. Periphyton were represented by 21 members of the families of Bacillariophyceae, Chlorophyceae and Myxophyceae. However, only 12 members of phytoplanktons were represented by the families of Bacillariophyceae, Chlorophyceae and Myxophyceae. The total density of periphyton ranged from 1,376 ind. m<sup>-2</sup> to 4,248 ind. m<sup>-2</sup>, which was dominated by the members of Bacillariophyceae. The population of phytoplankton were sparse (101.1 - 329.6 ind. l<sup>-1</sup>) at all the sampling sites. The diversity index was in range of 1.7565 to 2.0157 which shows the poor diversity of phytoplankton in Sainj river.

**Zooplankton:** Zooplanktons were represented by the taxa *cladocera* (01) and *Rotifera* (03). Density of zooplankton was present in the range of 36.7 – 143 ind. l<sup>-1</sup>. The diversity index was in the range of 1.0865 – 1.2976 at all the sites. It indicates the poor diversity of zooplankton in river Sainj.

**Macrozoobenthos:** Macrozoobenthos of Sainj River were represented by the members of Ephemeroptera (08), Trichoptera (07) and Diptera (04). Ephemeroptera contribution was maximum to the total macrozoobenthos. The density of macrozoobenthos was present in the range of 436– 1,996 ind. m<sup>-2</sup>.

#### (B) Fisheries

The river Sainj and its tributaries have variety of cold water fishes dominated by trout. The major fishes species reported in river sainj and its tributaries are given in Table 3.

**TABLE 3**  
**The major fishes species reported in river Sainj and its tributaries**

Scientific Name	Local Name
<i>Schizothorax plagiostromus</i>	Snow Trout
<i>Schizothorax progastus</i>	Snow Trout
<i>Schizothorax richardsonii</i> *	Snow Trout
<i>Salmo trutta fario</i> *	Brown trout
<i>Salmo gairdneri gairdneri</i> *	Rainbow trout
<i>Barilius</i> spp.	-
<i>Nemacheilus</i> spp.	-

\* Species observed during survey

The fisheries survey was conducted during April 2007 and October 2007. The catch per man-hour was 250 gm. *Schizothorax richardsonii* was the dominant species in catch composition. The size observed 100 mm to 200 mm..

**Fish Migration:** *Schizothorax richardsonii* is the only commercial species observed in river Sainj in the project area. This species in normal course of its life cycle undertakes long journey during winter months to migrate in the lower reaches in warmer waters. With the warming of water in the lower reaches, in summer season the species migrates towards the upstream reaches. During its upstream movement, in the months of May and June, this species breeds in the several side streams.

Only three species *Salmo trutta fario*, *Salmo gairdneri* and *Schizothorax richardsonii* were observed during fishery survey. The presence of small fishes near confluence of Jiwa Nallah indicates that there is a possibility of migration of these species in Jiwa Nallah.

### 3.3 SOCIO-ECONOMIC ASPECTS

A comprehensive socio-economic primary survey was carried-out in those villages where land is proposed to be acquired for the proposed Sainj hydro-electric project. For identification of PAFs, i.e., families likely to lose their lands and/or homesteads, extensive use of Record of Rights (ROR), viz., revenue records was made. Information to assess the socio-economic profile and property enumeration of project affected families (PAFs) was collected with the help of a detailed quantitative 100% primary survey in the affected villages. As per ROR, about 206 persons/ land titleholders were identified, who are expected to lose land (agricultural/non-agricultural/homestead) in varying proportion. However, during survey the survey team had covered 148 project affected families.

#### Demographic Profile of Affected Population

- Census survey covering 100% of the PAFs were carried-out in 3 village panchayats, namely, Sachen, Shainshar and Gara Parli, which included 11 project affected hamlets/ villages that reckoned about 148 families.
- The entire population within the project area is primarily Hindus. About 93.8% belong to the upper caste category, followed by Scheduled Castes (SC) which accounted for about 3.4% of the total population, followed by the Backward Caste category, which comprises of about 0.68% of the total PAFs.

- As per the survey, the total affected population is of the order of 436 persons in 148 families. Males and females constitute about 54.36% and 40.82% of the total affected population respectively.
- About 39.45% of the project-affected population is illiterate/ not going to school. The remaining population (60.55%) is either literate or is presently continuing with their education.
- About 36.47% are gainfully engaged in an economic activity. This group consists of persons engaged in cultivation, government service, private service, business, artisans and labour, which constitute about 29.81%, 3.89%, 0.92%, 0.46%, 0.46 and 0.92% respectively of the total surveyed population.\
- Practically all the affected families reared domesticated animals for milk, meat, eggs and labor. Cows are mainly reared for their milk. It was observed that bulls are used extensively for ploughing the agricultural fields..
- No family was houseless. About 37% of the houses were electrified. It was observed that many of the houses were single storey, and some houses had more than one floor. Houses on an average had about 2 to 3 rooms. Stone, brick and mud were used to build the walls of the houses, while the roof was mostly made of wood and tiles.
- PAFs made use of pipe and tap which is connected to a system of pipe network connected to taps which were either locally assembled or provided by the government.
- Some PAFs, if not all, own some material assets. These assets include television sets, tape recorders, transistor radio, LPG cylinder, refrigerators, bicycle, motor cycles, four wheelers, etc. In addition, there are some families who own agricultural implements such as, ploughs, pump sets, cultivators, chaff cutters, threshers, etc.
- As per the survey, it was observed that more than 75% of the PAFs were aware about the proposed Sainj hydro-electric power project.

#### **4. PREDICTION OF IMPACTS**

##### **4.1 IMPACT ON WATER ENVIRONMENT**

###### **4.1.1 Water quality**

###### **A) Construction phase**

**Sewage from labour colony:** The peak migrant population is likely to be of the order of 3,200. The quantum of sewage generated due to this population is expected to be of the order of 0.18 mld. Even at minimum flow, sufficient dilution is available. Thus, no significant impact on water quality of river Sainj is envisaged during construction phase.

**Effluent from crushers and other sources:** The effluent from the crushers and other sources, like adit, tunnel, would contain high suspended solids. It is proposed to treat the effluents in settling tanks. Thus, no significant impact is envisaged.

### **B) Operation phase**

**Effluent from project colony:** During operation phase, only a small number of O&M staff will reside in the colony. The sewage generated would be provided biological treatment before discharge.

#### **4.1.2 Sediments**

The proposed project is envisaged as a runoff the river scheme with a barrage. At regular intervals, the gates of the barrage shall be opened to flush the sediments. Thus, in the proposed project, sedimentation problems are not anticipated.

#### **4.1.3 Water Resources and downstream users**

The river stretch downstream of the barrage site upto the confluence point of tail race discharge will have reduced flow for a length of about 8 km. In the intervening stretch, the flow shall be implemented by (i) releases of flushing discharges from desilting chamber, (ii) contribution of flow from various streams/nallahs in the confluence of tail race disposal and (iii) gates of barrage will remain open leading to continuous flow in the downstream river stretch during monsoon months.

The river stretch downstream of the barrage site upto the confluence point of tailrace discharge (about 8 km) will have reduced flow i.e. 0.60 cumec. However, the flow will be augmented by contribution of flow from Kartol nallah (2.5 km downstream) joining the Sainj river on its right bank and other small khads joining the river from the left bank, which are Kotli, Khad (4 km downstream), Shana Khad (6 km downstream) and Nuhara Khad (7.5 km downstream) of the barrage. Thus, river Sainj will not be completely dry, in the intervening stretch. The reduction in flow or drying of the river in the intervening stretch is not likely to have any adverse impact on the downstream users. This is mainly because of the fact that settlements/ villages within this dry stretch are not dependent on the water of river Sainj, as the villagers use water of small streams or nallahs flowing adjacent to their habitation.

## **4.2 IMPACT ON AIR ENVIRONMENT**

**Pollution due to fuel combustion:** The major construction equipment would be operated through electricity. Therefore, fossil fuel combustion would be minimal. Diesel would be used only in contingency. Thus, no significant impact on ambient air quality is expected as a result of operation of various construction equipment. No significant impact is envisaged.

**Emissions from various crushers:** During crushing operations, there would be emissions of dust particles. Minimal impact is expected during construction phase. Therefore, commissioning of cyclone is suggested. Further, the labour camps would be located on the leeward side of the crusher with respect to predominant wind directions.

### **4.3 IMPACT ON NOISE ENVIRONMENT**

The operation of construction equipment is likely to have insignificant impact on the ambient noise level. However, blasting can have adverse impact on wildlife, especially along the alignment of the tunnel portion. A necessary mitigation measure has been suggested as a part of EMP.

### **4.4 IMPACTS ON LAND ENVIRONMENT**

**Impacts due to quarrying :** In a hilly terrain, quarrying is normally done by cutting a face of the hill. A permanent scar is likely to be left, once quarrying activities are over. With the passage of time, they become a potential source of landslide. Thus it is necessary to implement appropriate slope stabilization and quarry reclaiming measures.

**Impacts due to muck disposal :** A large quantity of muck is expected to be generated as a result of tunneling operations, construction of roads, etc. The same requires to be suitably disposed. Normally, muck is deposited in low lying areas or depressions. Proper disposal and reclamation has been suggested as a part of EMP.

**Impacts due to land acquisition:** The total land to be acquired for the project is 56.763 ha. A part of this land is required for labour camps, quarry sites, muck disposal storage of construction material, siting of construction equipment, which will be required temporarily and returned once the construction phase is over. Permanent acquisition of land is required for barrage axis, submergence area, project colony, etc. Proper compensation has been suggested as a part of the EMP.

### **4.5 IMPACTS ON ECOLOGY**

#### **4.5.1 Terrestrial Ecology**

**Increased human interferences:** A large population (3,200) is likely to congregate in the area during the project construction phase. This population residing in the area may use fuel wood (if no alternate fuel is provided). Therefore, alternate fuel should be provided to such population. Further, community kitchens should be provided using LPG or diesel as fuel.

**Acquisition of forest land:** The total forest land to be acquired is about 47.993 ha. Compensatory afforestation is proposed as a part of compensatory afforestation plan in the EMP.

**Disturbance to wildlife:** The operation of various construction equipment and blasting is likely to generate noise. These activities can lead to some disturbance to wildlife population. Further, the project area does not fall in the migratory routes of animals. Mitigation measures to minimize such impacts have been suggested in the EMP.

**Impacts on protected areas:** During project operation phase, the accessibility to the area will improve due to construction of roads, which in turn may increase human interferences leading to marginal adverse impacts on the terrestrial ecosystem. Sainj Wildlife Sanctuary (SWS) and Great Himalayan National Park (GHNP) is located within the study area. However, no land of the SWS and GHNP is proposed to be acquired for the project. Since



the project is in the vicinity of SWS and GHNP, a bio-diversity plan and anti-poaching strategy has been suggested to be implemented as a part of the EMP.

#### **4.5.2 Aquatic ecology**

##### **A) Construction phase**

Due to construction of the proposed Sainj Hydroelectric Project, about 0.8 Mm<sup>3</sup> of muck and debris would be generated at various construction sites. Based on the geological nature of the rock and engineering property of the soil, about 30% of the muck generated will be utilized as construction material. The remaining 70% would be dumped at designated sites. However, a proper muck disposal and management plan has been suggested as a part of the EMP to minimize such impacts.

##### **B) Operation phase**

The completion of Sainj Hydroelectric Project would bring about significant changes in the riverine ecology, as the river transforms from a fast-flowing water system to a quiescent lacustrine environment. Amongst the aquatic animals, it is the fish life which would be most affected. The migratory fish species, e.g. snow trout and brown trout are likely to be adversely affected due to obstruction created by the proposed barrage. With the completion of barrage, flow in the downstream stretch of the river would be reduced considerably more so during the lean period. A fish management Plan has been suggested to be implemented during operation of the project.

#### **4.6 IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT**

**Impacts due to influx of labour force:** During the construction phase a large labour force, including skilled, semi-skilled and un-skilled labour force of the order of about 3200 persons, is expected to immigrate into the project area. During the construction phase, the most important negative impact would be due to the temporary settling of labour force leading to filth, in terms of domestic wastewater, human waste, etc.

**Economic impacts of the project:** Apart from direct employment, the opportunities for indirect employment will also be generated which would provide great impetus to the economy of the local area. Various types of business like shops, food-stall, tea stalls, etc. Besides a variety of suppliers, traders, transporters will concentrate here and benefit immensely as demand will increase significantly for almost all types of goods and services. The locals will avail these opportunities arising from the project and increase their income levels. With the increase in the income levels, there will be an improvement in the infrastructure facilities in the area.

**Impacts due to land acquisition:** Another most important deleterious impact during construction phase will be that, pertaining to land acquisition. About 56.763 ha of land proposed to be acquired for the proposed Sainj hydro-electric project. Of this about 8.77 ha is private land (un-irrigated land). It is observed that about 216 PAFs are likely to lose land (agricultural and/or homestead) in varying proportions (refer Table – 4). No homestead land is proposed to be acquired



**TABLE – 4**  
**Village-wise details of project affected families**

<b>Village Name</b>	<b>Total</b>
Suchehan Kothi Vanogi	2
Fati Shainshar Koti Shainshar	129
Fati Gada Parli	76
<b>Total</b>	<b>206</b>

## **5. ENVIRONMENTAL MANAGEMENT PLAN**

### **5.1 COMPENSATORY AFFORESTATION AND BIODIVERSITY CONSERVATION PLAN**

#### **5.1.1 Compensatory Afforestation**

The total forest land to be affected due to the proposed project is about 47.993 ha. Of this, actual forest land to be acquired is 41.94 ha (including submergence area and other project appurtenance), while 6.053 ha is notional land. As a part of EMP, it is proposed to afforest double the amount of forest land being acquired for the project. Thus, a total of 83.88 ha (41.94x2) of land needs to be afforested. The afforestation work is to be done by the Forest Department. The expenditure required will be Rs. 5.90 million. In addition, the project proponent will pay an amount of Rs. 31.455 million to the Forest Department as Net Present Value (NPV). Further, cost of trees amounting to about Rs. 34.36 million shall be paid to the Forest Department, by the project proponents. Thus, total expenditure likely to be incurred on diversion of forest land in Rs. 71.715 million.

#### **5.1.2 Biodiversity Conservation**

##### **A) Conservation of Flora**

**In-situ Conservation Measures:** The in-situ conservation measures for the *Betula alnoides* species will be given highest priority. The Taxa will be identified and relocated in the similar habitats. Their niche requirements would be analyzed so that their relocation takes place smoothly and they are able to propagate naturally. The relocation sites will be selected in a manner so that these taxa are not exposed to any biotic or abiotic threat or pressure.

The nurseries of about 1 acre area will be located at the appropriate site in the broadleaf forests and the relocation habitats will be selected among the forests in the area. This exercise will be accomplished by the, State Forest Department. HPSEB will provide the necessary funding support. A provision of Rs.3.0 million has been kept for the same.

**Ex-situ Conservation Measures:** Ex-situ conservation measures will be pursued for threatened species which have low reproductive potential and efficiency. The taxa with low individual numbers will be selected and ex-situ conservation measures like seed collection, in vitro seed germination and nursery establishment will be carried out.

Plant tissue culture will be tried for mass multiplication of such taxa for which protocols are

already developed. Some of the species that need such conservation programmes are: *Desmodium gangaticum* (Safed kathi), *Delphinium denudatum* (Nirbishi), and *Polygonatum verticillatum* (Salam misri).

In-vitro regeneration of plant species of medicinal importance have been achieved through organogenesis and cell suspension cultures. Protocols for the in-vitro micro propagation of *Polygonatum verticillatum* (Jayanti Sengupta *et al.*, 1987) have been developed successfully. The use of in-vitro techniques not only helps in the conservation of this threatened species but also potentially increases the production of medicinally important compound for which the particular plant species is being exploited.

It is proposed that Institutions such as Y.S. Parmar University, Himachal Pradesh, Department of Botany, Punjab University, Chandigarh, NBPGR, New Delhi Himalayan Forest Research Institute of ICFRE at Shimla and G.B. Pant Institute of Himalayan Environment and Development, Regional Centre, Mohal (Kullu) shall be involved for the development of protocols for the in-vitro micro propagation and the subsequent re-introduction of these species in their natural habitats. The necessary funding support for setting up the laboratory and offices, chemicals and equipment, hardening facility and green houses/chick houses, etc. and maintenance for 5 years would be provided by HPSEB. A provision of Rs. 5.0 million has been considered for this purpose.

### **B) Conservation of Fauna**

Keeping in view the sudden influx of labour population in the 'wildlife rich areas, the following actions are suggested for the conservation of fauna in the region.

- i) Project authorities would ensure that strict vigil is kept especially during the breeding season of animals i.e. from October- December and when young ones are born/ nesting season, i.e. from March-June.
- ii) Activities like blasting or heavy machine operations producing noise levels more than 80-100 dB will be restricted during this period. Heavy penalties would be imposed for violation of this conduct by contractors/labourers, etc. during this period. These aspects shall be included in the Tender Document for the Contractor involved in construction works.
- iii) Information dissemination emphasizing the need of conservation and legal consequences on violation of Forest and Wildlife (Protection) Acts will be prioritised and publicised. Awareness would also be imparted to the labourers engaged in construction activities for exerting great restraint especially during critical months of breeding and nesting of animals and birds.
- iv) The signboards/Notice boards highlighting penalties for violation of rules, will be put nearby habitation areas of labourers.
- v) No firearms would be allowed in the valley and the visitors will be made to deposit any firearms with the forest check posts before entering these areas.

Some of the rare and endangered and Schedule-I animals including includes Snow leopard, Common leopard, Wolf, Leopard cat, Himalayan black bear, Himalayan brown bear, Bharal, Himalayan ibex, Himalayan tahr, Serow and Musk deer have been reported from the catchment area. Majority of the habitats of these animal species are away from the project sites, but some animals do stray into the areas where project works will be carried out. The project authorities would take the following steps in order to ensure habitat protection and

protection to animal and bird species like Monal and Western Tragopan around the project sites.

- Strict monitoring of laborers and associated workers for any activity related to endangering the life or habitat of wild animals and birds.
- Strict restrictions will be imposed on the workers at project sites to ensure that they do not harvest any produce from the natural forests and cause any danger or harm to the animals and birds in wild.
- Minimum levels of noise during construction activities will be maintained and no activity will be carried out at night since where the project site is in the close vicinity of natural animal/bird habitats.
- Fuel wood to the laborers will be provided from plantations meant for the purpose and/or the provision has been made for the supply of the free subsidized kerosene/LPG from the depots being set up for this purpose.
- It would be ensured that the contractors do not set up laborer colonies in the vicinity of forests and wilderness areas.

**C) Sainj Valley Conservation Cell**

- i) It is recommended that a Sainj Valley Conservation Cell (SVCC) be created under the aegis of Director, Great Himalayan National Park (GHNP). The funding support for this would be provided by the project authorities for a period of 5 years. A provision of **Rs.25.65 million** has been earmarked for setting up the Sainj Valley Conservation Cell.

**D) Environmental Awareness for Conservation**

The project authorities will provide assistance and funding support to the existing State Government agencies, like Forest Department, Greater Himalayan National Park in popularizing environmental conservation among the local inhabitants as well as outsiders. The packages will be in the form of incentives to the locals as well as educational awareness. A total of Rs. 2.0 million have been set aside for conducting various environment awareness programmes.

**E) Anti-Poaching Measures**

It is recommended that 2 check posts be developed in the major construction area i.e. one near intake and one near power house along the boundary of labour camps to coordinate anti-poaching activities in the GHNP. As already mention the SVCC will look after the anti-poaching measures. A total provision of **Rs.35.65 million** has been earmarked for biodiversity conservation, which includes Establishment of the Sainj Valley Conservation Cell, Conservation of Flora, Conservation of Fauna, and Environmental Awareness for Conservation.

Thus, a total provision of Rs. 107.365 million (71.715 + 35.65) has been earmarked for Compensatory Afforestation and Biodiversity Conservation.

## **5.2 CATCHMENT AREA TREATMENT PLAN**

The catchment area considered for treatment under the proposed Sainj hydroelectric project is 39,730 ha. The catchment area has been divided into 32 sub-watersheds in the present study. In the present study 'Silt Yield Index' (SYI), method has been used. CAT plan has been suggested for very high and high erosion category, as a part of the present EIA study, the expenses of which have to be borne by project proponents. The area under very high and high erosion categories is 13,234 ha, which is about 33.4% of the total catchment area intercepted at the barrage site. The following treatment measures have been suggested as a part of CAT plan:

- **Engineering measures**
  - Step drain
  - Check dams
  - Contour bunding
- **Biological measures**
  - Afforestation
  - Gap Plantation
  - Pasture development
  - Fuel wood and fodder development
  - Social forestry

The cost required for Catchment Area Treatment is Rs. 75.00 million which have to be borne by project proponent.

## **5.3 FISHERIES MANAGEMENT PLAN**

### **5.3.1 Release of minimum flow**

It is proposed to release 0.63 cumec from the barrage. The discharge shall be supplemented by contribution for the Kartol nallah (2.5 km downstream) joining river sainj on its right bank and other small khads joining the river from the left bank. These small khads include Kotli khad (4 km downstream), Shana khad (6 km downstream) and Nuhara khad (7.5 km downstream) of the barrage. The total discharge of these streams is about 1.4 cumec during lean season. Thus the minimum flow of 2.03 cumecs would be maintained during lean season.

### **5.3.2 Sustenance of Endemic Fisheries**

**Provision of fish ladder:** Snow trout (*Schizothorax richardsonii*) is the endemic species. The barrage on Sainj will be a barrier to the free movement of fish species. Therefore a provision of fish ladder has been made in the barrage.

**Supplementary stocking:** It is proposed to implement supplementary stocking programme in the project area. It is proposed to stock the river for a length of 10 km each on the upstream and the downstream sides. The rate of stocking is proposed as 100 fingerlings of about 30 mm size per km. All the three species i.e. Snow trout, Brown trout and Rainbow trout can be stock. The stocking can be done annually by the Fisheries Department, State

Government of Himanchal Pradesh. To achieve this objective, facilities to produce seed of trout would have to be created at suitable sites. The site would be identified in consultation with Fishery Department. The fishery department has proposed commissioning of a trout fish farm at Nagins (Banjar) located about 45 km from the proposed barrage site. The estimated amount for this facility is Rs. 13.23 million can be given to fishery department for up gradation of this farm. Seeds can be transported from this hatchery.

## **5.4 PUBLIC HEALTH DELIVERY SYSTEM**

### **5.4.1 Control of Malaria**

Various Primary Health Centres in the nearby villages and Hospital at District Head Quarters can coordinate the anti-malarial operations in association with the project authorities and implement the following measures:

- Site selected for habitation of workers should not be in the path of natural drainage.
- Adequate drainage system to dispose storm water drainage from the labour colonies shall be provided.
- Adequate vaccination and immunization facilities should be provided for workers at the construction site.
- The labour camps and resettlement sites should be at least 2 km away from a main water body or quarry areas.

### **5.4.2 Development of Medical Facilities**

There is no medical facility in the immediate vicinity of the project area. It is recommended that the dispensary should be developed during project construction phase itself, so that it can serve the labour population migrating in the area as well as the local population. One doctor and 10 paramedical staff are required for the dispensary. Further, a building shall be constructed to provide basic preventive, promotive and curative services to the labour colony with facilities for maternal and child health services, control of communicable diseases and medical care for minor ailments. The total expenditure for implementation of various public health measures shall be about Rs.14.59 million. In the DPR, a total provision of Rs. 9.4 million has been earmarked for development of health related infrastructure. Thus, an additional provision of Rs. 5.19 million (14.59 – 9.40), needs to be earmarked for development of Public Health Delivery System.

## **5.5 ENVIRONMENTAL MANAGEMENT IN LABOUR CAMPS**

The labour camps shall have the following facilities:

- Provision of Heating
- Provision of Water Supply
- Sanitation and Sewage Treatment Facilities in the form of community toilets and an oxidation ditch.
- Adequate facilities for collection, conveyance and disposal of solid waste shall be developed

## **5.6 MUCK MANAGEMENT PLAN**

As per the existing proposal for the construction of Sainj hydroelectric project about 0.805 Mm<sup>3</sup> of muck is to be generated. It is proposed that 0.283 Mm<sup>3</sup> of muck shall be utilized for various project works, The balance quantity of muck shall be disposed off at seven (7) muck disposal sites with a total area of about 10.729 ha. The dumping of muck will be done in the scientific manner by providing appropriate protection walls with deep foundations so that muck will not flow and washed away in the river. Masonry work, create work and check dam will also be provided wherever necessary in order to avoid the chances of soil erosion and to ensure flow of silt, free water. Besides these engineering measures, proper plantation will be done at the dumping sites for reclamation of the dumping areas. The total expenditure required for stabilization of muck disposal sites has been estimated to be of the order of Rs. 9.75 million.

## **5.7 RESTORATION AND LANDSCAPING OF CONSTRUCTION SITES**

### **5.7.1 Restoration Plan for Quarry Site and Borrow Area**

The following biological and engineering measures are suggested for the restoration of quarry site:

- Garland drains around quarry site to capture the runoff and divert the same to the nearest natural drain.
- Construction of concrete guards checks the soil erosion of the area.
- The pit formed after excavation be filled with small rocks, sand and farmyard manure.
- Grass slabs will be placed to stabilize and to check the surface runoff of water and loose soil.

### **5.7.2 Landscaping and Restoration Plan for other areas**

The working area of barrage site, power house complex colony area have been selected for beautification of the project area after construction is over. A total provision of Rs. 8.50 million has been earmarked for restoration of quarry and borrow area, reclamation of construction sites, landscaping and beautification.

## **5.8 ENVIRONMENTAL MANAGEMENT IN ROAD CONSTRUCTION**

The existing road from Suind to Neuli has also been proposed to be widened. However, new access roads will be constructed. Thus, approach roads of 5/7 m wide and about 19.50 km length will be constructed to connect different site locations of the project. Steeply sloping banks are liable to landslides, which can largely be controlled by provision of suitable drainage. As part of environmental management of road, landslides are proposed to be stabilized by engineering methods or bio-engineering measures or a combination of both. An amount of Rs. 8.84 million has been earmarked for implementation of measures to mitigate adverse impacts due to construction of roads.



## **5.9 GREENBELT DEVELOPMENT PLAN**

It is proposed to develop greenbelt around the periphery of various project appurtenances, selected stretches along reservoir periphery. The plantations would be carried out on an approximate area of 40 ha. This work would be completed in two years, which includes nursery creation, advance works, actual plantation and maintenance. The work will be carried out by Forest Department. A provision of Rs. 4.0 million has been earmarked for Green Belt Development.

## **5.10 CONTROL OF AIR POLLUTION**

It is suggested that the crushers will be provided with cyclones to control the dust generated. It should be mandatory for the contractor involved in crushing activities to install cyclone in the crusher. The same shall be monitored on a regular basis by the project proponent.

## **5.11 MEASURES FOR NOISE CONTROL**

Workers operating in high noise areas/ activities should be provided with effective personal protective measures such as ear muffs or ear plugs to be worn during periods of exposure. The other measures to control noise could be as follows:

- equipment and machineries should be maintained regularly to keep the noise generation at the design level;
- silencers and mufflers of the individual machineries to be regularly checked by the project proponent;
- exposure of workers to high noise areas, should be limited as per maximum exposure periods specified by OSHA.

## **5.12 WATER POLLUTION CONTROL**

### **Control of water pollution during construction phase**

It is recommended to construct settling tanks of adequate size at two or three sites to settle the suspended impurities in the effluents generated from crushers and tunneling sites.. The sludge from the various settling tanks can be collected once in 15 days and disposed at the site designed for disposal of solid wastes from the labour camps. The sludge after drying could also be used as cover material for landfill disposal site. An amount of Rs. 2.0 million needs to be earmarked for construction of various settling tanks.

### **Control of water pollution during operation phase**

It is recommended to provide a suitable Sewage Treatment Plant (STP) to treat the sewage generated from the colony. The cost required for construction of sewage STP in the project colony has already been covered in the budget earmarked for construction of the project colony.

## **6. RESETTLEMENT AND REHABILITATION PLAN**

The Resettlement and Rehabilitation Plan for the Project Affected Families of the proposed Sainj hydro-electric project has been prepared in line with the provisions and/or guidelines



as given in The National Rehabilitation and Resettlement Policy, 2007; which has been prepared by the Ministry of Rural Development (Department of Land Resources) and published in the Gazette of India, Extraordinary, Part 1, Section I, dated 31<sup>st</sup> October 2007.

### **6.1 Affected Properties, Land and Families**

A total of about 56.763 ha of land proposed to be acquired. Of this, about 8.770 ha is private land (un-irrigated land), which is proposed to be acquired from 3 village panchayats, namely, Sachen, Shainshar and Gara Parli. It is observed that about 206 project affected families (PAFs) are likely to lose land (agricultural and/or homestead) in varying proportions. Further, it was observed that many PAFs were losing their homesteads. It was observed 258 homesteads/sheds were either existing or newly constructed/under construction; on the khasras (plots) which are proposed to be acquired.

### **6.2 Resettlement Plan**

As per the information gathered from the revenue records and field investigations, it was observed that there are about 71 PAFs losing their homesteads and/or shed structures. The details of resettlement are given as below:

- Each family losing homestead be given a plot of 250 sq.m area. In addition about 50% of the total land requirement would be needed for providing civic amenities and infrastructure facilities at the relocation site. Thus, the total land required for resettlement site would be about 2.66 ha.
- The land for resettlement site has to be identified by the project developer in consultation with the district administration.
- Each displaced family would be provided a suitable one-time financial assistance for house construction @ Rs. 150,000 per family.
- Each displaced family to be given a one time financial assistance of Rs. 15,000 for construction of cattle-shed.
- Each displaced family shall be given a one time financial assistance of Rs. 10,000 per family as shifting allowance.
- A provision of Rs. 25,000 per displaced family is being kept for persons who are rural artisans, small traders or self-employed persons and who have been displaced.

It is proposed to construct a project colony with provision to accommodate 71 PAFs. The colony shall be provided with various amenities and infrastructure facilities as outlined in the National Policy for Resettlement and Rehabilitation 2007. The basic amenities to be provided at resettlement zone are listed as below:

- The new resettlement site would be connected to the main motor-able road by Water Bound Macadam Approach Road and internal village roads.
- Power supply shall be provided within the resettlement site/ colony to the resettled households.
- Piped water supply for drinking purpose would be provided by harnessing the natural

sources of water and constructing storage tanks. These community tanks could then be connected with pipeline, community taps.

- Sanitation facilities shall be provided at the resettlement site.
- Higher Secondary School with playground shall be provided. The school building will have at least 20 rooms, which would include primary section as well. Land for school is to be provided by the Project Authority, in consultation with local government/administration. Necessary electrical fitting for the bulb/tube-light, Fan are also proposed in each room.
- A Community hall shall be constructed at the Resettlement site for which an area of 100 sq.m can be earmarked.
- A Panchayat building shall be constructed at the resettlement site for which an area of 50 sq.m can be earmarked.
- Place of worship is to be constructed at the resettlement site.
- A Post-office building is to be constructed in the resettlement site for which an area of 40 sq.m can be earmarked.
- A fair price shop is to be constructed in the resettlement site for which an area of 30 sq.m can be earmarked.
- Space for market would be required in the resettlement site, for which an area of 200 sq.m can be earmarked.
- Space for Park and Play-ground would be required in the resettlement site, for which an area of 1000 sq.m can be earmarked. The project authority, in consultation with the District Collector would provide the land required for Park and Play ground purpose..
- A Primary Health Center, with 5 beds is to be constructed in the resettlement site for which an area of 1500 sq.m can be earmarked.

### **6.3 Rehabilitation Measures**

The details of rehabilitation benefits extended to the PAFs are summarized in the following paragraphs:

#### **Option-I Land for land as compensation**

- As per the revenue records, it is observed that about 31 land titleholders would be rendered “landless” after acquisition of land for the project. It is also observed that all the farmers being rendered landless are losing less than 1 ha of agricultural land. It is therefore suggested to give them atleast 1 ha irrigated cultivable land. It is often seen that irrigate lands are not easily available. Thus 2 ha of un-irrigated cultivable wasteland may be given.
- Further, there are about 160 PAFs who would be rendered as “Marginal farmers” after acquisition of land. They would also be given 2 ha of un-irrigated cultivable wasteland. Thus total requirement of land to meet the “land for land” option for landless and marginal farmers would be about (191 x 2) 382 ha of un-irrigated cultivable waste lands.
- It is also suggested that there are about 09 PAFs who would be rendered “small farmers” after acquisition of their lands. It is observed that these farmers would be

losing about 0.2 ha on an average, while they would be left with about 1.5 ha land on an average. It is suggested that they could also be given alternative cultivable land upto the extent lost by them. Thus another 1.90 ha is land would be required to be given to these farmers.

- In addition, there are about 6 PAPs who would also lose their land, which is about 0.17 ha on an average. They are left with about 3.72 ha on an average. These farmers/ land title holders could be given only cash compensation for their acquired lands.

Thus the total land required would be about (382 + 1.90) 383.9 **Say 384 ha** would be required for “land for land” option.

- A one-time financial assistance @ Rs. 15000 is proposed to be given to each PAF for cost for land development.
- An amount of Rs. 15000 is proposed to be given to each PAF for compensation of agriculture produce.
- One member from each of the project affected families would be given scholarships and other skill development opportunities.
- The project developer shall give preference to the affected persons or their groups or cooperatives in the allotment of outsourced contracts, shops or other economic opportunities coming up in or around the project site
- One person from each of the affected families would be give training facilities for development of entrepreneurship, technical and professional skills for self-employment.

At this stage it is difficult to know, which families cannot be given land or which families opt not to take land there, such a family may be given monetary compensation on replacement cost basis for their lands lost, for purchase of suitable land elsewhere.

#### **Option – II: Rehabilitation grant for Land have been recommended.**

- In case the PAFs have not been provided alternative agricultural land or Job, they will be provided with a Rehabilitation Grant equivalent to 750 days minimum agricultural wages or such other higher amount as may be prescribed by the appropriate Government.
- A monthly Subsistence allowance equivalent to twenty-five days minimum agricultural wages per month for a period of one year from the date of acquisition. This financial assistance is being extended to all the PAFs.
- One member from each of the project affected families would be given scholarships and other skill development opportunities.
- The project developer shall give preference to the affected persons or their groups or cooperatives in the allotment of outsourced contracts, shops or other economic opportunities coming up in or around the project site

- One person from each of the affected families would be given training facilities for development of entrepreneurship, technical and professional skills for self-employment.

#### 6.4 Budget for Resettlement & Rehabilitation

**OPTION – I:** The budget required in case alternate land is made available under “land for land” scheme is highlighted in Table – 5.

**TABLE – 5**  
**Budgetary estimate for implementation of R&R Plan (Option - I)**

S. No.	R&R Components	Cost (Rs.million)
1	Resettlement plan including basic facilities at resettlement site	
	Land for resettlement site = 2.66 ha	**
	One time financial assistance for house construction	10.65
	Financial assistance for construction of cattle-shed	1.07
	Transportation cost	0.71
	One time financial assistance for construction working shed	1.77
	Basic amenities & facilities in the resettlement site	12.47
	<b>Sub-Total (Resettlement) [1]</b>	<b>26.67</b>
2	Rehabilitation plan	
	Cultivable land required for “land for land” = 384 ha	**
	Land development cost	5.76
	Loss of agricultural produce	2.06
	Subsistence allowance	4.64
	One time financial assistance for “training for development of entrepreneurship”	2.50
	Scholarship for students	2.47
	<b>Sub-Total (Rehabilitation) [2]</b>	<b>17.43</b>
3	Monitoring and evaluation set-up [3]	0.90
	<b>Grand total [1+2+3]</b>	<b>45.0</b>

**\*\* Alternative land is to be identified and Cost of land has to be decided and finalized by the District Collector.**

A total budget of Rs. 45.0 million + 384.8 ha of un-irrigated land + 2.655 ha land for resettlement purposes would be required under Option – I, wherein “land for land” is made available to the project affected persons/ families in consultation with the District authorities and subject to availability of Government land in the districts.

**OPTION – II:** The budget required in case alternate land is not made available to the project affected persons/ families are highlighted in Table – 6.

**TABLE – 6**  
**Budgetary estimate for implementation of R&R Plan (Option - II)**

<b>S. No.</b>	<b>R&amp;R Components</b>	<b>Cost (Rs. million)</b>
1	Resettlement plan including basic facilities at resettlement site	
	Land for resettlement site = 2.66 ha	**
	One time financial assistance for house construction	10.65
	Financial assistance for construction of cattle-shed	1.07
	Transportation cost	0.71
	One time financial assistance for construction working shed	1.77
	Basic amenities & facilities in the resettlement site	12.47
	<b>Sub-Total (Resettlement) [1]</b>	<b>26.67</b>
2	Rehabilitation plan	
	One time financial assistance to PAF @ 750 days Minimum Agricultural Wages	11.60
	Subsistence allowance	4.64
	One time financial assistance for “training for development of entrepreneurship”	2.50
	Scholarship for students	2.47
	<b>Sub-Total (Rehabilitation) [2]</b>	<b>21.21</b>
3	Monitoring and evaluation set-up [3]	0.90
	<b>Grand total [1+2+3]</b>	<b>48.78</b>

Thus a total budget of Rs. 48.78 million + 2.655 ha of land for resettlement colony would be required under Option – II, wherein “land for land” is not made available to the project affected persons/ families.

**Thus, for the purpose R&R, Rs. 48.87 million + 2.655ha of land for resettlement colony has been suggested as a part of EMP.**

## **7. ENVIRONMENTAL MONITORING PROGRAMME**

The Environmental Monitoring Programme during construction and operation phase is given in Tables 7 and 8 respectively.

**TABLE-7**  
**Summary of Environmental Monitoring Programme during**  
**Project Construction Phase**

S. No.	Item	Parameters	Frequency	Location
1.	Effluent from septic tanks	pH, BOD, COD, TSS, TDS	Once every month	Before and after treatment from each septic tank
2.	Water-related diseases	Identification of water related diseases, adequacy of local vector control and curative measure, etc.	Three times a year	Labour camps and colonies
3.	Noise	Equivalent noise level ( $L_{eq}$ )	Once in three months	At major construction sites.
4.	Air quality	SPM, RPM, SO <sub>2</sub> and NO <sub>x</sub>	Once every season	At major construction sites
5.	Meteorological aspects	Wind direction & velocity temperature humidity, rain	Once every season	At one of the ambient air quality sampling sites

**TABLE-8**  
**Summary of Environmental Monitoring Programme during**  
**Project Operation Phase**

S. No.	Items	Parameters	Frequency	Location
1.	Water	pH, Temperature, EC, Turbidity, Total Dissolved Solids, Calcium, Magnesium, Total Hardness, Chlorides, Sulphates, Nitrates, DO. COD, BOD, Iron, Zinc, Manganese	Thrice a year	1 km upstream of barrage site Water spread area 1 and 3 km downstream of Tail Race discharge
2.	Effluent from Sewage Treatment Plant (STP)	pH, BOD, COD, TSS, TDS	Once every week	Before and after treatment from Sewage Treatment Plant (STP)
3.	Erosion & Siltation	Soil erosion rates, stability of bank embankment, etc.	Twice a year	-
4.	Ecology	Status of afforestation	Once in 2	-

S. No.	Items	Parameters	Frequency	Location
		programmness of green belt development	years	
5.	Water-related diseases	Identification of water-related diseases, sites, adequacy of local vector control measures, etc.	Three times a year	Villages adjacent to project sites
6.	Aquatic ecology	Phytoplanktons, zooplanktons, benthic life, fish composition	Once a year	1 km upstream of barrage site Water spread area 1 and 3 km downstream of Tail Race discharge
7.	Landuse	Landuse pattern using satellite data	Once in a year	Catchment area
8.	Soil	pH, EC, texture, organic matter	Once in a year	Catchment area

## 8. COST FOR IMPLEMENTING ENVIRONMENTAL MANAGEMENT PLAN & ENVIRONMENTAL MONITORING PROGRAMME

### 8.1 Cost for implementing Environmental Management Plan

The total amount to be spent for implementation of Environmental Management Plan (EMP) is Rs. 297.545 million. The details are given in Table-9.

**TABLE-9**  
**Cost for Implementing Environmental Management Plan**

S. No.	Item	Cost (Rs. million)
1.	Compensatory Afforestation NPV, Cost of Trees and Bio-diversity conservation	107.365
2.	Catchment Area Treatment	75.000
3.	Fisheries Management	13.230
4.	Public health delivery system	5.190
5.	Environmental Management in labour camp	8.360
6.	Muck management	9.750
7.	Restoration and Landscaping of construction sites	8.500
8.	Environmental management in road construction	8.840
9.	Greenbelt development	4.000
10.	Water pollution control	2.000
11.	Resettlement and Rehabilitation Plan	48.780
12.	Environmental Monitoring during construction phase (refer Table-11)	6.530
	<b>Total</b>	<b>297.545</b>



**8.2 Cost for implementing Environmental Monitoring Program**

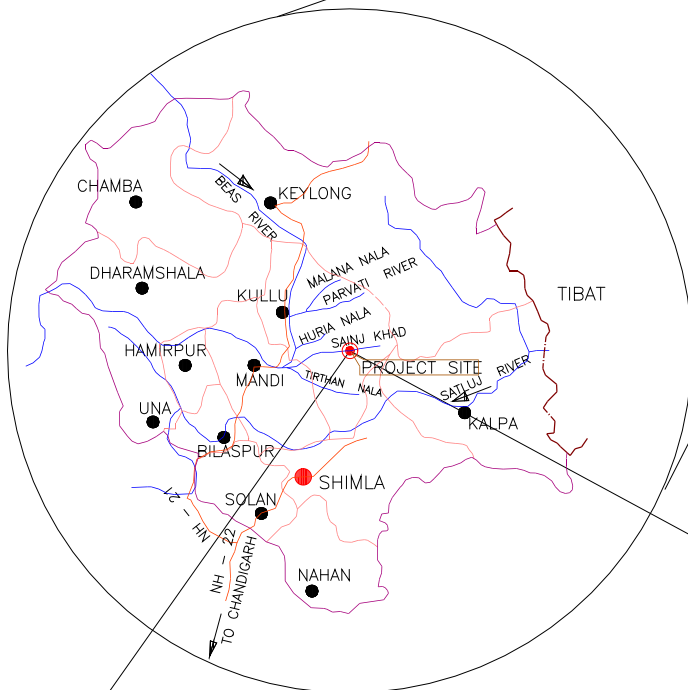
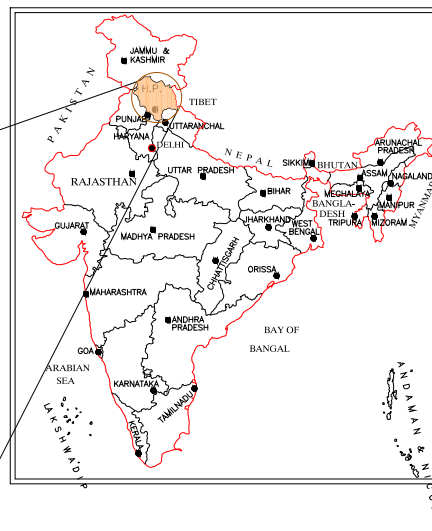
The cost required for implementation of the Environmental Monitoring Programme is of the order of Rs.6.53 million @ Rs.1.07 million/ year. A 10% annual price increase may be considered for every year. The construction period for estimation of cost for implementation of Environmental Monitoring programme during construction phase has been taken as 5 years. The details are given in Table-10. The cost required for implementation of the Environmental Monitoring Programme at operation phase is of the order of Rs.1.16 million/year. The details are given in Table-11.

**TABLE-10**  
**Cost for Implementing Environmental Monitoring Programme**  
**during construction phase**

<b>S. No</b>	<b>Item</b>	<b>Cost (Rs. million/year)</b>	<b>Total cost 4 years with 10% escalation (Rs. million)</b>
1	Water quality	0.18	1.10
2	Air quality	0.29	1.77
3	Ecology	0.50	3.05
4	Incidence of water related diseases	0.10	0.61
	<b>Total</b>	<b>1.07</b>	<b>6.53</b>

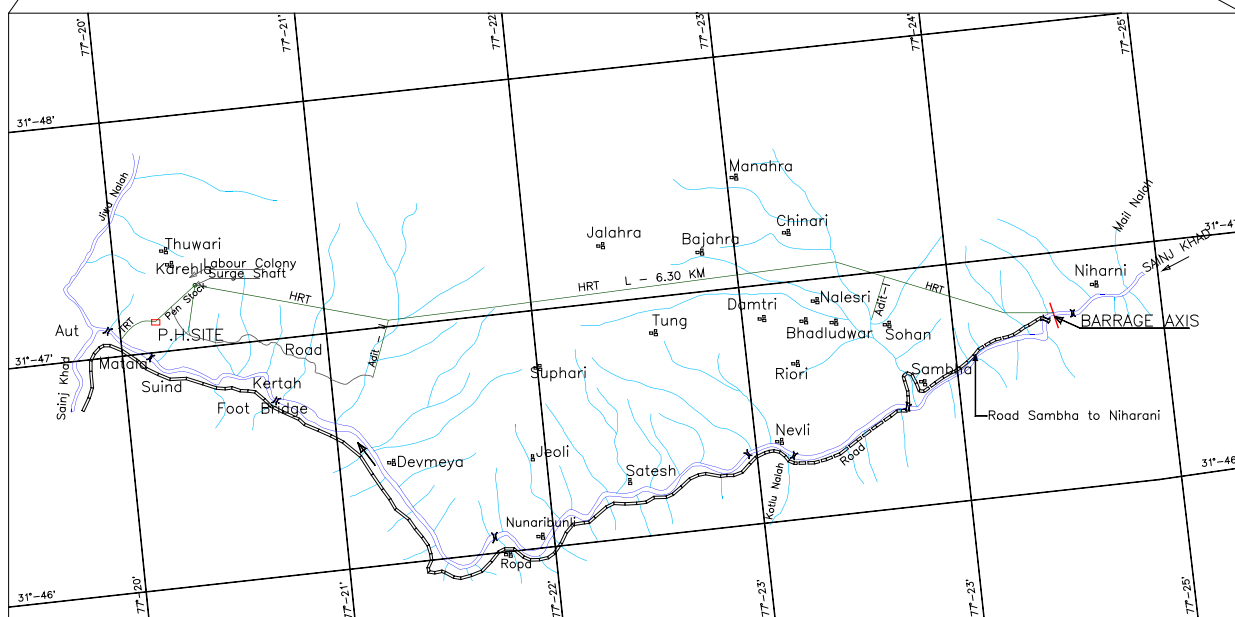
**TABLE-11**  
**Cost for Implementing Environmental Monitoring Programme**  
**during operation phase**


<b>S. No</b>	<b>Item</b>	<b>Cost (Rs. million/year)</b>
1	Water quality	0.46
2	Ecology	0.10
3	Incidence of water related diseases	0.30
4	Land use pattern	0.30
	<b>Total</b>	<b>1.16</b>

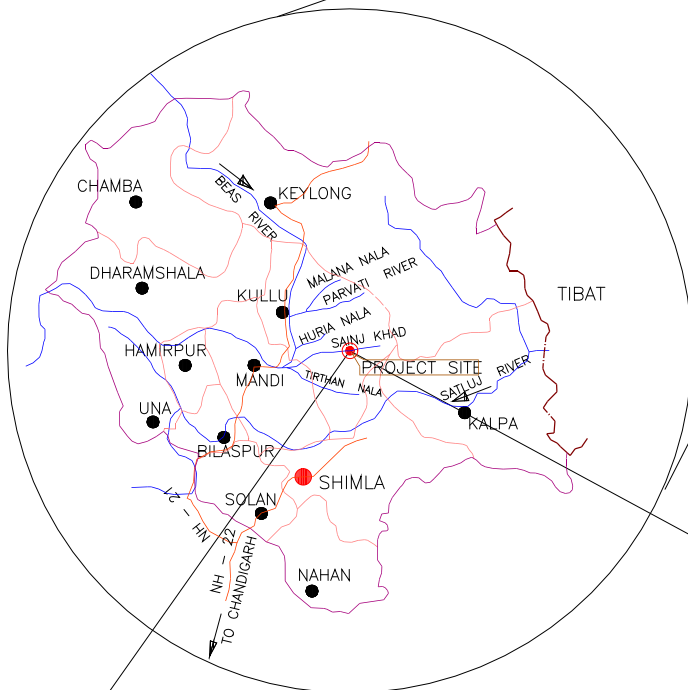
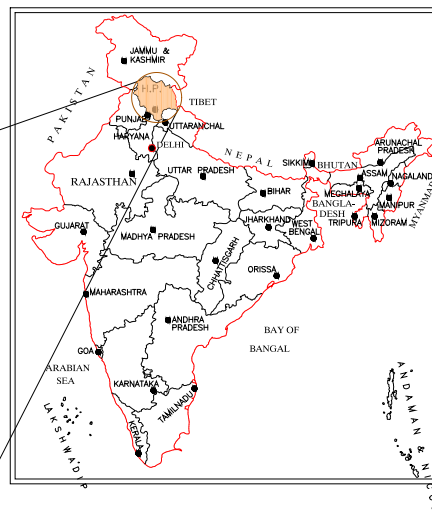


### LEGEND

- RIVER / NALA
- ROAD ( NH-22 )
- STATE BOUNDARY
- DISTRICT BOUNDARY
- INTERNATIONAL BOUNDARY

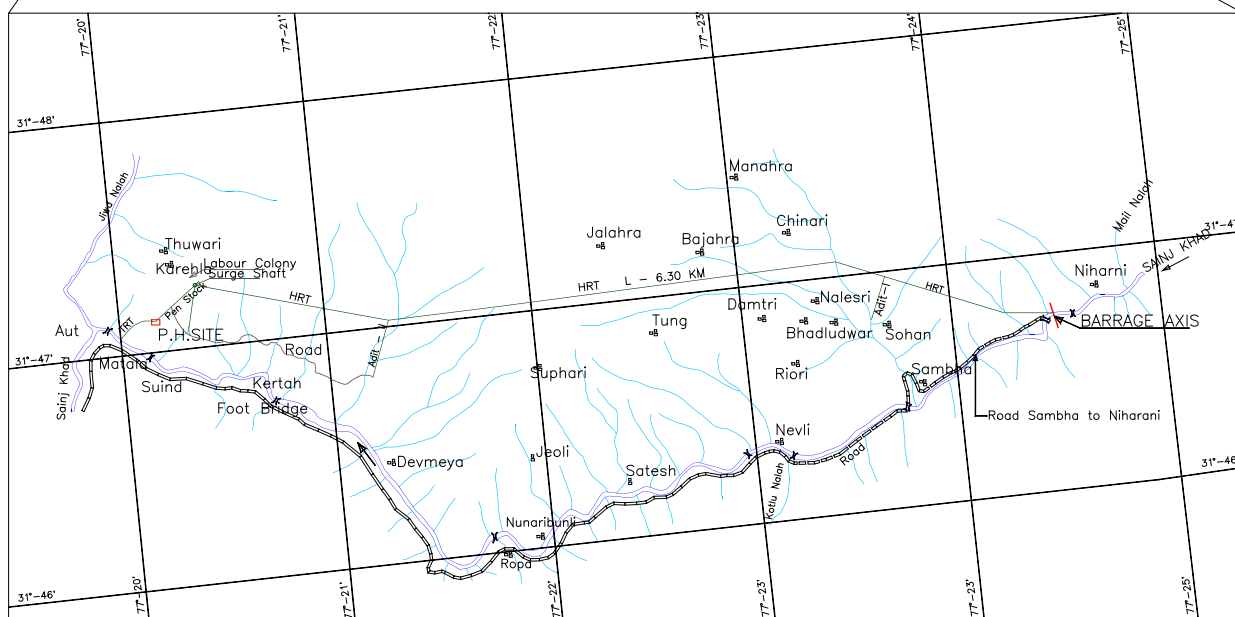



 WATER & POWER CONSULTANCY SERVICES (I) LTD. CENTRE FOR ENVIRONMENT		
CLIENT: HIMACHAL PRADESH STATE ELECTRICITY BOARD		
PROJECT: EIA STUDY FOR SAINJ H.E. PROJECT		
TITLE: PROJECT LOCATION MAP		
SCALE:		FIG. NO.
NTS		1

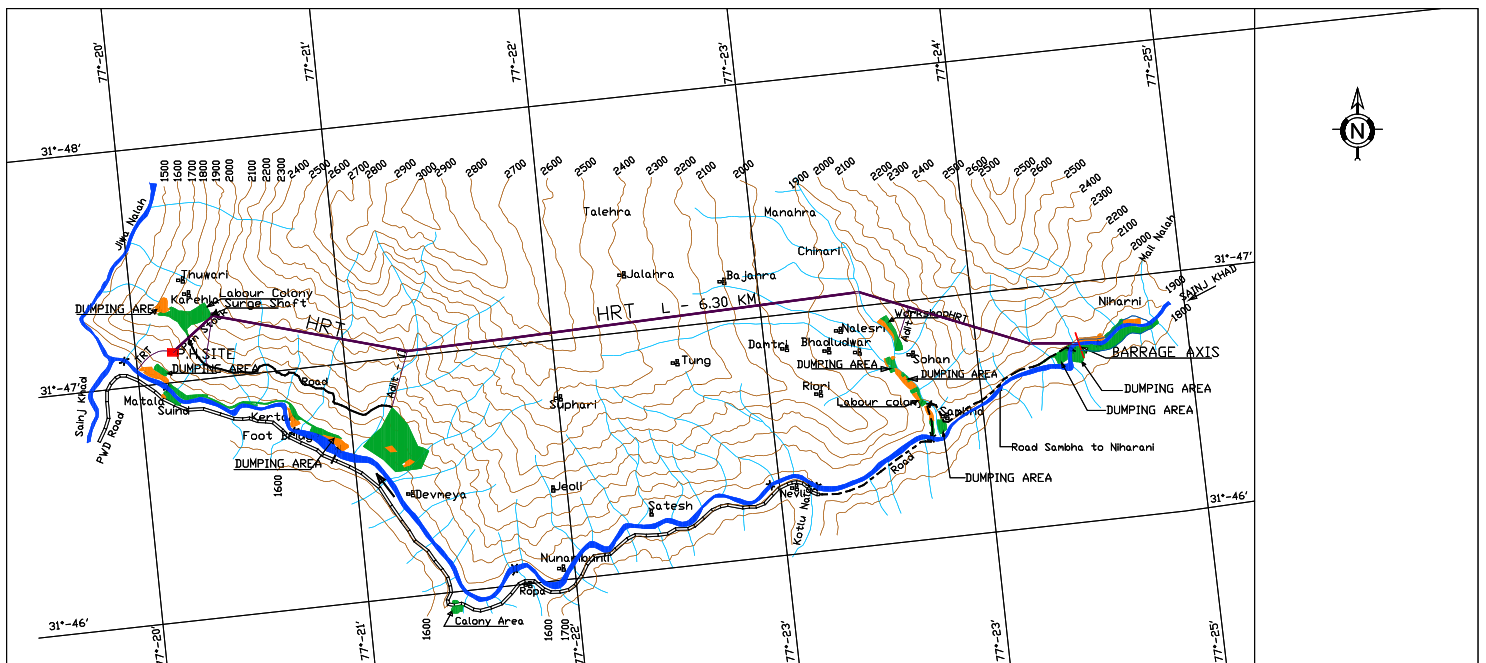


### LEGEND

- RIVER / NALA
- ROAD ( NH-22 )
- STATE BOUNDARY
- DISTRICT BOUNDARY
- INTERNATIONAL BOUNDARY



 WATER & POWER CONSULTANCY SERVICES (I) LTD. CENTRE FOR ENVIRONMENT		
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TITLE: PROJECT LOCATION MAP		
SCALE:		FIG. NO.
NTS		1



## LEGEND

RIVER / NALAH

CONTOURS

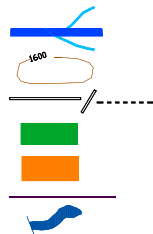
ROAD / FOOTPATH

FOREST LAND

PRIVATE LAND

HRT

SUBMERGENCE



**WAPCOS**  
CENTRE FOR ENVIRONMENT

CLIENT: HIMACHAL PRADESH STATE ELECTRICITY BOARD

PROJECT: EIA STUDY FOR SAINJ H.E. PROJECT

TITLE: PROJECT LAYOUT PLAN

SCALE:	DATE:	FIG. NO.
AS SHOWN		2