

Environmental and Social Impact  
 Assessment: 192 MW Hydroelectric  
 Power Project, Tehsil Manali, District  
 Kullu, Himachal Pradesh

AD Hydro Power Limited

Non-Technical Summary



February 2009

[www.erm.com](http://www.erm.com)

# 1 NON TECHNICAL SUMMARY – ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT OF ALLAIN DUHANGAN HYDROELECTRIC POWER PROJECT

## 1.1 ALLAIN DUHANGAN HYDROELECTRIC PROJECT: AN OVERVIEW

AD Hydro Power Limited, a Bhilwara Group Company (hereinafter referred to as ADHPL or the Company) is in the process of setting up Allain - Duhangan Hydroelectric Project (hereinafter referred to as ADHEP or the Project) of 192 Mega Watt (MW) [i.e. 2 x 96 MW] hydropower generation facility on Allain and Duhangan tributaries of the Beas river in tehsil Manali, district Kullu, Himachal Pradesh in India. The Project is located near village Prini approximately three kilometers (km) southeast (SE) of Manali town. The Project site is accessible by road from the nearest town Manali, which is approximately 320 km away from Chandigarh. The nearest air link is available at Bhuntar in Kullu, approximately 50 km from the site. The rail links connecting Manali through road are at Chandigarh, Kiratpur, Una and Pathankot.

The proposed hydro Project is a run-of-the-river scheme utilising the combined discharge of Allain and Duhangan streams. A 220 kV power transmission line (of approximately 175-km) will evacuate the power to the northern grid at Nalagarh in the district Solan, Himachal Pradesh. The Project is expected to be commissioned by end of year 2009.

ADHPL has taken up partial financing arrangement for the Project from the International Finance Corporation (IFC). To fulfil IFC's Environmental and Social requirements, the Project required Environmental and Social Impact Assessment (ESIA) study along with ESIA study for transmission line corridor.

### **The Allain Duhangan Hydroelectric Project**

ADHPL has acquired 79.32 hectare (ha) of land to be retained over the life of the Project. The Project has an estimated capital cost of construction of 9223 million Indian Rupees. The Project is expected to be commissioned by end of year 2009 by engaging 1500 – 2000 people at site. The operation phase of the Project would require 100 employees. ADHPL will own and operate the ADHEP for a period of 40 years, which is extendable to another 20 years.

The Project received Environmental Clearance from Ministry of Environment and Forests (MoEF) in December 2000 and Forest Clearance for diversion of forestland from Forest Conservation Division of MoEF in October 2002, January 2005 and April 2008.

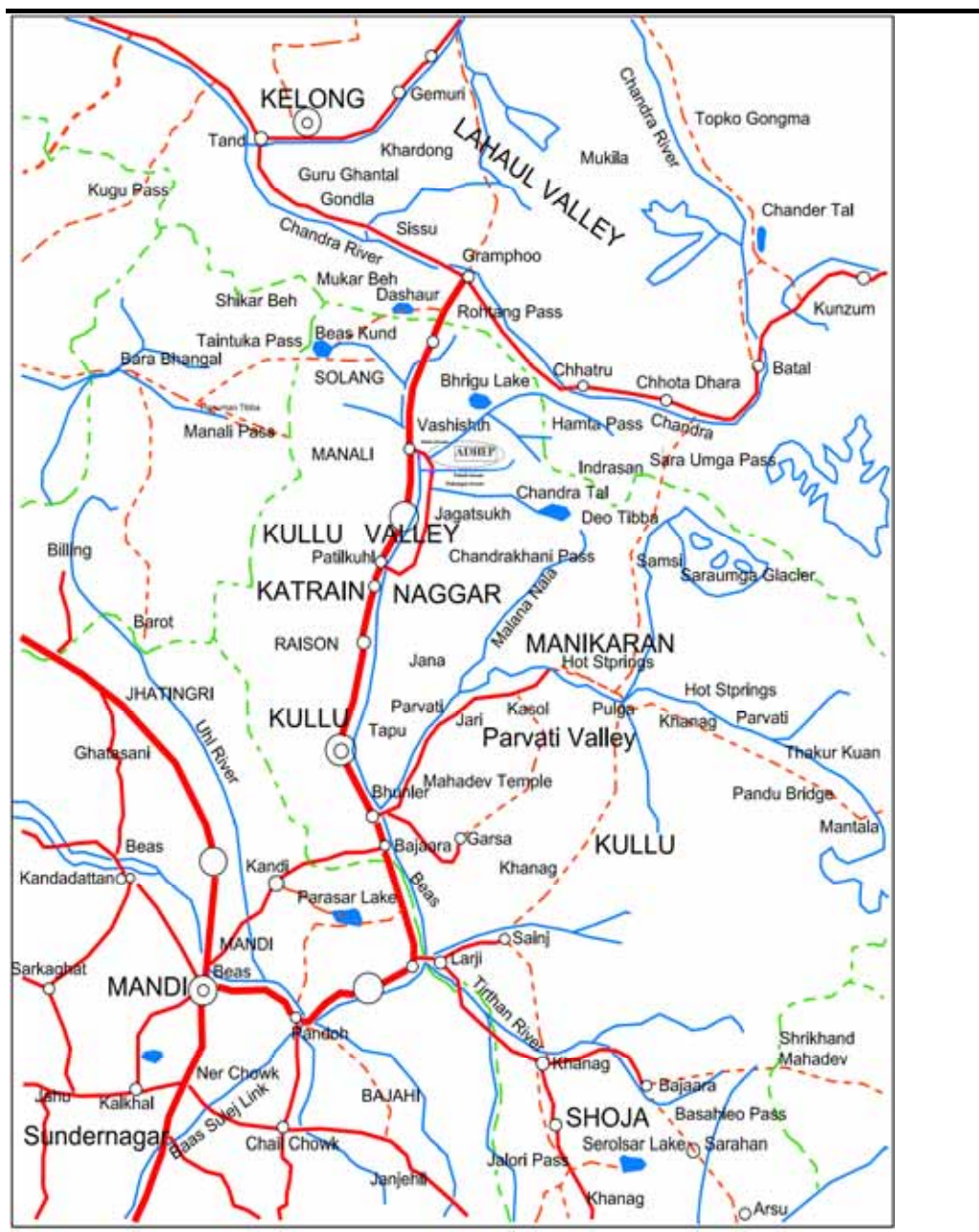
### **Hydroelectric Power facility**

The Project consists of high head underground power plant that would utilise flows from a combination of glacial snow melt and monsoon rains to supply peaking reservoirs via tunnels from catchment basins of the Allain and Duhangan streams. Both of the streams fall in the Beas River. The setting for the Project is the steep terrain of the Himalayas with the diversion structures on the two streams and an intermediate storage reservoir. From Allain diversion structure, a reservoir will be fed through circular shaped concrete lined headrace tunnels (HRTs) of 4093m. While from Duhangan diversion structure a D-shaped HRT of 4440 m will be maintained. The HRTs from Allain barrage are provided with 157 m and 235 m long adits while HRTs from Duhangan weir are provided with 246m and 700m long adits. The combined flows of the two rivers via a 1.69km long pressure shaft will feed a single powerhouse with two units each of 96 MW capacity (vertical Pelton Turbines) to be located in a rock cavern. The water from the powerhouse will be discharged into Allain stream through a tailrace tunnel followed by an open channel. The Project will have a total live storage of 0.37 million cubic meter (mcm) i.e. 0.12 mcm at Allain barrage, 0.225 mcm in intermediate reservoir and remaining 0.025 mcm in Duhangan tunnel.

### **Transmission System**

A 220 kV double circuit power transmission line of approximately 175 km starting from Prini village to Nallagarh [substation of Power Grid Corporation of India Limited (PGCIL)] in Solan district is under construction. The transmission line traverses through four districts of Kullu, Mandi, Bilaspur and Solan in Himachal Pradesh. A separate ESIA study has been conducted for the Transmission Line for the Project.

Figure 1.1 AD Hydro Power Project Site Location



## 1.2 IMPACT ASSESSMENT PROCESS

The environmental and social impacts of the Allain Duhangan hydroelectric project have been studied in detail. The ESIA documentation provides the details of the work carried out and recommends necessary actions and commitments to minimise, mitigate and monitor potential adverse impacts. These are summarised in this Non Technical Summary. The ESIA process included following considerations:

- Complying with legal requirements and IFC’s performance standards for environmental and social sustainability;
- Ensuring Public Consultation and Disclosure Process; and
- Management of Environmental and Social Impacts.

### 1.2.1 *ESIA Compliance*

The original Environmental Impact Assessment (EIA) documentation for the Allain Duhangan hydroelectric project was conducted in 1997 and was designed to meet the regulatory requirements of the Ministry of Environment & Forests (MoEF), Government of India. The Project received Environmental Clearance from MoEF in December 2000 on the basis of EIA conducted in 1997. To meet the requirements of International Finance Corporation (IFC), a draft Final ESIA report for the Project was submitted in December 2003 followed by an addendum to the ESIA in September 2004. Detailed studies on Wildlife Surveys (including Terrestrial Ecology) by World Pheasant Association and River Ecology by Foundation for Ecological Security were completed in June 2006 and May 2006 respectively.

The ESIA has now been revised and updated to further meet the requirements of the IFC's Performance Standards for Social and Environmental Sustainability; IFC's Environmental, Health and Safety (EHS) guidelines and to further provide guidance to ADHPL to mitigate Project related environmental and social issues. This revised and updated ESIA is based on an update of the environmental baseline data including additional ecological and social surveys, consultations, impact identification and evaluation and recommendations on environmental and social mitigation and management plan. A separate ESIA study has been conducted for 175km long power transmission line.

#### **Structure of Revised and Updated ESIA Report**

The Revised and Updated ESIA report comprises of:

- Non-technical Executive Summary (this document);
- The main Revised and Updated Environmental and Social Impact Assessment Report that consolidates earlier and fresh information. The format of the main report is in accordance with outlines given in IFC's requirement.

### 1.2.2 *Public Consultation & Disclosure of Information*

Following the public consultations on the draft ESIA, ADHPL responded to concerns raised by stakeholders and measures taken to incorporate these concerns into Project design and implementation has been incorporated in the addendum to ESIA and this revised and updated ESIA documentation. ADHPL will continue to consult with relevant stakeholders throughout the life cycle of the Project i.e. construction, demobilisation, operation and decommissioning phases of the Project. It will also report ongoing consultations as part of its annual reporting requirements to IFC. In addition, as a part of its commitment to meet IFC's public consultation and disclosure framework, ADHPL has made copies of the ESIA documentation available locally at the Project site and through the World Bank Info shop. The following sequence of activities was undertaken:

- May 2003: First public meeting in Prini village;
- August 2003: Summary of project information and ESIA disclosed on IFC's website;
- November 2003: IFC meetings with local NGOs at Prini
- December 2003: Revised ESIA disclosed locally with Summary translated in Hindi and distributed to each project-affected family;
- January 2004: Revised ESIA disclosed on IFC website and a list of "Frequently Asked Questions", with responses, distributed to project-affected families;
- January 2004: Second public meeting held in village Jagatsukh;
- February 2004: Hindi translation of entire ESIA disclosed;
- March, April, May 2004: Focus group meetings led by independent facilitators;
- May 2004: Third public meeting facilitated by independent panel of experts held in both Prini and Jagatsukh;
- July 2004: Focus group meetings with project affected people led by independent facilitator;  
*(Note: The public meetings were facilitated by independent third parties including Sh Shekhar Singh, Sh Harsh Mander and a Pune based NGO Kalpravriksh).*
- September 2004: ESIA Addendum disclosed locally and on IFC website in both English and Hindi.
- Environmental and Social commitment register – status as on 1 November 2007 disclosed on IFC's website;
- Review of compliance against requirements of Performance Standards of IFC, July 2006 for Environmental and Social Assessment studies of various category A and B projects.

- This revised and updated ESIA report covers IFC specified requirements to the extent of their applicability to the Project. It includes Environmental and Social Management Plan (ESMP) that covers action plans for the identified adverse impacts.

### 1.2.3 *Management of Environmental and Social Impacts*

#### *Key Project Impacts*

The revised and updated ESIA documentation identifies “key Project issues” that ADHPL needs to address and resolve during the Project’s construction and implementation stages. These include:

- Resettlement and compensation for private land (9.75 ha) that had direct impacts on the asset and livelihood base of project affected families. Some of these families required focussed rehabilitation support;
- Effects on cultural resources, tourism and protected areas;
- Changes in landuse and effects on topography, soil erosion/sedimentation;
- Effects on water resources and quality - hydrology, hydro-geology and surface and groundwater quality;
- Effects on ambient air quality, noise quality and ground vibrations;
- Effects on ecology - forests, terrestrial wildlife, aquatic ecology and fisheries;
- Effects on health and sanitation conditions;
- Safety and increase in traffic and associated issues on road safety;
- Effects of natural hazards - flood, cloudburst, forest fire, earthquake, landslides/ avalanche.

#### *Key Project Benefits*

The Allain Duhangan Hydroelectric Project will provide some benefits at the national, regional and community levels. In addition to the rehabilitation and compensation package for the each directly affected person, ADHPL is committed to providing community developmental benefits in a sustainable manner. The key macro-economic benefits anticipated from the Project are:

- Increased electricity availability, especially peaking power capacity;
- Increased investment and national income;
- Increased employment opportunities to the local people during project construction;
- Improved health care and educational facilities in the near-by villages.
- Improved market facilities in villages adjacent to the hydroelectric power facility; and
- Increased tourism potential of the area, leading to more income-generating opportunities.

ADHPL is responsible for implementing mitigation measures and specific action plans developed as part of Environment and Social Management Plan (ESMP). The contractors selected for the Project construction are responsible for implementing day-to-day, construction-related environmental mitigation and monitoring measures as specified in the ESMP. ADHPL is committed to executing its



*Public Consultation at Village Prini*

responsibilities in an environmentally and socially responsible manner and in compliance with all applicable environmental laws, regulations, IFC Performance Standards and EHS guidelines. Reportedly, ADHPL has stipulated such requirements in legal agreements with the contractors, suppliers and agents. Besides, ADHPL is required to ensure that adequate corporate resource, personnel, reporting and accountability systems are in place for the successful implementation of the ESMP.

The scheme of development of hydro-electric potential envisages utilisation of flows from two streams viz., Allain and Duhangan by means of separate water conductor system – one each from Allain and Duhangan leading to a common pooling point, the surge shaft from where a pressure shaft takes off leading to the powerhouse and thereafter discharging through a tailrace tunnel to a suitable location in the downstream reach of Allain stream. The Project has developed an intermediate reservoir to be fed through headrace tunnel from Allain diversion barrage. The water conductor from Allain stream is proposed to be located on its left bank whereas the water conductor from Duhangan on its right bank so that they could be conveniently led to the common surge shaft. A comparatively flat terrace was chosen for the headrace tunnels, intermediate reservoir, pressure-shaft and underground powerhouse and tailrace tunnel. An over ground switchyard has also been suitably located.

### **2.1 BARRAGE, WEIR & HEADRACE**

The Allain head regulator, the desilting basins and the barrage has been located across the streambed downstream of an existing narrow section of the Allain stream. The head works set up at Duhangan has been selected in view of the steepness of the stream. An upstream location has been selected for the trench weir due to logistical problems in approach, topographical considerations and the presence of landslide prone bank of the stream in the reaches downstream. Due to the presence of comparatively steep banks at the location of desilting basin, an underground chamber has been preferred for desilting. The alignment of head race tunnels from Allain and Duhangan has been evolved aiming the shortest straight traverse to the common surge shaft. The tunnel from Allain has been provided with bend downstream of the desilting basin and another small bend near the surge shaft to provide for a radial entry. In the case of head race tunnel from Duhangan, an additional bend has been introduced because of the traversing of the tunnel under Pahali stream, where it had to be deviated and taken upstream to ensure necessary rock cover.

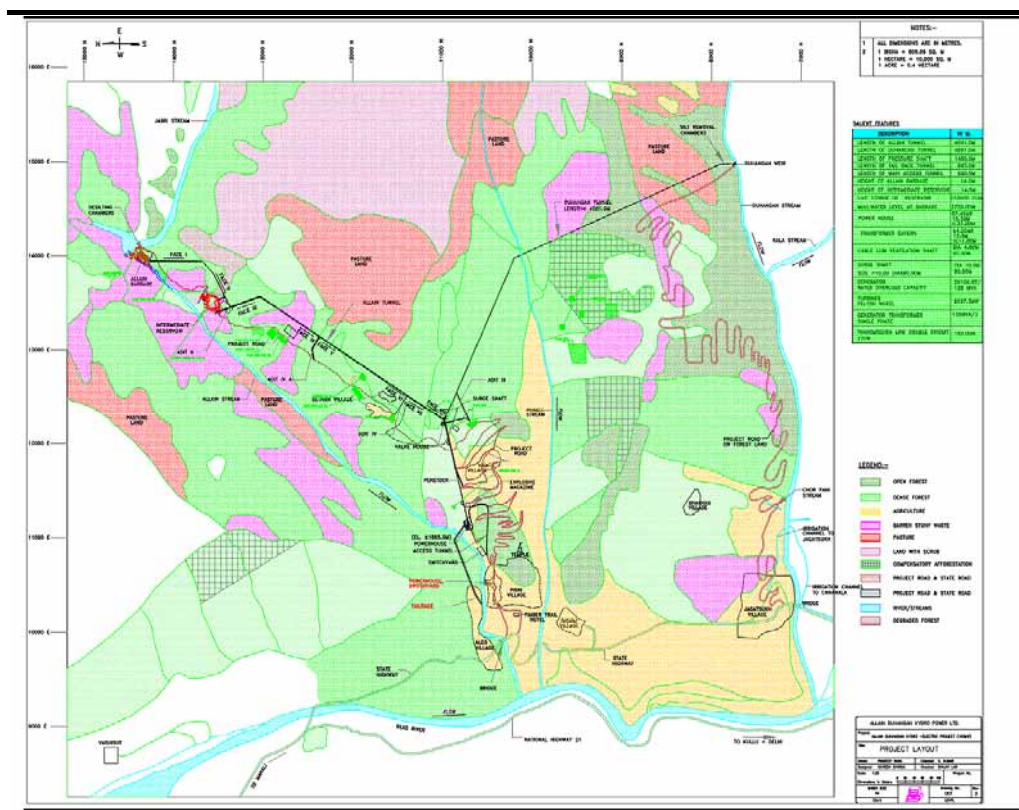
### **2.2 INTERMEDIATE RESERVOIR, SURGE SHAFT & PRESSURE SHAFT**

A diversion from Allain is proposed to feed an intermediate reservoir. Discharge from the two head race tunnels from Allain and Duhangan is proposed to be conveyed into a common pooling point, the surge shaft located near a relatively flat hill terrace near Hamta village. The junction shaft into which the two tunnels empty out and the pressure shaft take-off point is founded in rock to ensure its complete stability. Water from the surge shaft would then be conducted to an underground powerhouse through an underground pressure shaft.

### **2.3 POWER HOUSE & TAILRACE**

An underground powerhouse has been preferred to a surface powerhouse since the underground powerhouse requires deep excavation and involves extensive stabilisation of steep slopes. The tailrace tunnel would discharge at a location in the downstream reach of the Allain stream with a 75m long open channel. This alignment and location for discharge from the Pelton wheels of the power house has been selected after favourable comparison with another alternative as it had optimum construction work involvement and head for power generation. Optimisation studies have been carried out for evolving a suitable location for the surface switchyard. The location on the left bank of Allain stream has been selected since it involves least excavation in comparison with other alternatives and is located in a stable area and is easily approachable from the nearest project road.

**Figure S-2.1 Layout of AD Hydroelectric Power Project**



**2.4 ROADS & OTHER ANCILLARY WORKS**

An approach road of 8 m average width and approximately 16 km length has been constructed on the southern bank of Allain stream from Prini village to Allain Barrage site via villages Hamta and Saithan. Another approach road of 8 m average width and approximately 12 km length has been constructed to connect Duhangan weir site from the existing Manali -Nagar road, near village Jagatshukh.

An office and colonies for accommodation of the workforce have been constructed as a part of the Project development along the road along Allain stream.

A satellite imagery showing location of various Project structures and the landuse around them is shown in *Figure S-2.2*.

**2.5 CONSTRUCTION OF THE HYDROELECTRIC POWER PROJECT**

The construction works are planned to be executed by civil contractors as per allotted work under various packages. For convenience in construction management, the infrastructure and civil works of the Project are divided into various packages as under:

1. Access roads, bridges, slope stabilization and cross drainage works, permanent and temporary buildings, water supply, electrification of colonies, communication systems, workshops and stores etc;
2. Allain barrage, head regulator, de-silting arrangement, intake structure and Allain head race tunnel (HRT);
3. Duhangan weir, head regulator, de-silting arrangement, intake structure and Duhangan head race tunnel (HRT);
4. Intermediate reservoir, surge shaft and its associated works;
5. Pressure shaft and associated works; and
6. Powerhouse complex and its associated works including tail race tunnel/ channel and switchyard.

*Figure S-2.2 Project Components as shown on a Satellite Imagery of the Project Catchment*





The following environmental and social impacts are expected during the Project implementation:

- Landuse, topography, soil erosion/sedimentation;
- Water resources and quality - hydrology, hydro-geology and surface & groundwater quality;
- Ambient air quality;
- Ambient noise quality and ground vibrations;
- Ecology - forests, terrestrial wildlife, aquatic ecology and fisheries;
- Health and sanitation;
- Safety including road safety due to Project traffic movement;
- Socio-economic:
  - Land acquisition, compensation, resettlement, rehabilitation and livelihood;
  - Agriculture;
  - Cultural and tourism;
  - Community health, safety and security;
- Impacts due to potential natural hazards like flood, cloudburst, forest fire, earthquake, landslides/ avalanches; and
- Impacts due to the transmission line (as presented in separate ESIA study).

A description of the impacts is described in the following sub sections.

### 3.1

#### *IMPACTS ON LAND USE, TOPOGRAPHY AND SOIL EROSION/SEDIMENTATION*

A total of 67.599 ha of land has been acquired for the Project which includes 47.179 ha (69.79%) as forestland, 9.750 ha (14.42%) as private land and remaining 10.670 ha (15.79%) as government land. The land required for the Project would result in long term change of its landuse. During post construction (operation) phase, the landscape of the area under the various Project components is expected to be improved.

The Project would impact the topography by construction of road links to the ADHEP component sites, cross-drainages, excavations (open and tunnel areas). The open areas will remain susceptible to soil erosion, requiring rehabilitation. The Project is expected to generate solid waste in form of muck including overburden of approximately 887,000 m<sup>3</sup> (150,000 m<sup>3</sup> due to construction of roads and 737,000 m<sup>3</sup> due to construction of tunnels and other Project components). Overall, approximately 47% of the total muck generated would be reused in backfilling and remaining would be disposed-off in identified muck disposal areas of 11.6 ha.

The Project has provided arrangements for collection and disposal of domestic waste through onsite incinerator being operated as per the norms of HPPCB. During operation phase there will be generation of sludge from domestic wastewater treatment plant, which is planned to be used as manure in plantation after treatment. Other non hazardous solid waste from domestic services will be disposed of in the onsite incinerator.

A summary of potential impacts on landuse, topography and soil erosion/sedimentation are described in the following Table.

**TableS-3.1 Impact Assessment: Land-use and Soil**

Impact Area	Nature of Impact <sup>1</sup>	Targets/ Interests <sup>2</sup>	Magnitude <sup>3</sup>	Extent <sup>3</sup>	Overall significance <sup>4</sup>
Land use	Long term change in original land use, land degradation, (major)	Reduction of vegetation, loss of top soil	Moderate	Local - Project component areas, beneficial effect in terms of compensatory afforestation with higher success percentage expected and landscape development of area under the Project.	* Moderate
Topography	Long duration change – due to excavation of tunnels, development of other areas and construction of roads	Physiography of the area	Moderate	Medium spread - within the Project component areas, irreversible	* Moderate
Derogation of land and soil quality	Medium duration change - Cumulative contamination with dust, surface run-off and Project solid waste excavated muck disposal; reversible	Soil quality, flora and fauna, including grazing livestock	Low	Local -Localised near sources; contribution to existing background levels, provided dust control and overburden is managed	○ Minor with mitigation measures in place
	Physical effects on soils due to topsoil removal, nutrient loss.	Soil quality, flora	Low	Local - Project component areas only	○ Minor

<sup>1</sup> Description; short or long term; reversible or permanent; associated with construction, operation, decommissioning; cumulative, accidental, etc

<sup>2</sup> Targets and interests potentially affected.

<sup>3</sup> Adverse or beneficial; low, moderate or high magnitude; very localised (Project component sites only), local, medium, regional extent.

<sup>4</sup> Overall significance against criteria (○ minor; \*moderate; \*\*major)

### 3.2 HYDROLOGY, HYDRO-GEOLOGY AND WATER QUALITY

The construction of diversion structures during operation phase will result in disturbance of the existing flow pattern and water quality due to escape of suspended solids from construction activities finding their way into the two streams. During operation phase there will be following adverse impacts:



*Watershed Development by Forest Department on Allain stream near*

- Submergence at diversion structures;
- Diversion of water flows due to water diversion from Allain and Duhangan streams for hydro power generation resulting in reduced flows downstream Allain and Duhangan streams. The Allain and Duhangan streams are flowing from high elevation differences

before emptying into Beas River, it is expected that there will be low possibility of loss of groundwater regime;

- De-silting of silt deposit in the de-silting chambers at Allain and Duhangan diversion from diversion structures hydrology. The Project has considered de-silting activities to be mainly restricted during monsoon season, thereby resulting in low potential of increase of silt in the downstream water in Allain and Duhangan streams;
- Downstream tail race discharge from power house in Allain stream during the hydropower generation;

- The Project will have a small impoundment resulting low potential of thermal stratification and loss of dissolved oxygen; and
- Water storages in intermediate reservoir, which in case of its failure may result in high soil erosion, loss to ecology and structures along its path and a risk of accidents.

#### Minimum Water Flows to be Maintained Downstream the Diversion Structures

The minimum flows observed in a year during January and February being 1.54 m<sup>3</sup>/sec for Allain stream and 1.08m<sup>3</sup>/sec for Duhangan stream. As per the notification no. PC-F (2)-1/2005 dated 09 September 2005 by the Principal Secretary (Pollution Control) to the Government of Himachal Pradesh, a minimum discharge of 15% is to be ensured by all hydroelectric power projects. Accordingly, the Project will maintain 15% of available flow at any point of time. For the lean period a minimum discharges from the Allain diversion structures works out to be 0.231m<sup>3</sup>/sec.

For Duhangan stream, as per the directives of the Honourable High Court of India, the Project is required to discharge a total of 0.24939m<sup>3</sup>/sec (249.39 liters per second) in addition to 15% of minimum flow to be discharged from Duhangan weir structure. The directive recommended flow of 0.33585 m<sup>3</sup>/second (335.85litres per second) is to be maintained by the Project downstream the Duhangan weir. While for the year 2045, the recommended flow is 0.38709 m<sup>3</sup>/sec (387.09 litres per second). This flow will have to commensurate with increase of population of Jagatsukh village over the 40 years life of the Project and has to be re-assessed subsequently for any extended Project life.

A summary of impact on hydrology, hydrogeology and water quality is described in the following Table.

**Table S-3.2 Impact Assessment: Water Resources**

Impact Area	Nature of Impact <sup>1</sup>	Targets/ Interests affected <sup>2</sup>	Magnitud e <sup>3</sup>	Extent <sup>3</sup>	Overall significance <sup>4</sup>
<b>Surface Water</b>					
Sub-mergence of land	Long term Submergence of Land in the vicinity of Allain barrage structure	Local wildlife and ecology on nearby flat land	Low	Local	* Moderate
Hydrology	Long term - change in Hydrological Regime - Long term Flow modification due to diversion of water and installation of structures on Allain and Duhangan streams	Local inhabitants depending on the downstream water of Allain, Pahali and Duhangan streams.	High	Local/ Regional	** Major
Water quality	Medium term - increase in siltation load due to construction activities	Allain and Duhangan Streams within the catchment area	Moderate	Regional	* Moderate
Risk of high water flow	Short term - Failure of Intermediate and Allain impoundments - risk of occurrence very low	Increase in siltation load due to high soil erosions, destruction of ecology, accident	Low	Local/ Regional	O Minor, but would have major impact if occurred
Water quality	Short term contamination of surface water flows due to de-siltation and thermal stratification.	Downstream diversion structures Tailrace outlet at Allain stream	Medium	Local, small - mostly restricted to monsoon season	O Minor
Potential for decreased dissolved oxygen	Short term depletion of DO in reservoir due to reduced turbulence	Tailrace Discharge point in Allain stream	Low	Local, small scale	O Minor
<b>Groundwater</b>					
Ground-water	Long term, medium reduction	Aquifers along Allain stream beds stretch	Low	Local/ Regional	O Minor * Moderate

Impact Area	Nature of Impact <sup>1</sup>	Targets/ Interests affected <sup>2</sup>	Magnitude <sup>3</sup>	Extent <sup>3</sup>	Overall significance <sup>4</sup>
quantity		(5.6km) between diversion point and tailrace outlet; and Duhangan stream beds stretch (6.5km) between diversion point to confluence of Beas River			

<sup>1</sup> Description; short or long term; reversible or permanent; associated with construction, operation, decommissioning; cumulative, accidental, etc

<sup>2</sup> Targets and interests potentially effected.

<sup>3</sup> Adverse or beneficial; low, moderate or high magnitude; very localised (Project component sites only), local, medium, regional extent.

<sup>4</sup> Overall significance against criteria (○ minor; \* moderate; \*\* major)

### 3.3 AMBIENT AIR QUALITY

There exist potential adverse impacts on ambient air quality during construction phase of the Project from the following sources:

- Fugitive dust emissions due to removal of vegetation, excavation of land, road construction, hot mix plants and concrete mixers operation, excavation of tunnels, defuming of tunnels after blasting, etc;
- Air emissions from stacks of diesel generators meant to generate power for construction purposes and from vehicles engaged for construction purposes; and
- Occupational dust in the working areas.

The average ambient air quality (AAQ) monitored in villages was observed to be within the prescribed limits and with the addition of incremental levels in the baseline, it is expected that the AAQ will remain within the prescribed limits. The prevailing winds in Manali blow from N, NE, E and SE directions. The probability of movement of pollutants to villages in the west lies with easterly winds. There is advantage of elevation differences for the Project components are located at higher elevations than Prini and Jagatsukh villages.

During operation phase, the potential emissions will be from plying of a few Project vehicles and from diesel generator meant for power back up during incidence of power outage in the power house. The operation phase will result in positive impact on ambient air quality as hydroelectric power generation will be free of fossil fuel combustion.

The Project will have positive impacts on ambient air quality during operation phase as the hydropower generation will help save green house gases (GHG) emissions of approximately 0.63 million tons of equivalent of carbon dioxide per annum.

A summary of impacts on ambient air quality is described in the following Table.

**Table S-3.3 Impact Assessment: Air Quality**

Impact Area	Nature of Impact <sup>1</sup>	Targets/ Interests <sup>2</sup>	Magnitude <sup>3</sup>	Extent <sup>3</sup>	Overall significance <sup>4</sup>
Ambient air quality	Medium term - deterioration of ambient air quality during Project construction. However, impacts would largely be reversible. Emissions of	Nearby villages. Workers onsite. Vegetation and Wildlife.	High - dust emissions can be quickly suppressed.	Local/ Medium - impact mostly within the Project components areas and may	** Major significance

Impact Area	Nature of Impact <sup>1</sup>	Targets/ Interests <sup>2</sup>	Magnitude <sup>3</sup>	Extent <sup>3</sup>	Overall significance <sup>4</sup>
	SPM (dust) and to a smaller extent SO <sub>2</sub> , NO <sub>x</sub> , would occur during all stages of the project construction phase (of 66 months); and increase in traffic on Nagar – Manali Road			travel to some distances from project component locations.	
Deposition of pollutants, SPM (dust) in human beings and in local area	Medium term - Potential impact due to accumulation of SPM deposition	Potential effect on human health due to SPM deposition in the lungs; Potential effect on land and soil quality of nearby agricultural fields (Apple Orchards); Minor/Moderate effect on flora and fauna	Moderate	Localised -- adverse effect. Magnitude dependent on emissions and management of dust control.	* Moderate (In case of human health, as immediate consequences of dust will be on human beings) ○ Minor/moderate significance, in case of land, flora and fauna. However, should the control measures fail, the potential impact could be of major significance)
Ambient air quality during operation phase of the Project	Long term - beneficial impacts due to Project operation	Project operation will generate electricity without emitting conventional pollutants like from other power projects	High – beneficial	Regional – beneficial	** Major positive impact

<sup>1</sup> Description; short or long term; reversible or permanent; associated with construction, operation, decommissioning; cumulative, accidental, etc

<sup>2</sup> Targets and interests potentially affected.

<sup>3</sup> Adverse or beneficial; low, moderate or high in magnitude; very localised (within the project component locations only), local, medium, regional in extent.

<sup>4</sup> Overall significance against criteria (○ minor; \*moderate; \*\*major)

### 3.4

#### NOISE QUALITY & GROUND VIBRATIONS

Noise attenuation with respect to distance in all directions has been worked out through a standard mathematical model for sound wave propagation. An input of 95dB(A) as the resultant noise level generated from the construction activities including operations of diesel generators in the vicinity of major Project component locations was considered. It is expected that during construction activities noise level of 95 dB(A) will be attenuated to 55 dB (A) at a distance of 40 m and night time noise level of 45 dB(A) at a distance of 224 m from the source. The day time noise level will merge with the background day time noise level of 55 dB(A) [i.e. day time national standard for residential set up] at a distance of 300 m and beyond from the source while night time noise level will merge with the background night time noise level of 45 dB(A) [i.e. night time national standard for residential set up] at a distance of 1km and beyond from the source. There will not be any noise impact from the project components during night-time as the construction activities will be restricted to two day shifts only and no machinery operation is expected to operate during night time.

Due to blasting, the vibrations may cause damage to the nearby structures if appropriate control measures are not adopted. The calculations done for 20kg of explosive charge per delay showed the ground particle velocity up to 81m is above the safe level of 70 mm/sec for hard rock. However, at subsequent distances the ground particle velocities are expected to be within the safe limits for any structures. It can be concluded that the ground vibrations generated by blasting during the tunnel excavations will not likely to affect the structures proposed in the vicinity of less than 100 m from the point of blast with 20 kg of charge per delay.

A summary of impacts on ambient noise quality and ground vibrations is described in the Table below.

**Table S-3.4 Impact Assessment: Noise Quality & Ground Vibrations**

Impact Area	Nature of Impact <sup>1</sup>	Targets/ Interests <sup>2</sup>	Magnitude <sup>3</sup>	Extent <sup>3</sup>	Overall significance <sup>4</sup>
Ambient noise quality	Medium term - deterioration of ambient noise quality during Project construction and due to movement of traffic on roads to barrage along Allain stream and weir site along Duhangan stream. However, impacts would largely be reversible.	Nearby villages. Workers onsite. Vegetation and Wildlife.	Moderate - noise mitigations to include provision of noise barriers; use of controlled blasting techniques including delay detonators; Vehicular movements restricted to day time only etc.	Local/ Medium - will be restricted to short distances	* Moderate significance
Occupational noise	Medium term - occupational impacts on health of workforce engaged for construction activities	Potential effect on human health due to high noise emissions at the work place.	Moderate	Local. Magnitude depends on noise emission and use of personal protective equipment (PPE).	* Moderate ○ Minor, in case of mitigation measures and use of PPE.
Ground vibrations	Medium term - ground vibrations due to tunnel development for each of the Project components.	Nearby villages. Workers onsite. Vegetation and Wildlife.	Low - mostly underground tunnelling. Mitigations to include use of controlled blasting techniques including delay detonators and restricting only day time blasting; avoid blasting during bad weather etc.	Local Medium - Ground vibrations are expected to remain within less than 100 m.	* Moderate (with the mitigations in place).

<sup>1</sup> Description; short or long term; reversible or permanent; associated with construction, operation, decommissioning; cumulative, accidental, etc

<sup>2</sup> Targets and interests potentially affected.

<sup>3</sup> Adverse or beneficial; low, moderate or high in magnitude; very localised (within the project component locations only), local, medium, regional in extent.

<sup>4</sup> Overall significance against criteria (○ minor; \*moderate; \*\*major)

### 3.5 ECOLOGY

Approximately 324 plant species (trees: 23; shrubs: 53; herbs: 249) were recorded from the Hamta-Jagatsukh catchments whereas 284 species (trees: 18; shrubs: 46; herbs: 220) were recorded in the Project and surrounding area. A total of 49 species have been identified as rare-endangered, however, none of them falls in current criteria of International Union for Conservation of Nature and Natural Resources (IUCN).

#### **Rare and Endangered Plant Species within the Project catchment**

Among 49 species, 5 species have been categorized as **Critically Endangered** (*Saussurea obvallata*, *Gentiana kurroo*, *Arnebia benthamii*, *Dactylorhiza hatagirea* and *Saussurea costus*); 12 species as **Endangered** (*Aconitum heterophyllum*, *Angelica glauca*, *Betula utilis*, *Bergenia stracheyi*, *Dioscorea deltoidea*, *Meconopsis aculeata*, *Paris polyphylla*, *Podophyllum hexandrum*, *Polygonatum cirrhifolium*, *Picrorhiza kurrooa*, *Taxus baccata* subsp. *wallichiana* and *Zanthoxylum armatum*); 8 species as **Vulnerable** (*Aconitum violaceum*, *Polygonatum verticillatum*, *P. multiflorum*, *Rheum australe*, *R. webbianum*, *Rhododendron campanulatum*, *R. anthopogon* and *Valeriana jatamansi*); 1 species as **Near Threatened** (*Hippophae salicifolia*); 1 species as **Extinct in Wild** (*Saussurea costus*) and 22 species were identified as **Rare**.

The development of Project will result in loss of forest due to diversion 47.179 ha of forestland for reservoir, buildings, roads and other ancillary facilities. Of the 47.179 ha of forestland, 9.55 ha is additional diverted forestland and 6.192 ha involving underground works. The Project development would result in loss of 1746 trees comprising of 374 individual trees of *Abies pindrow*; 320 of *Quercus dialtata*; 314 of *Quercus semecarpifolia*; 238 *Picea smithiana*; 152 *Pinus wallichiana*; 130 *Acer acuminatum* and 95 *Cedrus deodara*. None of these species are reportedly fall under rare or endangered category.

Moderate impact to the wildlife is expected due to the construction of various Project components. The Project will be implementing mitigation measures to minimise impacts on wildlife and undertake afforestation measures in the Project catchment and compensatory afforestation through the Forest Department at the Project cost.

#### **Mitigation measures to minimise impacts on Wildlife**

- Restricting construction activities and movement of Project traffic during day time only;
- Blasting activities for tunnel development to be taken up by using delayed detonator techniques to minimise vibrations during fixed day timings only;
- Openings of all the tunnels/adits to be lighted during night time and guarded all the time. If unguarded these tunnel openings must be temporarily closed to avoid any wildlife finding refuge in such tunnels during night time or periods of no construction activities;
- In case any wildlife is found to have taken up a refuge in any such tunnels, all construction labour to leave that place immediately, trained personnel from Department of Forests and Wildlife Warden's office and approved experts should be intimated for rescue of such wildlife. Any construction activities to be taken up only after any trapped wildlife finds its safe escape;
- The Project is to minimise damage to plantation in and surrounding the Project component areas. If any damage is noted, the Project is to take up plantations in all areas damaged due to Project construction in addition to statutory compensatory afforestation to be taken up by the Project through State Department of Forests; and
- Follow up Biodiversity and Wildlife Management and Catchment Area Treatment Plans

### **3.5.1 Ecological Sustenance Downstream Allain and Duhangan Diversion Structures**

In Duhangan and the Allain streams there are successive waterfalls of about a kilometer and a kilometer and a half upstream of the confluence respectively. These waterfalls are over 10 meters high with deep plunge pools, and because of the nature of the fall over hanging rock, it is not possible for fish to climb or leap over. Fish fauna was observed only up to these waterfalls in the two streams. In the Pahali stream fish were found up to about 500 meters above the bridge on Manali – Nagar road. However, during peak flow or monsoon season, there is possibility of fish migrating upstream for some distances.

The Project will ensure a minimum of 15% of available flows as explained above in **Section 3.2** in both Allain and Duhangan streams. It is expected that with these flows together with flows available from other sub-streams downstream the Allain and Duhangan streams would result in support to ecological sustenance including fish fauna of the riverine ecosystem.

**Table S-3.5 Impact Assessment: Ecology**

Impact Area	Nature of Impact <sup>1</sup>	Targets/ Interests <sup>2</sup>	Magnitude <sup>3</sup>	Extent <sup>3</sup>	Overall significance <sup>4</sup>
Forestland	Long term – Loss of Forestland, vegetation, trees removal from 41.669 ha of land (excluding 5.51 ha of forestland required for underground work) – impact irreversible	Loss of floristic diversity by reduction of vegetation, standing trees, loss of top soil supporting vegetation	Moderate adverse impact – Some beneficial effect in terms of compensatory afforestation with higher success percentage expected	Local - within Project component areas	* Moderate
Wildlife	Long term - excavation of tunnels, construction activities, movement of vehicles on Project roads	Disturbance to wildlife, including grazing livestock	Moderate adverse impact – Some beneficial effect in terms of compensatory afforestation, pasture development	Local – near Project component areas	* Moderate
Fisheries - construction phase	Short term – construction activities resulting in silt, erosion affecting quality of water downstream Allain and Duhangan stream	Water quality affecting aquatic flora, fauna and dependent birds	Low – considering mitigation measures are in place	Regional contribution to existing background levels.	○ Minor with mitigation measures in place
Fisheries – Operation phase	Long term – reduced water flows downstream Allain and Duhangan streams - desilting of desanders during monsoon season	Water quality affecting aquatic flora, fauna and dependent birds	Low – the desilting is mostly restricted during monsoon season to minimise adverse impact. Minimum discharges to be maintained for ecological sustenance of the streams	Regional	* Moderate
Physical impact	Long term Submergence of Land in the vicinity of Allain barrage structure	Local wildlife and ecology on nearby flat land	Low	Local	* Moderate A
Compensatory Afforestation and landscape and pasture development	Long term – beneficial impact due to compensatory afforestation	Increase of floristic diversity, standing trees, improvement in grazing areas for livestock	Moderate – beneficial	Medium – beneficial	* Moderate beneficial

<sup>1</sup> Description; short or long term; reversible or permanent; associated with construction, operation, decommissioning; cumulative, accidental, etc

<sup>2</sup> Targets and interests potentially affected.

<sup>3</sup> Adverse or beneficial; small, large, etc; very localised (Project component sites only), local, medium, regional.

<sup>4</sup> Overall significance against criteria (○ minor; \*moderate; \*\*major)



### 3.6 *TOURISM & CULTURAL PROPERTY*

The Nagar - Manali, near Manali area comprises of a few hotels, two trekking lines and an ancient temple each at Prini and Vashist. A few springs also exist in Vashist and Jagatsukh. Another area of tourism interest is skiing undertaken at about 5 km upstream the Allain barrage location. In this area skiing is done by foreigners who directly fly to this region through helicopter service available in Manali.

The Project road from Prini to Allain barrage site will provide access to Panduropa a wetland site of mythological significance resulting in positive impact on tourism.



*“Panduropa”, a wetland with mythological significance - on way to the site selected for Allain barrage, from Sethan village.*

The Project during construction phase would have some minor impact on trekking for which mitigating measures are to be followed.

There can be cultural impacts due to differences in customs of outside workers and local residents. These risks could be reduced by providing adequate facilities in workers camps and by employment of preferably local labour. The cultural aspects located near to the Project components include the ancient temple at village Prini, a Tibetan Monastery near village Saithan, Lord Shiva's Temples at Jagatsukh, Pandurupa pond of historical importance up the village Saithan and a graveyard under the bridge on Nagar - Manali road near village Jagatsukh. The Project road for an access along Duhangan stream is to start from the bridge area near graveyard area, for which ADHPL has already taken steps to change the road path to minimize hindrances to the graveyard. The Project has also plans to provide health care facilities for the communities.

### 3.7 *IMPACT ON HEALTH & SANITATION*

Health risk includes potential disease hazards due to lack of hygienic/sanitation (water supply and human waste disposal), vector and water borne diseases and spread of sexually transmittable diseases like AIDS. Incidences of Malaria, Dengue, Jaundice, Dysentery etc are reported in and around the Project area. With the development of the Project, potential health risks would also grow if left unchecked. Mitigation measures include proper sanitary health care and human waste disposal facilities. Sanitation facilities are included in the Project estimate to take care of cost to be borne towards human waste disposal facilities. The Project has also plans to provide health care facilities for the communities around the Project site.

### 3.8 *IMPACT OF PROJECT ROAD CONSTRUCTION - INCREASE IN TRAFFIC AND ROAD SAFETY*

It is expected that during construction phase approximately 58 truck trips per day will be added apart from other project traffic on Nagar - Manali Road. The increase in traffic volume poses potential for additional safety risks to other users of the road. Presently, Nagar - Manali road has lower traffic volume as it is longer than alternative roads between Kullu and Manali.

The Project has acquired land mainly from three villages of Prini, Jagatsukh and Aleo in Tehsil Manali, District Kullu.

Villages Hamta and Saithan are affected by the road passing through these

#### Project Area

The Project Affected Families are mainly located in three villages of Prini, Jagatsukh and Aleo, and are primarily dependent on agriculture and apple plantations. Jagatsukh and Aleo fall on the main road while Prini is about 0.5 km from the main road.

villages. The Project has acquired 67.599 ha of land of which 9.750 ha is private land, 10.670 ha is Government land and remaining 47.179 ha is forestland. The major impacts of the Project would include:

- Loss of private property;
- Loss of asset including plantations;
- Loss of livelihood and income directly linked to the above two losses; and
- Other indirect losses.

The Project would not impact any homestead land or residential structures, hence no physical

rehabilitation is envisaged. By the land records, no PAF will become landless. However, it was observed that in some cases, ownership, as indicated by the land records, did not reflect the actual or de-facto use and ownership of land.

Through the survey it is estimated that of 185 families, 102 families were losing less than 10% of their total land, 47 families were losing less than 50% of the land, 3 families were losing less than 75% of their total land while 4 families stand to lose more than 75 of their total land. This latter category of PAFs falls in the “most vulnerable” category.

Apple trees are the main assets that would be impacted in this project, as primarily plantation land is being acquired. Approximately 19 families will be losing more than 100 apple trees while a majority of the PAFs stand to lose less than 50 trees. Though agriculture is practised in the area, it is mostly for subsistence and not for income.

In terms of household income, loss of income for most PAFs is in the range of 25%, nevertheless impacts on livelihood could be significant especially in case of small and marginal landowners.

Land has been adequately compensated at market value through direct negotiations with the community. The Project has prepared a Rehabilitation Plan to ensure that income of the Project affected people is restored. A Community Development Plan has been prepared to offset impacts on the village communities in and around the Project area and to usher in development activities as per the needs of the people in the area.



*Women in Aleo, a Village in the Project Area*

The project has made efforts to avoid any impact on common property like places of worship, grazing grounds etc. The local land revenue department in each village has affirmed through a written document that no such property is getting affected in any of the three villages of Aleo, Prini and Jagatsukh.

### 3.10 *NATURAL HAZARDS*

The Project has reportedly considered factors its Project design to counter natural hazards like earthquake, dam failure, cloudburst, forest fire risk, landslides, and avalanches. Mitigation and monitoring would be required as per the ESMP.

### 3.11 *CUMULATIVE IMPACTS*

The revised and updated ESIA study has included potential impacts of the proposed hydroelectric power Project together with other possible existing or future foreseeable impacts of different Project activities on the same environmental resource or receptor that will achieve higher significance and gravity of such impacts.

The Project is a run-of-the-stream scheme on Allain and Duhangan streams, which are perennial tributaries of the Beas River. The possible cumulative impacts can be due to present and future foreseeable projects in the Project catchment area, either upstream or downstream or both. The area above diversion points is mostly snow covered with lesser availability of head, difficult topography/ access or having catchment running towards other side of watershed i.e. leading to Chenab river in the Lahul Spiti District, thereby lowering the feasibility of future projects upstream, either in Allain or in Duhangan streams. A 3 MW small hydropower project has recently started functioning downstream of Allain stream near Aleo. With the operation of ADHEP, it is reported that the capacity of this small hydropower will be reduced to 1 MW.

There are several projects that have been identified downstream of the Beas River. Some of the major ones include of Malana (86MW), Parbati Stage I, II & III (750+800+501 MW), Larji (126 MW) and Uhl stage III 100 MW. (There are also over 65 small scale hydropower projects ( $\geq 3$  MW) identified in the catchment of the Beas River). All these projects in the Beas Catchment pose cumulative impacts on the Beas River. Mitigation measures of a minimum discharge of 15% of the available flow together with peak hour discharges from tail race will minimise some impacts downstream the Beas River.

### 3.12 *INTERNATIONAL WATERWAYS*

The Allain and Duhangan streams are tributaries of the Beas River. Beas River is a tributary of Sutlej River, which in turn is finally a tributary of the Indus River, a subject falling outside the Indian Territory i.e. into the territory of neighbouring country Pakistan. Any project on tributaries of Beas/Sutlej Rivers requires formalities to be meted with the requirements laid down in the Indus Water Treaty, 1960 signed by India and Pakistan in the presence of the World Bank. The Indus System of Rivers comprises three Eastern Rivers (the Sutlej, the Beas and the Ravi) and three Western Rivers (the Indus, the Jhelum and the Chenab). Any Project on western rivers requires prior intimation to the Pakistan authorities for alterations in flow pattern.

The present Project being run-of-the-river-stream Project without impoundments in Dam on tributaries of eastern River Beas in turn tributary of River Sutlej requires no such formalities as per the Treaty. The proposed Project being a run-of-the-streams scheme, there would be insignificant impacts on the Indus River.

#### 4.1 OVERVIEW

The ESMP provides a delivery mechanism to address potential adverse impacts, to instruct the Project executing teams and contractors to implement standards of good practice to be adopted for all the Project work. ADHPL will own and operate the ADHEP for a period of 40 years, which is extendable for another 20 years. During this time ADHPL will have the sole responsibility to meet the identified environmental and social requirements under the ESMP.

ADHPL will ensure following action items to be complied with throughout the life cycle of the Project:

- Standards and guidelines;
- Inspections, monitoring and auditing;
- Periodical ESMP review and amendments;
- Reporting and communication of Project related information including internal and external reporting and communication;
- Documentation and record keeping;
- Organisation, roles and responsibilities for the ESMP implementation and for functioning of Environmental Management System (EMS) and Safety Management System (SMS) Procedures.

##### 4.1.1 Standards and Guidelines

Besides the compliance with the stipulated conditions under various permits (approvals, clearances and licences) obtained for construction and operation of the proposed Project, ADHPL is also required to comply with regulatory provisions and applicable international standards.

###### **Legal and Regulatory Requirements and Applicable International Standards**

ADHEP is governed by various legislative rules and regulations set by Himachal Pradesh State Pollution Control Board (HPPCB) and Ministry of Environment and Forests (MoEF). Various specifications and guidelines of Central Pollution Control Board (CPCB) are also applicable. The Project has obtained techno-economic clearance from CEA, Environmental Clearance and Forest Clearance (for diversion of forestland) for the Project from MoEF.

The contents of the revised and updated ESIA report have been designed to meet the documentation requirements of applicable Indian regulations and standards and international standards i.e. Performance Standards on Social and Environmental Sustainability and General Environmental, Health and Safety (EHS) guidelines of IFC as described below:

- Performance Standard 1: Social and Environmental Assessment and Management System;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Pollution Prevention and Abatement;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage.
- IFC's safeguard policy on Safety of Dams (OP4.37) and International Waterways (OP7.50);
- Environment, Health and Safety (EHS) General Guidelines of IFC

ADHPL has defined environmental management system as per the provisions of ISO 14001 and OHSAS 18001. The developed system will help environmental and safety related requirements under the international standards.

#### 4.1.2 Inspection, Monitoring and Auditing

Inspection and monitoring of the Project activities vis-à-vis the suggested mitigation measures will minimise adverse impacts and increase effectiveness of environmental and social suggested mitigations. Through the process of inspection, monitoring and auditing, ADHPL will ensure that all the contractors comply with the requirements of stipulated conditions under various permits as well suggested mitigations for Project cycle related activities.

Internal and external monitoring is proposed in the Project. Internal monitoring of the ESMP implementation will be the responsibility of a special Monitoring & Evaluation cell within ADHPL. The internal and external monitoring and evaluation will be an ongoing process and will continue effective even after the construction activities of the Project are over.

The Project will also ensure monitoring of environmental parameters as per the following Table

**Table S-4.1 Monitoring of Environmental Parameters**

S.N.	Description of Parameters	Schedule and duration of monitoring
1. Air Quality (SPM, RPM, CO, SO <sub>2</sub> , NO <sub>x</sub> )		
1.A	In the vicinity of the villages Hamta, Jagatsukh (near proposed colony) and Prini (near camp sites)	One sample over 24 hours continuous duration, twice a week on a quarterly basis except during monsoon & snowfall.
1.B	In the surrounding areas near Reservoir (village Hamta) and Switchyard site near village Prini	One sample over 24 hours continuous duration, twice a week on a quarterly basis except during monsoon & snowfall.
2. Water Quality		
2.A	Treated Wastewater quality generated from Workshop and STP	Twice a week for selected parameters like, pH, TSS, TDS, COD, BOD and Oil and Grease. The detailed analysis should be carried out once in three months.
2.B	Surface & groundwater quality in the vicinity of the downstream Allain and Duhangan streams and nearby springs for groundwater quality as per Drinking Water Standard IS: 10500:1991, as re-confirmed in 2002.	Once in three months.
3. Ambient Noise		
3.A	Ambient Noise levels at the nearby villages	Quarterly
4. Ecological Resources		
4.A	Inventory of flora and fauna at intermediate reservoir and along Allain and Duhangan streams	Once in two years in project monitoring area
5. Soil Quality		
5.A	Soil quality at all the locations reported under baseline	Once a year on all reclaimed areas and adjoining villages

*Note: Monitoring under serial nos. 2 and 4 to be taken up throughout the Project life cycle while under serial nos. 1, 3 and 5 may be restricted to construction phase.*

In addition to the above, all conditions specified by the regulatory bodies governing environmental control and monitoring required during operational phase. The Project will comply and monitor conditions (of HPPCB and Department of Environment & Science and Technology, Government of HP) including the following:

- Maintenance of requisite percentage of water flow downstream of the diversion works in order to maintain the riverine ecology and furnish basis of arriving at this percentage.
- Monitor the impact on macro-invertebrates with diversion of the flow and also correlate it with maintenance of a minimum percentage of water flow downstream of the diversion works.

- Get a third party post environmental monitoring of the project in order to assess the implementation of various components of EMP including CAT plan.
- Department of Environment and Scientific Technologies, Govt. of Himachal Pradesh will monitor directly the implementation of EMP and the projected expenses of INR 5.0 million to be borne by ADHPL.

The Project will also comply and monitor conditions (of MoEF) under Forest Clearance and Environmental Clearance including the following:

- Annually furnishing of progress on compliance of all the conditions specified in the Forest Clearance to Regional Office of MoEF at Chandigarh
- Six monthly monitoring reports to the Ministry and its Regional Office, at Chandigarh under the Environmental Clearance;
- Complying with all the conditions which the State MoEF, Government or Conservator of Forests (Central), Regional Office-Chandigarh may stipulate from time-to-time in the interest of conservation, protection or development of forests and environment protection; and
- Provide full co-operation, facilities and documents/data during inspection by officials from Regional Office MoEF (Chandigarh), who would be monitoring the implementation under the Forest (Conservation) Act and implementation of environmental safeguards under the Environment (Protection) Act, 1986.

#### **4.1.3 ESMP Review and Amendment**

ADHPL will annually review the ESMP and identified management action plans to address any changes in the organisation, process or regulatory requirements. Upon any amendment, the amended ESMP will be communicated to all the staff by the Deputy/Assistant General Manager Environment, Health, Safety and Social [DGM/AGM (EHS&S)].

External auditing will be carried out half yearly during the construction phase. These reports will be forwarded to IFC for necessary review. During Operation phase, the external auditing will be done on an annual basis.

#### **4.1.4 Reporting, Review and Communication**

ADHPL will ensure external reporting of environmental and social performance through DGM (EHS&S). External reporting includes reporting of status of compliance of conditions stipulated under various permits as well as reporting of environmental statement under the provisions of Environment (Protection) Act, 1986 and amendments. Project will ensure mechanism for timely reporting of responses against any complaints or notices issued by regulatory agencies or other stakeholders.

To ensure effective implementation of the ESMP, the inspections and audit findings will be communicated internally by the DGM/AGM (EHS&S) to all concerned department managers for effective implementation of suggested mitigation measures of their Project component. Open communication on EHS&S issues will be ensured on regular basis during the work specific team briefing, onsite work group meetings, work specific instructions and meeting with stakeholders.

#### **4.1.5 Documentation and Record Keeping**

The Project will maintain following documents for effective implementation of the ESMP:

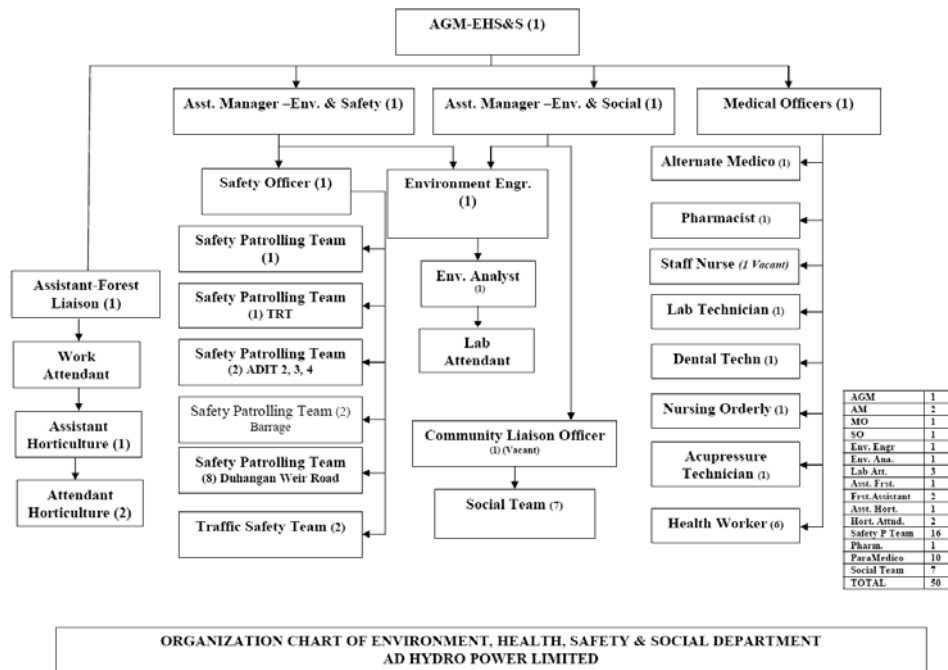
- Master environment management system document;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports; and

- Complaints register and issues attended/closed.

The ESIA and ESMP will be placed for review by stakeholders and kept at the Project office near Prini village in Manali.

#### 4.1.6 Organisation, Roles & Responsibilities

The overall management and co-ordination of the environment, health, safety, and social requirements of the Project is being managed by DGM/AGM (EHS&S). The Project will have adequate staff of specialists and support staff throughout the project life cycle and would be responsible for implementation of mitigation measures, internal and external monitoring and reporting under the ESMP. The Project has developed the following organisation chart to fulfil environment, health, safety and social requirements under the ESMP.



The usual activities of the DGM (EHS&S) and his team will include the following:

- Preparation of required EMS and SMS documents;
- Ensuring availability resources and appropriate institutional arrangements for implementation of ESMP;
- Selection of appropriate monitoring agency for carrying out various monitoring and analysis;
- Compliance of legislative and IFC requirements including ADHPL's policies, programs and contractual terms and ESMP and communication with the regulatory agencies;
- Overall implementation of EHS&S mitigations by construction contractors, sub contractors, workforce at site etc;
- Carryout audits, and inspection of all the project activities;
- Preparation of necessary documents and record keeping system;
- Review and updating of ESMP for effective its implementation; and
- Functioning of EMS under ISO 14001 and SMS under OHSAS 18001.

#### 4.1.7 Training of Project Personnel & Contractors

Regular job specific training and EHS induction training needs will be imparted to project personnel and contractors and sub-contractors engaged for the Project activities. Specific training will also be imparted to undertake the required ESMP management actions and monitoring activities. The Project will ensure that all concerned team members assigned for implementation of ESMP understand the following aspects through the training programme:

- Purpose of ESMP for various project activities;
- Requirements of the mitigation measures under the management plan and specific Action Plans;
- Understanding of the sensitive environmental and social features within and surrounding the Project areas; and
- Aware of the potential risks from the Project activities.

#### **4.2** *GRIEVANCE REDRESSAL MECHANISM*

A Grievance Redressal Cell has been established at the Project office. The cell has representation from ADHPL, local administration, civil society and the Project Affected Families.

The GRC will look into complaints and concerns about ownership disputes, inheritance of assets, distribution of compensation among heirs, missing affected assets and persons in the census etc. The procedure will not replace existing legal processes but will, based on consensus, seek to resolve the issues quickly in order to expedite the receipt of compensation, without resorting to expensive and time-consuming legal actions.

In addition to the above, if there are any grievances related to environmental management issues in the project area, the GR cell will record these grievances and suggestions and pass it on to the relevant authorities for necessary action and follow-up.

#### **4.3** *MANAGEMENT ACTION PLANS UNDER THE ESMP*

In addition to the suggested mitigation measures, the Project will develop and implement following management action plans under the ESMP:

- a) For implementation during construction phase
  - Construction Labour Management Plan;
  - Traffic Management Plan;
  - Muck Disposal Plan;
  - Health Management Plan (Construction Phase);
  - Construction Demobilisation Plan
- b) For implementation during the Project life cycle
  - Resettlement Action Plan (RAP);
  - Indigenous People's Development Plan (IPDP);
  - Community Development Plan;
  - Biodiversity & Wildlife Management Plan;
  - Catchment Area Treatment Plan;
  - Minimum Water Discharges & Fisheries Monitoring Plan
  - Emergency Response Plan; and
  - Desiltation Management Plan (for Desilting Chambers on Allain & Duhangan Streams).

ADHPL will work upon the above mentioned management action plans for necessary changes, where required while being practised. A brief description of the above mentioned plans is given as following:

##### **4.3.1** *Construction Labour Management Plan*

The peak labour strength of approximately 2000 persons is expected during the Project construction. A brief of the measures that have been suggested for the construction labour under the construction labour management action plan include the following:

- Provisions of labour camps provided with individual dwelling units supported with piped water supply,
- Provision of common toilets and bathing facilities duly segregated for male and female labour;
- Supply of kerosene, coal/fuel wood by the contractors for their labour to prevent deforestation.



- Collection of domestic waste and disposal in the onsite incinerator;
- Monthly inspection of labour camps to focus on the following:
  - General observations on cleanliness;
  - Drinking water availability with respect to source, cleanliness of storage tanks and quality fit to be consumed;
  - Provision of sanitation facilities to water availability in toilets their cleanliness and drainage;
  - Provision of garbage collection, segregation and disposal facilities.

#### 4.3.2 *Traffic Management Plan*

It is expected that there will be increase of traffic for construction related activities of the Project. This would disturb local people in the area and also increase chances of road accidents requiring a traffic management plan to minimise adverse impacts. The traffic management action plan includes the following elements:

1. Transport management planning;
2. Driver training;
3. Access road maintenance;
4. Vehicle management and maintenance, and
5. Community liaison and safety.

The traffic management action plan covers the following aspects:

- Sourcing or recruitment of drivers and number of qualified drivers needed,
- Drivers' training and approval,
- Hours of driving and rest periods,
- Driver, vehicle and load security arrangements,
- Driver communication with control point and vehicle equipment,
- Language/communication,
- Source of suitable vehicles,
- Vehicle quality and specification,
- Vehicle management and preventative maintenance programme,
- Vehicle routes, route planning and alternative routes,
- Overall vehicle movements – access route selection and management,
- Strategic vehicle parking locations – to minimise impact of vehicles on local community, villages, roads, and
- Inspection and audit of the project traffic.

The traffic management is to be monitored on daily basis to evenly spread traffic flow during a day so as to avoid congestion and minimise chances of road accidents. The plan also describes roles and responsibilities of ADHPL personnel and of contractors.

#### 4.3.3 *Muck Disposal Plan*

As per the revised muck disposal, a total of 887,000 cubic meter of earthwork is involved for the Project construction. Of this excavation for construction of 28 km long road for both Allain and Duhangan areas will result in generation of 150,000 cum muck and remaining 737,000 cu m will be generated as rock spoil, the major components of which will be from underground rock cuttings. It is expected that a total of 415,000 cu m (47%) will be reused in project construction works such as wire crates, retaining walls, rip-rap, soling etc. (including for road filling). The remaining 472,000 cum of muck will be disposed in the identified muck disposal sites.

The following steps shall be used for proper redressal of the muck disposal sites:

- Provision of retaining walls/ wire-crates at each disposal site to retain the muck in the specified area;
- Maintaining slope stability by leaving 5 m berms for filling at each of the disposal site with an angle of repose not more than 35°;
- Provision of catchment and toe drains at each disposal site to facilitate rain/snowmelt water to natural drain;

- Provision of silt traps in the catchment and toe drains to arrest any scree escaping with running water and arrangement of regular cleaning of these drains;
- Transportation of muck to the disposal site through tipper during non-peak hours (if passed through public road) and proper compaction by using bulldozers, where required to maintain stability. Compacting will also reduce area requirement for muck disposal by 15-24% depending on type of compaction;
- Stabilisation and rehabilitation of each of the disposal site by planting indigenous plant species like Fir, Blue pine, Walnut, Horsechestnut, Kharsu, Poplar etc and grasses like festuca grass etc;
- Provision of rip – rap treatment of filled muck surface depending on the type of land using boulders and soil from the muck and further consolidated by planting grasses, etc. This kind of treatment would be especially effective to prevent erosion due to running surface water.

#### **4.3.4 Health Management for Construction Labour and People in the Vicinity**

About 2000 people (including dependants) will be working during the construction period. According to the criteria of Ministry of Health and World Health Organisation, one Health Centre with one doctor and minimum five health personnel (nurses, compounders etc) will be required with at-least ten beds. Additional provisions recommended include:

- Three Mobile Dispensary i.e. ambulances will be procured and provided by the project for meeting immediate and urgent medical calls in and around the project area including emergency calls from local villages;
- Infrastructure on medical/health assistance like testing/diagnostic, emergency operating and recuperating facilities etc.;
- Employment of services of Medical Officers, Compounders, Lab Technologist, Epidemiologist, Drivers and other helping staff to provide the medical facilities.
- Construction of buildings for housing a permanent hospital and a separate Field Hospital.

During operation phase, the stagnant water and vegetation provide favourable breeding conditions for mosquitoes and snails. In the proposed project, water storage will be at Allain barrage location, inside the tunnels and at intermediate reservoir. During operation phase, ADHPL will make regular field surveys and take necessary actions to curb the disease if thriving in the area with additional budget.

#### **4.3.5 Construction Demobilisation Plan**

The construction demobilisation will involve following three activities:

- Demobilisation of Project construction activities – removal of construction equipment;
- Reinstatement of Project component areas; and
- Post reinstatement due diligence and close.

The Project will ensure that removal of construction equipment is taken up along with removal of all empty containers, wastes such as diesel, lubricants, used oil, metal waste and packaging waste will be managed in accordance with the Waste Management Plan.

Area restoration will include any underground structures created or constructed as part of the Project component development. ADHPL will ensure the following elements taken up for the reinstatement/rehabilitation of all disturbed areas that were under the development of Project components both along Allain and Duhangan sides:

- Ecological restoration;
- Physical restoration such as restoration of original contours to get the same original topography/ physiography;
- Storm drainage restoration;
- Soil restoration and addressing soil erosion related issues through appropriate control measures including those identified in the Catchment Area Treatment Plan;
- Access restoration including for grazing land;
- Infrastructure and other utility restoration, if they were disrupted or re-routed earlier in the Project;
- Other restoration elements as agreed between land owner, local community and ADHPL; and
- Comply with all conditions of statutory approvals.

While restoring the site, ADHPL will ensure that there is no leaching of contaminants into the surrounding soils.

Before demobilisation and area restoration, ADHPL will undertake a due diligence survey of the Project components areas to identify environmental actions required for restoration/rehabilitation of sites related to each of the Project components along Allain and Duhangan streams. Based on due diligence survey, ADHPL will work out a detailed actions required for demobilisation and restoration/reinstatement of areas under the Project components. Upon completion of restoration ADHPL will conduct a due diligence and close out reporting process that will be adopted for post reinstatement monitoring. The objective is to close the environment related risks and liabilities that could have arisen due to the Project activities in the Project component area and any disturbance that has been created directly/indirectly in the surrounding area. The post reinstatement monitoring will also help to assess the performance of reinstatement methods and procedures adopted and their effectiveness.

#### **4.3.6 Resettlement Action Plan**

It is estimated that approximately 185 families will be impacted through land acquisition. No tenants or share croppers were identified as per the Census Survey.

##### **Policy Objective**

The policy objective influencing the Resettlement Action Plan (RAP) is to *avoid or minimize, to the extent possible, the hardships and impoverishment that land acquisition may cause, and to mitigate any adverse impacts thereof at the household and community levels.* These objectives are detailed and made more specific in terms of the principles and guidelines to be followed for land acquisition, adoption of compensation/entitlement policies and planning and implementation of rehabilitation activities in the ESIA document.

##### *Entitlement for Loss of Land*

The compensation modalities are based on the assumption that no residential structures, homestead land, common property resources (CPRs) and cultural property will be impacted by the project.

Compensation for the acquired lands and assets has been paid at costs negotiated on the basis of the approved state Government norms. Families losing more than 75% of their land after acquisition have been identified and reportedly provided with an option of cash compensation or alternative land including for affected Scheduled Tribe families.

##### *Rehabilitation for Loss of livelihood*

As per the plan, rehabilitation assistance is to be provided to all vulnerable PAFs (women-headed households, families with aged and physically and mentally challenged members, and families below the poverty line). In addition PAFs who will be rendered vulnerable losing more than 25% of their total landholding and whose livelihoods and incomes are to be affected by the loss of land and asset (mainly trees) will also be eligible for rehabilitation. The rehabilitation assistance will allow the PAFs to tide over the transition period immediately after incurring the loss and till the time they are able to re-establish their original economic activities or initiate new ones. Rehabilitation support included the following provisions:

- Transition Allowance for a specified period of time for loss of income and livelihood as defined in the entitlement framework.
- Income restoration programmes as well as Land Purchase Assistance.
- A broader Community Development Programmes, targeted at all the village community in the four villages influenced by the project.

### **Focus on Women**

The entire rehabilitation exercise will undertake immediate and practical initiatives to ensure that the lives of women in the area are significantly improved and that they are able to adapt to the potential changes that the project may bring about in the local environment and economy. Some of these steps include:

- Ensuring that women play an equal role in decision making on the utilisation of compensation money.
- Reducing workloads of women by encouraging and enabling the village development programme to focus on basic necessities like provision of drinking water, access to fuel wood and fodder, improved household appliances, specially for cooking and agriculture and most importantly, access to better health services.
- Increasing incomes of women by setting up micro-credit and Self Help Groups, training and improving access to markets.

The income restoration strategy will have the following components:

- Land Based Livelihoods
  - Restoring Apple Orchards
- Improving Productivity of land
  - Non-land based livelihoods
  - Employment during construction phase
  - Skill Upgradation and micro-enterprise

#### *Implementation Mechanism for RAP*

The RAP requires for an implementation mechanism to be set in place for the delivery of the entitlement package, as well as to meet the objective of the rehabilitation action plan. The strategy of implementation includes the delineation of roles and responsibilities of organisations/institutions, as well community groups, the procedures to be followed along with the support facilities available and finally a monitoring and evaluation plan.

#### *Public Consultation and Disclosure Plan*

The PCDP has recorded the issues that were raised at public consultations and lays out a detailed plan for consultation with different stakeholders at different stages of the project. It also suggests medium and forums for such interactions and information dissemination processes.

#### **4.3.7** *Indigenous People's Development Plan*

IFC guidelines require that the:

- Indigenous people benefit from the development projects
- The project should avoid or mitigate potentially adverse affects on indigenous people caused by the Bank-assisted projects.

As per the survey, there are four project affected families. Most of these tribals belong to Lahaul and Spiti and may have land at both Lahaul and in Manali area. They do not live in any separate clusters of hamlets but are part of the main village, and in no major way, different from the other village community. The Project area also does not fall within the "Scheduled Area" of the state (which is determined by the Sixth Schedule of the Constitution on the basis of preponderance of tribal population; compactness and reasonable size of the area; under-developed nature of the area; and marked disparity in economic standard of the people). **Hence a separate Indigenous People's Development Plan is not recommended for the ADHPL's project.** The vulnerable families among STs are eligible for special support as other such families.

#### **4.3.8** *Community Development Plan*

The Community Development Plan initiated for the project villages was prepared through detailed consultation with and capacity building of the villagers. The specific components of the CDP include:

- Stakeholder consultations to identify the programmes and processes, as well as the community's willingness and ability to contribute to the same;
- Trust Building measures: Small and low cost initiatives to generate support for the CDP and to meet immediate needs of the village;
- Development of village specific micro plans, through Participatory Rural Appraisal (PRA) methods and training of the village community to develop micro plans;
- Develop village funds with contribution from villagers and project proponents; and
- Monitoring and evaluation of the CDP

#### *Responding to other community concerns*

The villagers have voiced several concerns ranging from invasion of their local culture and lifestyle by the presence of outsiders, fears about damage to crop and trees through pollution and dust, especially during construction, increase in pressure on local services and amenities etc. Some of these concerns would be addressed and assuaged through consultations and proper information dissemination, so that rumours and unnecessary issues do not get encouraged. The ESMP will ensure that dust, pollution and safety concerns will be minimised and that there would be negligible impacts on crops and habitation. Similarly, the villagers will be informed in detail about the project activities and assured that they will continue to have adequate water, even after a part of the water in Duhangan stream is diverted.

While no major impacts are envisaged on common property resources, there may be families who may lose access to the fuel wood they used to access from the forest areas to be impacted by the project. The Community Development Programme has the scope and flexibility to address these community level issues CDP can explore possibilities of afforestation or regeneration of degraded areas or village common lands, or exploring opportunities on alternative fuels in the area.

Concerns have also been raised about loss of access to high quality potato seeds from the potato farm, which is now closed. While this issue was not brought out by villagers during various public consultations held, the project proponents will provide seeds of similar quality to the village Panchayats, if so requested.

The labour camps constructed will have adequate infrastructure for basic services and would not in any way depend upon the infrastructure at the villages. Local communities will be trained and supported financially to set up petty business and services to cater to the needs of the labour camps and the project in general.

#### **4.3.9 Biodiversity and Wildlife Management Plan**

The impact assessment has highlighted some concerns regarding the adverse impacts on ecology of the Project catchment and surrounding area mainly due to deforestation, soil erosion, habitat destruction, threat to wildlife and potential extraction of firewood from forests in the Project area.

The mitigation measures suggested under the plan include the following:

- a) Compensatory afforestation over 83.4 ha (on double degraded land). Afforestation is to be ensured by Forest Department as per the approved afforestation plan. The Project will ensure that only trees enumerated by the Forest Department are felled for the Project development by the Forest Department;
- b) Identify areas prone to landslides and associated soil erosion. Ensure mitigation measures, such as, loose boulder check dams, gully plugging and bioengineering would be implemented for preventing excess loss of soil. Soil loosened is to be fixed properly and provided with necessary embankment where sloppy area is involved;
- c) Ensure slope stabilization measures to be taken on downstream of Allain stream in the area of tail race discharge. These would be in the form of biological measures by planting grasses and climbers along with other soil binding plants or through measures, such as the use of wire mesh or stonewall. Also ensure protection of slopes in the Project catchment especially of Duhangan stream as the slopes along Duhangan which are rich in biodiversity and would have been damaged due to felling of trees for road construction;

- d) The Project will also develop landscape and slope stabilisation in all the open areas involved for the Project development as an ongoing process. Indigenous species would be used for afforestation. Use of blue pine, which is one of the regeneration species, will be useful and effective. A number of individual trees that would be taken up for afforestation include *Quercus dialata*, *Quercus semicarpifolia*, *Cedrus deodara*, *Acer sp*, *Picea smithiana* (Rai) and *Abies pindrow* (Tosh). These species would be planted in forest gaps, which are often termed as culturable blanks falling in the tree zone. Other sites, where afforestation may be undertaken are near villages Prini, Saithan and Jagatsukh and upstream of intermediate reservoir area;
- e) Besides compensatory afforestation, efforts would also be made to develop pasturelands. Since roads and other construction activities in the high altitude regions of the Project catchment will impact rich pastures (temperate, sub alpine and alpine), pasture development would be useful for maintaining the ecological continuity of habitats across the altitudinal gradients. Some of the endangered species, for example, Ibex, Musk Deer, Bharal etc also graze on alpine pastures. By developing alternate pasturelands, there will be no reduction in the availability of grazing grounds for wild animals;
- f) A large number of labourers and other workers are likely to be working during the project construction phase and resulting in likely pressure on the neighbouring forests for firewood both for cooking purposes and for warming the shelters during winter months. The Company is to ensure supply of fuel (LPG and Kerosene). In case of requirement of fuel wood, it should be sourced from Forest Department. The company or its Construction Contractor is to maintain log of fuel purchased and utilised in construction camps;
- g) Provide proper fencing of construction camp to restrict movement of labour. All contractors to be instructed for a complete ban of any poaching by their labourers. The Company is to ensure a check in this regard through its security personnel and regular visit of its officials;
- h) Arrangement of sanitary waste disposal by making pits for defecation at the construction sites and covering it by soil cover on daily basis to avoid contact with flies and other vectors of diseases. Provision of temporary cover around the pits (including septic tanks) to avoid accidental fall of any wildlife during night time;
- i) Removal and shifting of debris to dumping grounds. No dumping of debris down slope should be allowed to reduce collateral damage. Ensure that the constructed road is supported while construction itself. Check dams, culverts, stonewalls and other necessary and frequently used techniques would be employed while undertaking this activity. In altitude ranges of above 2,400 m and within oak and conifer forests, blasting and road work may be done in months other than May and June, the breeding season for most birds.
- j) Openings of all the tunnels/adits to be lighted during night time and guarded all the time. If unguarded these tunnel openings must be temporarily closed to avoid any wildlife finding refuge in such tunnels during night time or periods of no construction activities. During operation phase, all the adits will be properly closed and secured;
- k) In case any wildlife found having taken up a refuge in any such tunnels, all construction labour to leave that place immediately, trained personnel from Department of Forests and Wildlife Warden's office and approved experts should be intimated for rescue of such wildlife. Any construction activities to be taken up only after any trapped wildlife finds its safe escape;
- l) Provision of enclosures and other measures for high noise generating machinery and equipment;
- m) Blasting activity to be restricted only once in a day when exposed to surroundings. Blasting time should be fixed to day time only to ensure that domestic or wild animals and local people (mostly grazers) are not in the reaches of the impact zone;
- n) Blasting for road building or tunnelling should be timed sequentially and not simultaneously so that disturbance is restricted to an area for a period of time rather than throughout the area.
- o) Proper insulation of electric wires to avoid electrocution of wildlife;
- p) Regular disposal of excavated materials. Truck movement should be restricted to only day time duration.
- q) Ensure no quarrying is taken up from hillside or rivers within the Project catchment;
- r) Ensure minimum light to be maintained for safe and secure operations during night time both during construction and operation phases of the Project;
- s) Ensure proper working of sewage treatment plant for domestic water. Treatment plant for wastewater generated from workshop, drilling sites and camps sites with discharge only after ensuring standards to minimise impact on aquatic and benthic life downstream;
- t) Ensure controlled discharge of flushing from de-silting chambers – mostly restricting these to monsoon season.
- u) Maintain a minimum recommended discharge in both the streams immediately after diversion points.

#### **4.3.10 Catchment Area Treatment Plan - Land Management, Afforestation & Soil Erosion**

The Catchment Area Treatment Plan for the Project extends from the Prini village near the proposed underground Power House up to and beyond the Allain barrage site and from Jagatsukh Village up to and beyond the Duhangan weir site. Afforestation under CAT is proposed on 800 ha of double degraded forestland land pasture development on 200 ha of land as identified with Forest Department.

Among a variety of trees to be planted under the afforestation scheme using identified species, which are commonly found in the area. To prevent incidences of soil erosion, 9 spurs, 77 check walls, 65 check dams will be provided at locations in support of local forest department. Adequate provision for soil erosion like proper compaction of dumps and rip-rap stabilization of areas reduced of vegetation.

#### *Monitoring and Implementation of Environmental Safeguards for CAT*

The state and Project level committees will be monitoring the progress achieved on catchment area treatment plans etc as approved by the MoEF, both in terms of funding by the project authorities and implementation in the field by the State Government Forest Department. In addition to participation of local people in the implementation of environmental mitigation measures will also be ensured.

The Govt. of Himachal Pradesh has also taken necessary action to ensure that the commitments made by the implementing Agency to the Ministry of Environment & Forests, are implemented at site.

#### **4.3.11** *Minimum Water Discharges and Fisheries Monitoring Plan*

The Project will ensure discharge of a minimum of 15% of the available regular flow from the diversion structure of Allain and Duhangan streams.

The minimum flow contributed by other channels post diversion structure on Allain has been found to be 0.226m<sup>3</sup>/sec in the month of February during driest year of 1973-74. The 15% of the lean season minimum flow (1.54 m<sup>3</sup>/sec) along with flow available through other channels downstream the Allain would make the available total flow of 0.597 (0.231+0.226) m<sup>3</sup>/sec i.e. 51,580 m<sup>3</sup>/day, which is about 38% of the minimum flow ever observed on Allain at Aleo.

A minimum of 15% of the available regular flow is to be discharged from the diversion structure on Duhangan stream. As per the directives of the Honourable High Court of India, the Project is required to discharge a total of 0.24939m<sup>3</sup>/sec (249.39 liters per second) in addition to 15% of minimum flow to be discharged from Duhangan weir structure. The directive recommended flow of 0.33585m<sup>3</sup>/second (335.85litres per second) is to be maintained by the Project downstream the Duhangan weir. For the year 2045, the recommended flow is 0.38709m<sup>3</sup>/sec (387.09 litres per second). This flow will have to commensurate with increase of population of Jagatsukh village over the 40 years life of the Project and has to be re-assessed subsequently for any extended Project life.

In order to demonstrate ADHPL's commitment to downstream users, it is recommended that flow measuring devices both electronic and manual measurement are installed on Allain, Duhangan and Pahali streams.

To preserve water quality downstream due to flushing from de-silting chambers, the flushing is to be done over longer period and during high flow periods during monsoon months. Also adequate sewage treatment plant for domestic wastewater from the project should be maintained to assure safe water quality.

ADHPL will ensure six monthly monitoring of essential parameters of water for biological sustenance as well to conduct fish catch surveys downstream Allain, Duhangan and Pahali streams.

#### **4.3.12** *Emergency Response Plan (ERP)*

The project requires detailed Emergency Response Plan both for probable hazards likely to take place during construction and operation phases. The ERP is to address hazards associated with handling of heavy machinery and explosives required for construction and excavation activities. Following natural/accidental hazards may occur during construction phase of the project:

- slope failure at the project component locations including en-route proposed roads;
- accident due to explosives handling;

- accident due to heavy equipment/machinery;
- sabotage in case of magazine; and
- accidents due to fly rock during excavations/drilling.

In order to take care of above hazards/disasters, suitable safety and control measures and action plan, along with reporting requirements would need to be drawn up. For the operation phase, ADHPL will prepare an elaborate and detailed emergency response plan to counter any event like earthquake, landslides, avalanche, forest or other fires and any accident related to failure of the Project impoundment. Elaborate procedures on do's and don'ts have to be worked out with reporting mechanism, emergency preparedness team and tie up with local administration. ADHPL is to ensure an elaborate ERP (with defined roles and responsibilities) available prior to commissioning of the Project.

#### **4.3.13 De-silting Management Plan**

During operation phase there will be flushing of de-sanders for de-silting of settled silt.

On Allain stream, the Project has planned de-silting (flushing/dischARGE) of settled silt from four de-sanders installed on Allain diversion structures. Flushing from de-sanders on Allain diversion structure will be mostly restricted to monsoon season during rainy days through a total of 65 number of flushes per annum with a variable frequency of 10 (15%) flushes during June; 29 (45%) flushes during July, 20 (30%) flushes during August and 6 (10%) flushes during September using automatic de-silting mechanism with a standby provision for manual de-silting mechanism.

On Duhangan stream, there will be one de-sander (de-silting chamber) to be installed at its diversion structure. The settled silt from de-sander will be flushed mostly during monsoon season on rainy days through a total of 15 number of flushes per annum with a variable frequency of 2 (13%) flushes during June; 7 (47%) flushes during July, 4 (27%) flushes during August and 2 (13%) flushes during September using automatic de-silting mechanism with a standby provision for manual de-silting mechanism.

The discharge management from de-sanders on Allain and Duhangan diversion structures will be restricted to monsoon season on rainy days to get maximum dilution. The Project will ensure that the discharge will be of about 1200 m<sup>3</sup> per flushing through vertical lift slide type de-silting gates with a velocity of approximately 6.5 m/sec and discharge time of more than one hour to restrict incremental concentration of silt in the final water of Allain and Duhangan streams remain in the range of 100 to 500 mg/litre.

#### **4.4 SUGGESTED MITIGATION MEASURES**

In addition to the above mentioned management action plan, ADHPL will ensure compliance of the mitigation measures as suggested in *Table S-4.2*.

#### **4.5 TRANSMISSION LINE IMPACT ASSESSMENT**

Refer to environmental and social impact assessment that has been separately conducted for the Project related transmission line as per the requirement of IFC.



#### **4.6** *COMPLIANCE WITH THE STATUTORY APPROVALS*

Various provisions as stipulated in the Environmental Clearance, Forest Clearance and other approvals as issued by Ministry of Environment and Forests (MoEF), Himachal Pradesh State Pollution Control Board (HPPCB) and other agencies will be adhered to without failure.

#### **4.7** *ENVIRONMENTAL & SOCIAL COMMITMENTS*

ADHPL will continually work to meet all identified environmental and social commitments. The identified commitments will be reviewed on six monthly basis by senior Project team with the support of external consultant(s).

#### **4.8** *ESTIMATED BUDGET FOR ESMP*

An estimated budget of Indian Rupees 622.21 million will be available for ESMP implementation excluding costs of land acquisition. The budget doesn't include mitigation measures, which are integrated with the Project costs.

**Table 4.2 Environmental Mitigations and Management for Hydroelectric Power Project**

S.N.	Project Activities/Aspects	Associated Impacts	Mitigations – Action Plans	Timeline	Responsibility
<b>A</b>	<b>Construction Phase</b>				
	<b>Social Impacts:</b>				
A-1	Land acquisition for the project components	Loss of land, livelihood, assets etc. broader socio-economic impacts	<ul style="list-style-type: none"> <li>▪ Compensation for land and assets negotiated on the basis of current HP government norms</li> <li>▪ No physical displacement of people</li> <li>▪ A Rehabilitation Action Plan to restore loss of livelihood.</li> <li>▪ Rehabilitation Assistance ( Transition Allowance, income restoration measures and employment ) for vulnerable families and families losing more than 25% of their total land</li> <li>▪ An option between land-for- land or cash compensation for families losing more than 75% of their total land and Scheduled Tribe families.</li> <li>▪ Community Development Programme for the project area.</li> </ul>	Prior to project construction	ADHPL - EHS&S Local Administration Appointed Agency for Monitoring
A-2	Women's safety and security	Women's safety and security may be adversely affected due to influx of outside labour force	<ul style="list-style-type: none"> <li>▪ The Company will fund a police station to be set up at village Prini.</li> <li>▪ Company will provide security staff at all project component sites. Security Staff will have instructions to ensure women's safety</li> <li>▪ Provision of security will also be considered at additional locations if requested by the villagers.</li> <li>▪ Separate colony for labour force with segregated facilities and regular checks to monitor the same</li> <li>▪ The Government will be requested to depute women police staff at the Prini Police station to register local complaints related to women. It is suggested that the GRC will liaise with the Police Station to monitor complaints relating to women's security in particular.</li> <li>▪ All contractors will be bound through contractual provisions to observe environmental, health and safety regulations of the Company, including compliance with local security requirements. Violations of these regulations will result in fines and/or cancellation of contracts.</li> </ul>	Throughout the Project life	ADHPL - EHS&S Local Administration Respective village community
A-3	Community Safety	Safety of community due to falling objects from higher elevation during road construction. and maintenance	<ul style="list-style-type: none"> <li>▪ Ensure following safety measures during road construction and maintenance:</li> <li>▪ Areas with steep slopes to be protected from falling boulders by providing temporary barricades/ net/ brugg mesh.</li> <li>▪ Construction/ maintenance of the road must be done in close supervision of the safety office;</li> </ul>	Throughout the Project life	ADHPL - EHS&S Local Administration Village community

			<ul style="list-style-type: none"> <li>▪ Restrict speed of vehicles in areas with steep slopes</li> <li>▪ Vegetate/re-vegetate areas damaged due to falling boulders;</li> </ul>		
A-4	Acquisition of the Government Potato farm land at Hamta for the project	Loss of availability of potato seeds to local people	<ul style="list-style-type: none"> <li>▪ Project would provide seeds of similar quality to the village Panchayats, as requested.</li> <li>▪ Company will make arrangements to provide potato seeds at same rate at which farmers procured it from the potato farm.</li> </ul>	Throughout the Project life	ADHPL - EHS&S Local Administration Respective village community
A-5	Loss of land	Loss of income generation opportunity by Project Affected Families.	<ul style="list-style-type: none"> <li>▪ The Company will ensure that preferential employment opportunities are given to the Project Affected Families and local communities to address their employment issues by;</li> <li>▪ Skill up gradation and training program for income restoration. Identifying suitable jobs, training to the villagers for jobs and educating for bank loans for trucks to the local youth,</li> <li>▪ Providing indirect employment opportunities to women's group by offering them plantation work to be given to women's groups</li> <li>▪ Offering contracts to local people as per their skill set</li> <li>▪ Giving priority in jobs to the local people with first priority given to the project affected family</li> <li>▪ Giving transition allowance for the vulnerable families</li> <li>▪ Ensuring no deployment of child labour.</li> <li>▪ Employment in project to at least one member of each project affected family as per clause No.5.16 of the Implementation Agreement with the Govt of HP.</li> <li>▪ For rehabilitation assistance including skill development all family members above 18 yrs have been considered as a separate unit</li> <li>▪ Hiring of taxis from village where requirement and rates match with Company's needs.</li> </ul>	Construction Phase	ADHPL - EHS&S Local Administration Respective village community
A-6	Influx of labour force in the area	The migratory labour would disturb the social and cultural fabric of the affected villages	<ul style="list-style-type: none"> <li>▪ Regular check to control interference of labour force with local residents</li> <li>▪ Construction Labour Management Plan, which includes management for labour accommodation, fuel arrangement for labour and issues related to their health management.</li> <li>▪ The Company will stipulate in its labour contracts that preference will be given to hiring local labourers first, and then to Pahari/Nepali labourers</li> <li>▪ Labour camps will be set up catering to all migrant labour force. This should be located at a suitable distance from the nearest settlement. This clause will be included in the contract.</li> </ul>	During Construction	ADHPL - EHS&S Respective village community

		Large influx of migratory labour would lead to adverse sanitation conditions	<ul style="list-style-type: none"> <li>▪ The contractors will be required to provide of civic amenities for construction labour including toilets, sewage collection systems,</li> <li>▪ Company will implement awareness programmes on various communicable diseases, hygiene and sanitation;</li> <li>▪ Company will establish treatment plants for wastewater from workshops &amp; colonies, and make provision of fuel for labour force, conversion of biodegradable waste into compost.</li> </ul>		
A-7	Deployment of Security	Threat of force community	<ul style="list-style-type: none"> <li>▪ Security personnel engaged do not use force except when used for preventive and defensive purposes in proportion to the nature and extent of threat.</li> <li>▪ For any issue with the community, take support of local administration;</li> <li>▪ A grievance mechanism to allow the affected community to express concerns about the security arrangements and acts of security personnel.</li> </ul>		
A-8	Tourism	Interference on tourism	<ul style="list-style-type: none"> <li>▪ Company will ensure regular check and measures to control interference of construction labour with local residents and tourists.</li> <li>▪ Any damage to the trekking route due to construction work would be repaired.</li> <li>▪ Company to maintain that the number of trekkers and tourists is likely to increase due to the construction of road up to Allain and Duhangan barrage sites, which will create additional employment opportunities for the local population.</li> </ul>	Throughout the Project life	ADHPL EH&S Village commujties Local administration
A-9	Social upliftment activities	Beneficial impacts to the affected communities	<ul style="list-style-type: none"> <li>▪ Community will provide health and clinical facilities to the local communities;</li> <li>▪ Company to engage in improving education, sport and cultural activities of the affected villages</li> <li>▪ Provide training to younger people for support in livelihood earning.</li> <li>▪ Participate in LADA required activities</li> </ul>	Throughout the Project life	ADHPL EH&S Village communities Local administration
		<b>Temporary Occupation by Construction Labour</b>			
A-10	Establishment of buildings, storage facilities, workshops for maintenance of vehicles and machinery/equipment	Deterioration in surface water quality or soil and ground water quality when discharged untreated	<ul style="list-style-type: none"> <li>▪ Treatment plants for wastewater generated from workshop and domestic wastewater generated from office and colony</li> </ul>	Ongoing	ADHPL - EHS&S Construction Engineer HPPCB
A-11	Camp Activities - Provision of civic amenities for	Health Risks due to - lack of health and sanitation conditions	<ul style="list-style-type: none"> <li>▪ Construction of toilet facilities and sewage collection system for treatment.</li> <li>▪ Provision of treatment plant for sewage before its disposal, meeting the</li> </ul>	During Construction	ADHPL - EHS&S Local Health Administration

	<p>construction labour, and</p> <ul style="list-style-type: none"> <li>- movement of truck drivers for transporting construction material.</li> </ul>	<p>through disposal of sewage on open land which may cause mosquito nuisance, water borne diseases etc.</p> <ul style="list-style-type: none"> <li>- Chances of spread of sexually transmittable diseases like AIDS</li> </ul>	<p>stipulated standards of discharge.</p> <ul style="list-style-type: none"> <li>▪ Construction of a hospital at Prini and a mobile dispensary unit at Jagatsukh, Hamta, Khnoon and Duhangan Weir sites.</li> <li>▪ Community Awareness programmes on HIV/AIDS, Malaria, Tuberculosis and other communicable diseases.</li> <li>▪ Health checkups facilities for employees and contract labourers</li> </ul>		HP Factory Inspectorate
A-12	Water supply	Impact due to drawing of water for domestic purposes	<ul style="list-style-type: none"> <li>▪ Emphasis on optimisation water usage, including, where feasible, recycling.</li> </ul>	Ongoing	ADHPL - EHS&S Construction Engineer
A-13	Fuel requirement of workers during construction phase	Pressure on forest produce for fuel use	<ul style="list-style-type: none"> <li>▪ ADHPL will require all contractors, to observe Indian national and World Bank Group environmental, health and safety regulations, policies and guidelines including compliance with a prohibition on the felling of trees for meeting fuel wood requirements.</li> <li>▪ Labour contracts will contain conditions to ensure that illegal felling is not done by the contract labour.</li> <li>▪ Provisions for use of kerosene oil or LPG as the primary fuel by the labour. This will be the contractor's responsibility and included in the contract.</li> <li>▪ Use of fuel wood as secondary option. This will be sourced from the State Forest Department and records of procurement and distribution for use will be maintained by the contractor.</li> <li>▪ All contractors will be bound through contractual provisions to observe environmental, health and safety regulations of the Company, including compliance with conditions regarding no-illegal-felling of trees for meeting fuel wood requirements. Violations of these regulations will result in fines and/or cancellation of contracts.</li> </ul>	During Construction	ADHPL - EHS&S Construction Engineer
A-14	Solid waste disposal	Improper solid waste disposal could lead to health hazards.	<ul style="list-style-type: none"> <li>▪ Company will implement measures for Solid waste disposal which includes the following:</li> <li>▪ Identification of all solid waste generation sources. All bio-degradable including kitchen waste to be put into humus pit, which can be covered with soil for composting.</li> <li>▪ Construction of toilet facilities and sewage collection &amp; treatment systems for labour camps;</li> <li>▪ Construction of public toilets in the village;</li> <li>▪ Provision of toilets at all construction sites; and</li> </ul>	During Construction	ADHPL - EHS&S Construction Engineer/ Contractor

			<ul style="list-style-type: none"> <li>Development of codes of practice for safety and disposal of muck and solid waste prior to taking up construction activities</li> </ul>		
A-15	General	Health, Safety, Solid Waste Disposal (domestic and project)	<ul style="list-style-type: none"> <li>Develop codes of practice for safety and disposal of muck and solid waste prior to taking up of construction activities</li> </ul>	During Construction	ADHPL - EHS&S, HPPCB & Factory Inspectorate
<b>Site Preparation – Construction of Roads etc.</b>					
A-16	Forestland diversion for establishing project components	Loss of 47.179 ha of forestland and removal of trees and other vegetation	<ul style="list-style-type: none"> <li>Compensatory afforestation of double degraded forestland.</li> </ul>	During Construction	ADHPL - EHS&S DFO MOEF
A-17	Demolition and Removal of structures, if any	Noise disturbance and dust	<ul style="list-style-type: none"> <li>Water sprinkling and Demolition limited to day time only</li> </ul>	During Construction	ADHPL - EHS&S Construction Engineer/ Contractor
A-18	Construction of Roads and Development of other areas	Dust raised during various construction activities; Soil erosion; Reduction in water quality	<ul style="list-style-type: none"> <li>Realignment of road, where feasible to avoid cutting of large trees and area falling under forest/ devbans.</li> <li>Sprinkle water on unpaved roads to reduce incidence of dust in air</li> <li>Proper engineering designs of access roads. High slope area is provided with adequate erosion control measures like grass turfing etc.</li> <li>Provide adequate culverts and drainage channels</li> <li>Provision of adequate steps for access to local people</li> </ul>	During Construction	ADHPL - EHS&S Construction Engineer/ Contractor DFO
A-19	Transportation -Vehicular movement, Loading/ unloading	Causes dust nuisance as well as NO <sub>x</sub> pollution due to vehicular emissions	<ul style="list-style-type: none"> <li>Traffic Management through daily arrangements for fleet management</li> <li>Sprinkling of water on construction road</li> </ul>	During Construction	ADHPL EHS&S - Safety Officer  HR Manager  Community Liaison Officer
<b>Water Resources</b>					
A-20	Diversion of Allain and Duhangan streams for construction of Allain Barrage and Duhangan weir.	Soil erosion and Reduction in water quality.	<ul style="list-style-type: none"> <li>Adequate provision for proper channel for carrying diverted water from both streams.</li> <li>Ensure constant natural flow of water.</li> </ul>	During Construction	ADHPL EHS&S Construction Engineer Contractor
A-21	Construction may adversely affect the	Potential impact on water springs (Chor Pani) used as	<ul style="list-style-type: none"> <li>Ensure best available civil engineering techniques to preserve working of the drinking water sources i.e. Dhani, Pahali, Chor Pani or Jamlu</li> </ul>	During	ADHPL EHS&S

	drinking water sources of Jagatsukh & Prini village at Chor Pani /Dhani stream, & Jamlu Devta/Pahali streams respectively.	drinking water supply to Jagatsukh village (near road to Duhangan weir)	<p>Devta.</p> <ul style="list-style-type: none"> <li>▪ Ensure joint monitoring mechanism for protection of drinking water resources</li> <li>▪ In case of any abruption to the water source, ensure drinking water supply to the effected village. (The company has given an undertaking that the riparian rights (i.e. the rights of access of drinking and irrigation) will be restored in case of any disturbance to such sources.</li> </ul>	Construction	<p>Construction Engineer</p> <p>Contractor</p>
A-22	Access to and impact on pastureland	Access to existing pasture land may be disturbed due to construction of road and the livestock may get difficulty in reaching these pastures.	<ul style="list-style-type: none"> <li>▪ Ensuring access to pasture land is maintained through the construction and later during the operation phase of the project.</li> <li>▪ Repairing of any footpath damaged during the construction of the roads.</li> <li>▪ Providing appropriate steps along the retaining wall structures of the project roads to facilitate movement of people and livestock to the pastures</li> <li>▪ Providing ramps where necessary (temporary or permanent) with slopes appropriate for animal movement.</li> <li>▪ Realignment road where feasible</li> <li>▪ Enhancing existing degraded pasturelands by restoring degraded areas in consultation with the community.</li> <li>▪ Developing 200 hectares of pastures as identified in the Catchment Area Treatment plan with the help of State Forest Department.</li> </ul>	Throughout the project phases	
<b>Construction of Other Project Components</b>					
A-23	Excavation and blasting during tunnel development	High Impulsive Noise levels	<ul style="list-style-type: none"> <li>▪ Adopting optimised blasting techniques using delay detonators, blasting in confined areas (inside the tunnels)</li> </ul>	Ongoing	<p>ADHPL EHS&amp;S - Safety Officer</p> <p>Construction Engineer</p> <p>Blasting Specialist</p> <p>Contractor</p>
A-24	Blasting Operations for Tunnel Development	Impulsive ground vibrations. Impacts short term and reversible.	<ul style="list-style-type: none"> <li>▪ Adopting optimised blasting techniques using delay detonators, blasting in confined areas (inside the tunnels)</li> <li>▪ Ensuring ground vibrations do not affect structures beyond 81 m from point of blast.</li> <li>▪ Periodical monitoring of ground vibrations.</li> <li>▪ Regular monitoring of ground vibrations will be undertaken.</li> <li>▪ Intimating blast timings to villagers and ensure prior sounding of prior siren as well that any cattle and local people are away from the locations</li> </ul>	Ongoing	<p>ADHPL EHS&amp;S - Safety Officer</p> <p>Construction Engineer</p> <p>Blasting Specialist</p> <p>Contractor</p>

			at the time of blasting.		
A-25	Blasting Operations for Tunnel Development	Affects wild life through air & noise pollution. Short term and reversible impacts	<ul style="list-style-type: none"> <li>▪ Optimised blasting operation.</li> <li>▪ Controlled Traffic management.</li> <li>▪ Provision of enclosures and other measures for high noise generating machinery/equipment</li> </ul>	Ongoing	ADHPL – EHS&S Construction Engineer Blasting Specialist Environment Engineer Safety Officer
A-26	Excavation and blasting during tunnel development	Occupational health hazards  Deteriorates workers health (occupational health hazards) due to air & noise pollution, accidents & injuries. Restricted to construction phase – short term and reversible	<ul style="list-style-type: none"> <li>▪ Optimised blasting restricted to tunnels (confined area) only provided with adequate exhaust system</li> <li>▪ Compulsory use of respiratory personal protective equipment.</li> <li>▪ For those working in deep caverns, arrangement of life line should also be made.</li> <li>▪ Use of fire proof cables inside the tunnels for lighting during construction phase.</li> </ul>	Ongoing	ADHPL EHS&S Safety Officer  Construction Engineer Contractor
A-27	Excavation and blasting during tunnel development	Occupational safety hazards  Construction place safety hazards	<ul style="list-style-type: none"> <li>▪ Provision of safety management on daily basis under direct supervision of a permanent safety officer on site during construction and operation phases; Provision of adequate safety personal protective equipment like safety helmets, safety goggles, gum boots, gloves etc.</li> <li>▪ Provision of fireproof cables inside the tunnels to prevent any short-circuiting during construction phase.</li> <li>▪ Develop code of practice for safety and entry procedures to excavated tunnels during construction phase.</li> </ul>	Ongoing	ADHPL EHS&S - Safety Officer  Construction Engineer Contractor
A-28	Excavations, drilling, transportation and other project activities	Soil erosion/sedimentation during construction phase	<ul style="list-style-type: none"> <li>▪ Reuse of over 30% of muck in road construction,</li> <li>▪ Proper staking and their compacting, afforestation, improvement of landscape measures and catchment area treatment to reduce incidence of soil erosion.</li> <li>▪ Provision of measures to control silt/sediments during construction phase, provision of check walls, check dams and spurs.</li> </ul>	Ongoing	ADHPL EHS&S – Env Engr Safety Officer  Construction Engineer Contractor DFO HPPCB



A-29	Impact of dust on apple crops	The dust raised by the increased vehicular traffic may lead to reduction in apple production in the affected project villages.	<ul style="list-style-type: none"> <li>▪ Water trucks will sprinkle roads under construction to minimise dust;</li> <li>▪ All roads will be bitumen topped;</li> <li>▪ Traffic management through daily fleet management to avoid accidents and congestions at various points;</li> <li>▪ Vehicles carrying construction material to be covered and use of water sprinkling,</li> <li>▪ The Company will be restricting vehicular movements at the areas other than project sites;</li> <li>▪ Loads of construction waste material will be sprinkled with water;</li> <li>▪ The Company will discuss explore crop insurance with the community during construction phase of the project;</li> <li>▪ The Company will consider any and all claims of impacts on crop production for appropriate compensation through the established grievance redressal mechanism to verify the same.</li> </ul>		
A-30	Water withdrawal for construction purposes i.e. for dust suppression, workshop, domestic supply at construction site and colony etc.	Reduced flow - Impact due to drawing of water	<ul style="list-style-type: none"> <li>▪ Optimise water use</li> <li>▪ Emphasis on reuse of water during wet drilling of tunnels.</li> </ul>	Ongoing	ADHPL EHS&S – Env Engr
A-31	Muck and other solid waste including associated overburden disposal	Impact on landuse, topography, soil etc.	<ul style="list-style-type: none"> <li>▪ Reuse of maximum solid waste. Minimum 30% of muck to be reused in road construction, improvement of landscape measures</li> <li>▪ Disposal of Muck (excavated rock and soil) as per Muck Disposal Plan.</li> <li>▪ Further possibility for reuse of muck is to be considered by getting it tested for feasible strength and other features.</li> </ul>	Ongoing	ADHPL EHS&S – Env Engr Safety Officer Construction Engineer Contractor HPPCB
A-32	Stock piling of solid waste (spoil) and muck their disposal	Increase in SPM level during high winds	<ul style="list-style-type: none"> <li>▪ Proper staking and compacting of muck and spoil,</li> <li>▪ Afforestation and improvement of landscape as per catchment area treatment plan</li> <li>▪ Other dust preventive measures like water sprinkling etc to reduce incidence of high SPM during windy conditions.</li> </ul>	Ongoing	ADHPL EHS&S – Env Engr Construction Engineer Contractor DFO
A-33	Construction phase – diesel generator set operation for	Increase in SO <sub>2</sub> and NO <sub>x</sub>	<ul style="list-style-type: none"> <li>▪ Standby operation during construction phase only</li> <li>▪ Provision of stipulated stack height, DG set operations at dispersed</li> </ul>	Ongoing	ADHPL EHS&S –

	power generation in case of abrupt power supply from State Electricity Board	levels	locations <ul style="list-style-type: none"> <li>▪ DG sets will be spread at 4 locations within the project area</li> </ul>		Env Engr Construction Engineer HPPCB
A-34	Diesel generators, Concrete Mixing Plants and other machinery generating noise and vibrations	Increase in noise and vibrations	<ul style="list-style-type: none"> <li>▪ Provision of enclosures for high noise producing machinery like concrete mixing plants, DG sets and other equipment,</li> <li>▪ Provision of mufflers (silencers) on DG sets</li> <li>▪ Provision of temporary but proper foundation supported with rubber padding to control vibrations.</li> <li>▪ Optimised operation of construction related machinery</li> </ul>	Ongoing	ADHPL EHS&S – Env Engr Construction Engineer HPPCB
A-35	Construction equipment operation	Noise generation	<ul style="list-style-type: none"> <li>▪ Day time operation of high noise generating equipment</li> <li>▪ Regular maintenance of equipment</li> <li>▪ Provision of enclosures for high noise generating equipment</li> </ul>	Ongoing	ADHPL EHS&S Construction Engineer Contractor
A-36	Transportation – vehicular movements	Increase in noise levels Adverse effect due to air and noise pollution due to vehicular traffic movement	<ul style="list-style-type: none"> <li>▪ Fleet management on daily basis</li> <li>▪ Restricted vehicular movement during non peak traffic hours.</li> <li>▪ Vehicles carrying construction material will be properly covered and water sprinkling,</li> <li>▪ Vehicular traffic is mainly confined to project area and vehicles carrying construction material will be properly covered</li> </ul>	Ongoing	ADHPL EHS&S – Safety Officer Construction Engineer Contractor
A-37	Transportation – Due to increase in vehicular Traffic on Manali – Nagar roads	Increase of traffic will lead to increased incidences of road accidents Blocking of roads due to transportation on the Nagar – Manali Road	<ul style="list-style-type: none"> <li>▪ Regulated traffic on daily basis with the help of local administration so as to avoid blocking of the roads.</li> <li>▪ Nagar – Manali road although not commonly used by tourists en-route Manali. Regulated traffic on daily basis with the help of local administration so as to avoid blocking of the roads.</li> </ul>	Ongoing	ADHPL EHS&S – Env Engr, Safety officer Local Traffic Administration
A-38	Deployment of construction labour not belonging to the project area and restriction on employment of child labour.	Influx of people of various cultures will have substantial effect on local culture. Employment of child labour would be in violation of IFC norms.	<ul style="list-style-type: none"> <li>▪ Regular check and measures to control through supervisors that construction labour does not interfere with the local inhabitants for their cultural values.</li> <li>▪ Labour contractors to give priority on hiring local labourers</li> <li>▪ Labour camps to be establish for all migrant labourers. Camps to be located at a suitable distance from the nearest settlement.</li> <li>▪ Provision of civic amenities at the camps.</li> </ul>		ADHPL EHS&S – Env Engr, Social Scientist
A-39	Wildlife habitat and flora	Impact on Flora and Fauna-wildlife, biodiversity and	<ul style="list-style-type: none"> <li>▪ Compensatory afforestation of degraded forest land as per the Forest Clearance issued by MoEF;</li> </ul>	Throughout	ADHPL EHS&S –

		riverine ecology.	<ul style="list-style-type: none"> <li>▪ Optimized blasting to control air pollution, controlled traffic management;</li> <li>▪ Discharge of accumulated silt in controlled manner to minimise impact on riverine ecology. Monitoring of fish throughout the project life</li> <li>▪ Ensuring silt levels does not increase 30% of the baseline in Allain and Duhanan streams.</li> <li>▪ Maintenance of minimal light to avoid disturbance to night animals/birds, if any, and for safe and secured project operations;</li> <li>▪ All openings of all the tunnels/adits to be lighted during night time and guarded all the time. If unguarded these tunnel openings must be temporarily closed to avoid any wildlife finding refuge in such tunnels during night time or periods of no construction activities;</li> <li>▪ In case any wildlife is found to have taken up a refuge in any such tunnels, all construction labour to leave that place immediately, trained personnel from Department of Forests and Wildlife Warden's office and approved experts should be intimated for called for rescue of such wildlife. Any construction activities to be taken up only after any trapped wildlife finds its safe escape;</li> <li>▪ The Project is to minimise damage to plantation in and surrounding the Project component areas. If any damage is noted, the Project is to take up plantations in all areas damaged due to Project construction in addition to statutory compensatory afforestation to be taken up by the Project through State Department of Forests;</li> <li>▪ Catchment Area Treatment Plan involving afforestation over 800 ha will be implemented;</li> <li>▪ Provision of contractual agreements with employees/contractors for not to hunt or gather and otherwise disturb wild life and vegetation in the project area. In case of otherwise is proved, erring person will be fined heavily or leading to cancellation of contracts.</li> </ul>	project phases	Env Engr Construction Engineer DFO
	<b>Catchment Area Treatment</b>				
A-40	Repair of slope failures and erosion	Reduced downstream sedimentation	<ul style="list-style-type: none"> <li>▪ Strict implementation of Catchment Area Treatment Plan through periodical internal and external monitoring and evaluation.</li> </ul>	Ongoing	ADHPL EHS&S – Env Engr Construction Engineer DFO
A-41	General maintenance and	Improvement of terrestrial	<ul style="list-style-type: none"> <li>▪ Strict implementation of Catchment Area Treatment Plan</li> </ul>	Ongoing	ADHPL EHS&S –

	ecological protection	habitation by compensatory afforestation conservation of flora and fauna through periodical monitoring by internal and external agencies.  Conservation of water resources			Env Engr DFO
<b>B</b>	<b>Demobilisation of Temporary Construction Infrastructure</b>				
B-1	Demobilisation and removal of all temporary buildings and magazines	Aesthetics, health, safety, reduction in water quality	<ul style="list-style-type: none"> <li>▪ Convert accommodation to schools/ local welfare activities if close to any village else demolish or remove such temporary building from site</li> <li>▪ Re-vegetate bare areas</li> <li>▪ Remove all construction equipment from project site</li> <li>▪ Remove all waste from site and dispose it off appropriately as per the requirement of HPPCB</li> <li>▪ Rehabilitate muck and other spoil dumping sites.</li> <li>▪ All adits gates must be closed, locked and sealed before commissioning of the Project.</li> </ul>		ADHPL EHS&S – Env Engr DFO Construction Engineer Safety Officer HPPCB DFO
B-2	Los of jobs/economic dependence	Socio-economic	<ul style="list-style-type: none"> <li>▪ Prepare a demobilisation plan and communicate to concerned contractors, sub contractors and temporary staff engaged for the Project;</li> <li>▪ Develop alternatives with the local administrations and village communities for the affected temporary staff</li> </ul>		
<b>C</b>	<b>Operation Phase</b>				
C-1	Water diversion for hydroelectric power generation	Impact due to diversion of water for power generation during operation phase and reduced flow in stretches between diversion structure and tail race discharge point on Allain and downstream of the Duhangan stream.	<ul style="list-style-type: none"> <li>▪ Provision of maintaining minimum recommended flow of 15%of regular flows downstream of Allain and Duhangan diversion structures. A minimum flow of downstream the Duhangan stream will be as per the findings of I&amp;PH Committee set up by the Hon'ble High Court as per their order June 2006)</li> <li>▪ Installation of flow measuring gauges (meter with recording provisions) both electronic and manual measurement basis.</li> </ul>	Throughout during operation phase	ADHPL EHS&S – Env Engr Liaison officer I&PH Department
C-2	Wastewater generation from project workshop and	Improper wastewater disposal by the Project could lead to health	<ul style="list-style-type: none"> <li>▪ Company will ensure the proper management of wastewater/sewage generated by the project in the following manner:</li> <li>▪ Provision of treatment plants for wastewater (from camp, colony and</li> </ul>	Throughout during operation	ADHPL EHS&S – Env Engr

	project offices/campsites	hazards and could also damage agricultural crops or deterioration of surface water quality if discharged untreated	workshop) <ul style="list-style-type: none"> <li>Provision of sewage treatment plant for domestic sources</li> <li>Compliance with the standards for discharge as prescribed by HPPCB</li> <li>Regular participatory monitoring of treated water before it is discharged into disposal outlet.</li> </ul>	phase	HPSCB
C-3	Flushing of silt accumulated in the de-silting chambers	Deterioration of quality of downstream of Allain and Duhangan water	<ul style="list-style-type: none"> <li>Ensuring controlled discharge of accumulated silt from de-silting chambers to a level not exceeding 30% of the baseline in Allain and Duhangan streams.</li> <li>Restricting flushing mostly during monsoon season;</li> <li>Follow the De-silting Plan.</li> </ul>	Throughout during operation phase	
C-4	Vehicular movement and hydropower generation	Minor increase in noise levels	<ul style="list-style-type: none"> <li>Limited vehicular movement during operation phase</li> <li>Regular maintenance of company owned vehicles</li> </ul>	Throughout during operation phase	ADHPL EHS&S – Env Engr Safety Officer
C-5	Development of Reservoir	Beneficial impacts to avi-fauna	<ul style="list-style-type: none"> <li>Regular cleaning and maintenance of the reservoir</li> <li>Pasture Development and Afforestation in the reservoir surroundings</li> </ul>	Throughout during operation phase	ADHPL EHS&S – Env Engr Environment Engineer
C-6	Reduction of water flow in the stretch between diversion point to tailrace discharge in Allain stream while in Duhangan stretch between diversion point to its confluence in Beas River	Reduced flow and increased silt level during operation phase	<ul style="list-style-type: none"> <li>Provision of maintaining minimum recommended flow as mentioned in SN E.1 both in Allain and Duhangan streams immediately after diversion points;</li> <li>Sewage Treatment plant for domestic wastewater;</li> <li>Controlled discharge of flushing from de-silting chambers over longer period or during high flow periods</li> <li>Provision of check walls with boulders, stones and with/ without meshes at 5 locations, check dams with boulders &amp; stones at 4 locations and spurs at 5 locations as per details given in Catchment Area Treatment.</li> </ul>	Throughout during operation phase	ADHPL EHS&S – Env Engr HPPCB DFO
C-7	Illumination – provision of light along all the project component areas	Poses potential of disturbance to mammals and birds at nights	<ul style="list-style-type: none"> <li>Minimum light will be maintained for safe and secured project operations</li> </ul>	Throughout during operation phase	ADHPL EHS&S – Env Engr Security Officer Safety Officer
C-8	Development of water storage reservoir and submergence area near	During project operation water storage poses potential to provide	<ul style="list-style-type: none"> <li>Provision for control of water borne diseases vectors through regular health monitoring and taking up mitigations as suggested in ESIA.</li> <li>Regular Cleaning and maintenance of the area to attract avi-fauna</li> </ul>	Throughout during operation	ADHPL – EHS&S Health Officer

	Allain diversion point	breeding grounds for vector and water borne diseases – Impacts will be long term and irreversible if not controlled		phase	I&PH Department
C-9	Community Health, Safety and Security	Project related health, safety and security of community	<ul style="list-style-type: none"> <li>▪ A grievance redressal cell will be functional through the Project operation phase, to look at all EHS and security related issues.</li> </ul>	Throughout during operation phase	ADHPL – EHS&S Health Officer Village communities
C-10	Wildlife Conservation and Biodiversity Development	Flora and Fauna	<ul style="list-style-type: none"> <li>▪ Ensuring silt levels does not increase 30% of the baseline in Allain and Duhangan streams.</li> <li>▪ All adits gates must be closed, locked and sealed throughout during operation phase. In case of any routine maitenance, all such opening should be monitored as per the details given in serial number A-39 above;</li> <li>▪ Follow up Biodiversity and Wildlife Management and Catchment Area Treatment Plans.</li> </ul>		
C-11	Disaster Management - Natural Hazards Control	Any incidence of natural hazards can hamper with local resources and affect people in the surroundings	<ul style="list-style-type: none"> <li>▪ Ensuring height of the Allain barrage and the intermediate reservoir measured from the base to full reservoir level is 12m and 14m respectively. With the free board provisions, the heights are 14 m and 14.5 m respectively. Both Allain Barrage and the Intermediate Reservoir structures lie within low risk category with reference to height criteria as specified by International Commission On Large Dams. However, with reference to the water storage capacity, both Allain barrage and Intermediate reservoir having 0.125 and 0.225 million cubic meter respectively of storage capacity fall in moderate risk category of 0.1 to 1 million cubic meter capacity of International Commission On Large Dams. The measures for the safety of water storage structures include: <ul style="list-style-type: none"> <li>▪ Provision of detailed engineering by taking adequate engineering measures of earthquakes, cloudburst in the detailed engineering design aspects for project components like Allain barrage and intermediate reservoir sites. For other components also measures of landslides, avalanche, forest fires etc. will be taken up</li> <li>▪ The project structures need to be verified for its designs with the highest applicable safety factor for the Himalayan Zone (Zone - V) as per the detailed findings of Roorkee University, Roorkee, on seismic impacts on tunnels as well ensuring through hydraulic model testing to confirm the</li> </ul> </li> </ul>	Throughout during operation phase	ADHPL EHS&S – Env Engr Security Officer Safety Officer Emergency Response Team

			<p>safety of the water storage structures proposed for the project. Company has carried out hydraulic model tests to confirm the safety of the structures.</p> <ul style="list-style-type: none"> <li>▪ Undertake Dam Break Analysis for the impoundments to ensure safety measures are taken up prior to Project commissioning;</li> <li>▪ Provision of automatic shutoff of powerhouse in case of natural calamity</li> <li>▪ Provision of linkage of cut off of water flow from diversion points into the intermediate reservoir</li> <li>▪ Company is to undertake regular inspection and maintenance of diversion structure safety design and appoint an independent engineer to verify design and conduct inspections during project construction phases of the project.</li> <li>▪ Comprehensive maintenance inspection of tunnels for any leakage after every five years cycle. In case any leakage is noticed from outside, review the emergency situation and arrange for corrective measures accordingly;</li> <li>▪ An independent-engineer will periodically report to project lenders about review findings of the safety of all structures at the design, construction and operation stages.</li> <li>▪ Regular education to downstream users or likely affected people about do's and don'ts in case of any mishap.</li> <li>▪ Provision of warning system for any major release due to any natural hazard/accident</li> <li>▪ Company will ensure a well-rehearsed emergency response plan to be in place before project commissioning with mechanisms of mock trials for regular checks and controls to effectively meet any emergency.</li> </ul>		
D	Decommissioning/Abandonment				
D-1	Decommissioning / Abandonment Restoration of Area	Restoration of Project Area and Alain and Duhangan Channels	<ul style="list-style-type: none"> <li>▪ Conduct detailed ESIA for decommissioning of the Project;</li> <li>▪ Obtain environmental clearance and related approvals prior to decommissioning from HPPCB and MoEF and other agency to be in force at that point of time;</li> <li>▪ Develop Decommissioning Environmental and Social Management Plan (DESMP) to include the following: <ul style="list-style-type: none"> <li>▪ Dewatering and de-silting plan (of water storages);;</li> <li>▪ Original flow restoration plan (in Allain and Duhangan streams);</li> <li>▪ Tunnels closure plan i.e. to plug the tunnels;</li> <li>▪ Dismantling plan for structures of Project components;</li> </ul> </li> </ul>	Decommissioning phase	ADHPL – EHS&S Civil Engineer Contractor Safety Officer Env Engr. DFO I&PH

			<ul style="list-style-type: none"> <li>▪ Waste management plan;</li> <li>▪ Land transfer plan (to include transfer of forestland back to forest department, roads to local administration, other areas to local community etc. in consultation with local administration and respective Panchayats of villages Prini and Jagatsukh); and</li> <li>▪ Landscape development plan (by re-vegetating forest and open land in consultation with the forest and horticulture departments) of the Project ;</li> <li>▪ Develop and implement Post De-commissioning Monitoring Plan;</li> <li>▪ Remove sediments and dispose of properly</li> <li>▪ Demolish intermediate reservoir/ dam structures. Keep an option of converting intermediate reservoir back to an agricultural field or re-vegetate in discussion with the local administration and or divisional forest department.</li> <li>▪ Re-vegetate exposed areas at Allain barrage and Duhangan weir sites</li> <li>▪ Plug tunnels/adits/surge shaft</li> <li>▪ Ensure implementation of post project monitoring plan for annual inspection of the Project components including tunnels/adits plugged.</li> </ul>		LADC HSPCB MoEF
D-2	Loss of Jobs/economic dependence	Socio-economic	<ul style="list-style-type: none"> <li>▪ Prepare a demobilisation plan and communicate to the employees/sub contractors/community dependents (for their livelihood on the Project);</li> <li>▪ Ensure implementation of statutory provision in force at the time of decommissioning</li> <li>▪ Work with affected employees/community to find alternative income generation resources and develop a post project community development plan.</li> </ul>	Decommissioning Phase	ADHPL Respective Village Community Project Employees Local Administration



**ERM has over 145 offices  
Across the following  
countries worldwide**

Argentina	Netherlands
Australia	Peru
Belgium	Poland
Brazil	Portugal
China	Puerto Rico
France	Singapore
Germany	Spain
Hong Kong	Sweden
Hungary	Taiwan
India	Thailand
Indonesia	UK
Ireland	USA
Italy	Venezuela
Japan	Vietnam
Korea	
Malaysia	
Mexico	

**ERM India Private Limited**

6th Floor, Block 4B,  
DLF Corporate Park,  
DLF City, Phase-III,  
Gurgaon NCR – 122 002  
India  
Tel : 91-124-4170300  
Fax: 91-124-4170301  
Email: india@erm.com

[www.erm.com](http://www.erm.com)