

EXECUTIVE SUMMARY REPORT

1. INTRODUCTION

M/s. Jal Power Corporation Limited (JPCL) proposes to develop a hydroelectric project for harnessing the power potential of river Rangit, in West Sikkim district within the state of Sikkim. The scheme envisages construction of a 29 m high concrete dam across river Rangit to the north of village Rishi. The proposed Rangit-IV HEP is located downstream of Rangit Hydroelectric project (Stage-III) under operation by National Hydro Power Corporation (NHPC). The project proposes to utilize the tail water of Rangit (Stage-III) hydroelectric project as well as discharge of Kalej-Khola a major tributary of Rangit river. This project is being conceived, as a run of the river scheme. The water from the reservoir will be diverted for power generation through 6 km long Head Race Tunnel (HRT) to a surface power house located at the confluence of Rothak Khola with Rangit river. The coordinates of the dam site 27°13'10"N and 88°18'10"E. A head of about 103.6 meter will be utilized to generate power of 120 MW for generating energy 585 MU for 90% dependable year. The total land required for the project is 116.25 ha of which forest/government land is 84.53 ha. The balance 31.72 ha of land is owned by private land owners. The project layout is enclosed as Figure-1.

2. ENVIRONMENTAL BASELINE STATUS

Before start of EIA study a "Scoping Matrix" was formulated to identify various issues likely to be affected as a result of the proposed project. For these impacts or aspects, environmental baseline data has been collected from secondary as well as primary data sources. The baseline status has been categorized in the following categories:

- Physico-chemical Aspects
- Biological Aspects
- Socio-economic Aspects

2.1 Physico-chemical Aspects

Water resources

As per the DPR, maximum flood peak value has been estimated is 7156 cumecs including snow melt contribution. Thus, as per DPR, the design PMF of 7160 cumecs is recommended for Rangit Stage-IV HE Project.

Water quality

There are no water polluting industries, less agriculture land with negligible use of agro-chemicals, pollution loading from other sources is virtually negligible. It was also revealed from the analysis of water samples collected for three seasons that the concentration of various cations, anions, BOD, COD, DO and heavy metals values is well within the permissible limits.

Meteorology

The mean annual average rainfall at this station is 2311.9 mm. The mean daily maximum temperature and mean daily minimum temperature in the study area varies from about 29.6°C in June and 4.9 °C respectively.

Ambient air quality

The ambient air quality was monitored in the study area at four locations in the project area for the three seasons. It was observed that SPM, RPM, SO₂ and NO_x level are well below the permissible limit specified for residential, rural and other areas.

Noise Level

Noise levels have been monitored for three seasons in the study area. The noise levels were observed to be well within permissible limits specified for residential area.

Land use Pattern

The land use pattern of the study area has been studied through digital satellite data. (IRC-1C/1D and PAN). The data was processed through ERDAS software package to obtain land use classification. It is observed that major portion of the study area comes under vegetation(78.52%), agriculture land is less only 4.37%.

Geology

The project site is located within a tectonic window structure (thrust) named as Rangit Window. At this site rocks of Gondwana and dolomites of Buxa Formation shows repetition.

Seismicity

As per IS: 1893:2002, the entire Sikkim falls in Zone-IV. As far as MSK intensity scale is concerned, the region lies within the high damages risk zone (VIII) corresponding to a magnitude of 6.7 in the Richter scale.

2.2 BIOLOGICAL ENVIRONMENT

Vegetation

The major forest types observed in the area are Tropical semi-evergreen forests and Riverine semi-evergreen forests. Terrestrial ecological survey was conducted for four seasons namely Summer, Post-monsoon, Winter and monsoon season. A total of 102 plant species were recorded during floristic survey at various sampling sites. *Garuga pinnata* was the dominant species in the secondary forest. *Boehmeria platyphylla* was dominant among the shrub layer while *Paspalum* sp. was dominant in the herbaceous layer.

Wildlife

Based on the observations during the field visit and information collected from locals and forest department major mammal species observed in the study area include Leopard, Wild dog, Civet Cat, Wild cat Amongst reptiles, Common Lizard, Calotes, Gunther, Pit viper are reported. The major avi-faunal species include Black Breasted

Thrush, Black Bulbul, Black Naped Green Woodpecker, Black-headed Rufous Backed Shrike, etc. No rare and endangered species observed in the submergence area.

Aquatic Ecology

As a part of field studies for the project aquatic ecological survey was conducted for three seasons. The phytoplankton communities in river Rangit were dominated by *Navicula clavata*. The phytoplankton density in winter is much lower than that observed in summer season. The dominant species in winter and summer seasons were *Navicula*, and *Pinnuliria*. Two zooplankton species were observed at various sampling sites. However, in pre monsoon season density of zooplankton species was much higher as compared to winter season.

Fisheries

Schizothorax richardsonii (snow trout), *Schizothorax curvifrons* *Acrossocheilus hexagonolepis* are the major fish species in the project area. It is the only migratory fish found in the project area. It moves downstream during the summer and monsoon months. None of the fish species inhabiting the river has been included in IUCN red list.

2.3 SOCIO-ECONOMIC ASPECTS

The total population of the study area is of the order of about 46,730. The overall percentage of male and female population is 52.27% and 47.73% respectively. The average sex ratio (number of females per 1000 males) and family size in the SAVs are 913 and 5.0 respectively. The average tribal population constitutes about 15.8% and there are about 19 villages in the study area village that have a tribal population of more than 20% of the total resident population. The overall average literacy rate in the SAVs is 54.5%. The male and female literacy rates are 60.9% and 47.2% respectively.

3. PREDICTION OF IMPACTS

Based on the project details and the baseline environmental status, potential impacts as a result of the construction and operation of the proposed Rangit-IV hydroelectric project have been identified.

3.1 WATER ENVIRONMENT

Water Resources

The reduction in flow or drying of the river in the intervening stretch is not likely to have any adverse impact on the downstream users. This is mainly because of the fact that the villages within the affected river stretch do not use water from river Rangit and utilizes water from streams flowing adjacent to their settlements. The water from such streams is conveyed through gravity to the point of consumption.

Water quality

a) Construction phase

Sewage from labour camps

No impact is anticipated on river water quality, as a result of disposal of sewage (0.042 mld) from labour camps. This is mainly because of the fact that the organic loading as a result of disposal of untreated sewage from labour camps is much lower than the carrying capacity. No adverse impact is envisaged on water quality of river Rangit.

Effluent from crushers

The effluent from crushers will have high suspended solids, which can marginally affect the water quality. To mitigate the same, settling tank shall be provided.

b) Operation phase

Effluent from project colony

Since, only a small number of O&M staff will reside in the area in a well designed colony which will have a Sewage Treatment Plant (STP) and other infrastructure facilities. The problems of water pollution due to disposal of sewage are not anticipated.

Impacts on reservoir water quality

Since, the difference in FR and MDDL is not very high, i.e. about 10 m, the annual variations upto MDDL would prevent formation of any significant temperature stratification. Thus, no problems related to reservoir stratification are anticipated.

Eutrophication risks

Considering the low fertilizer usage in the area, significant loading of nutrients is not anticipated. Hence, eutrophication is not anticipated in the proposed project.

3.2 AMBIENT AIR QUALITY

Pollution due to fuel combustion in various construction equipment

Based on the mathematical modeling, the increase in SPM and SO₂ is not expected to increase significantly due to combustion of fuel in various construction equipment.

Emissions from various crushers

There could be marginal impact to settlements close to the sites at which crushers are commissioned. It should be ensured that the labour camps, colonies, etc. be located on the leeward side and outside the impact zone (about 1.5 to 2 km) of the crushers.

3.3 NOISE ENVIRONMENT

Based on the results of modeling studies, no significant increase in ambient noise level is anticipated due to operation of various construction equipment and vehicular movement.

3.4 IMPACTS ON LAND ENVIRONMENT

Quarrying operations

Operation of construction equipment

As most of the major construction sites are located at least 1 km from the construction site no significant impact is anticipated on these villages.

Construction of roads

The construction activities for roads can give rise to erosion hazards for which various management measures have been recommended as a part of Environmental Management Plan.

Land requirement

About 116.25 ha of land is required for various project appurtenances of which government/forest land is 84.53 ha. The balance land is private land (31.72 ha). Appropriate compensation measures as per the ownership has been recommended as a part of the EIA study.

3.5 IMPACTS ON TERRESTRIAL ECOLOGY

Impacts due to increased human interferences

The workers and other population groups residing in the area may use fuel wood, if no alternate fuel is provided, which can result in cleaning of trees appropriate management measures have been recommended to mitigate this impact.

Diversion of forest land

About 84.53 ha of government/forest land is to be acquired. No rare or endangered species are reported in the forest land to be acquired for the project. Appropriate management measures have been recommended for compensation in lieu of the forest land to be acquired.

Disturbance to wildlife

The impacts on terrestrial fauna are not expected to be significant as no major fauna is observed in the project area.

3.6 IMPACTS ON AQUATIC ECOLOGY

a) Construction phase

Impacts due to discharge of sewage from labour camp/colony

Due to perennial nature of river Rangit, it maintains sufficient flow through out the year and provision of appropriate sewage treatment facilities ensures that, no adverse impacts on water quality are anticipated.

b) Operation phase

Unless the desired flow is maintained downstream of the dam, aquatic ecology in general and fisheries in particular would be affected in the stretch downstream of the dam site upto confluence of tail race discharge in river Rangit. The mitigation measures for minimizing these impacts have been suggested as a part of the EIA Report.

Impacts on migratory fish species

The obstruction created by the dam would hinder the migration of certain migratory species especially *Schizothorax* (from upper reaches to the lower reaches). Stocking of selected river stretches is recommended in the EIA report as a mitigation measure.

3.7 SOCIOECONOMIC IMPACTS DURING CONSTRUCTION PHASE

Employment potential

Apart from direct employment, the opportunities for indirect employment like shops, food-stall, tea stalls, etc. besides a variety of suppliers, traders will also be generated which would provide great impetus to the economy of the local area. However, number of families could be displaced from their lands, and economic activity.

Impacts on infrastructure

The west Sikkim Jorethang Gyalzing road passes on the right bank of the proposed dam site. The road is not coming under submergence, but may be affected by the abutment stripping and other construction activities at the dam site.

Impacts due to land acquisition

About 31.72 ha of private land is to be acquired for the proposed project. 8 families are likely to be affected. A detailed R&R Plan for project affected families has been formulated as a part of the EIA report.

4. ENVIRONMENTAL MANAGEMENT PLAN

4.1 Facilities in labour camps

Following facilities are recommended for the labour camps:

- * Labour camp site shall have electricity and ventilation system, water supply and community latrines with semi-permanent structures for their workers
- * Water to be disinfected before consumption.
- * Commissioning of community latrines and septic tanks are proposed to be constructed.
- * Adequate facilities for collection, conveyance and disposal of solid waste shall be developed for solid waste collection conveyance and disposal.

4.2 ENVIRONMENTAL MANAGEMENT IN ROAD CONSTRUCTION

Various measures related to design, construction, drainage have been recommended for amelioration of adverse impacts due to construction of roads.

4.3 RESTORATION PLAN FOR QUARRY SITES

Biological and engineering measures have been suggested for the restoration of various quarry sites.

4.4 RESTORATION AND LANDSCAPING OF PROJECT SITES

Garden complex, View points, landscaping will be done. A total provision of Rs. 0.3 million can be earmarked for restoration and landscaping of project sites.

4.5 GREENBELT DEVELOPMENT

An area of about 10 ha is proposed to be developed under greenbelt development. Areas along reservoir periphery, project appurtenances, site office, road side, etc. will be covered under Greenbelt Development Programme.

4.6 COMPENSATORY AFFORESTATION

The loss of forest land is to be compensated by compensatory afforestation as per stipulations of The Indian Forest Conservation Act (1980). The forest/Government land involved in the project is 84.53 ha. Accordingly a total of (84.53×2) 169.1 ha of land is proposed to be afforested in the degraded forest area.

4.7 PUBLIC HEALTH DELIVERY SYSTEM

The public health delivery system suggested for the project includes dispensary in the area and first aid box at each construction site. These facilities will be manned by trained doctors and para-medical staff.

4.8 CONTROL OF AIR POLLUTION

It should be mandatory for the contractor involved in crushing activities to install cyclone in the crusher. To prevent the entrainment of fugitive emissions regular spray water is recommended.

4.9 CONTROL OF WATER POLLUTION

It is recommended to provide a suitable Sewage Treatment Plant (STP) to treat the sewage generated from the colony during project operation phase.

4.10 FISH MANAGEMENT

Following measures are recommended:

- * In the intervening stretch between the dam site and the tail race outfall point, a minimum flow of 1.81 cumecs shall always be released from the dam.
- * Supplementary stocking of River Rangit and for a length of 10 km each on the upstream and the downstream side of the dam site.

4.11 NOISE CONTROL MEASURES

The labour should be provided with effective personal protective measures such as ear muffs or ear plugs to be worn during periods of exposure. Silencers and mufflers of the individual machineries to be regularly checked.

4.12 ESTABLISHMENT OF AN ENVIRONMENTAL MANAGEMENT CELL

It is recommended that project proponents establish an Environmental Management Cell (EMC) at the project site with requisite manpower. The task of the Cell will be to coordinate various environmental activities, to carry out environmental monitoring and to evaluate implementation of environmental mitigatory measures.

5.0 REHABILITATION & RESETTLEMENT PLAN

The resettlement and rehabilitation plan for the project affected families/ persons of the proposed Rangit-IV hydroelectric project has been formulated within the provisions and/or guidelines as given in the National Policy on Resettlement and Rehabilitation for the Project Affected Persons – 2003 (NPRR – 2003), formulated by the Department of Land Resources, Ministry of Rural Development. 8 families are likely to lose land as well as homestead. Various measures recommended as a part of Resettlement and Rehabilitation Plan are given as below:

Rehabilitation measures

- Cash assistance equivalent to 2 ha for PAF be given @ Rs. 1.73 million/ha.
- Subsistence allowance equivalent to 20 days of minimum agricultural wages per month for a period of 1 year, upto 250 days of MAW will be extended to all PAFs.
- All PAFs to be given additional assistance equivalent to 500 day of Minimum Agricultural wages as recommended in NPRR 2003 for 55 families
- Grant for purchase of fertilizers @ Rs. 10,000/PAF for 8 PAFs.

Resettlement measures

- An area of about 150 sqm to be given to each as homestead plots.
- Provision of financial assistance towards construction of house @ Rs. 100,000/PAF.
- Provision of financial assistance towards construction of cattle-shed @ Rs. 3000/PAF.
- Assistance for shifting of building materials, belongings, cattle, etc. from the affected zone to the resettlement zone @ Rs. 5000/PAF.

Area Development Activities

- Upgradation of educational facilities in the project affected village for which a provision of Rs. 0.5 million be earmarked.
- Upgradation of Community health facilities in project affected village for which an amount of Rs. 0.5 million be earmarked.
- Upgradation of sanitation facilities in project affected village for which an amount of Rs. 0.5 million be earmarked.
- Provide financial assistance to the tune of Rs.1000/month for a period of 6 months to one member of each PAF to avail training for development of entrepreneurship to take up self-employment.
- An amount of Rs.500 per month for a period of 24 months is proposed to be given to one student for each PAF.

6. CATCHMENT AREA TREATMENT PLAN

In the present study 'Silt Yield Index' (SYI), method has been used to prioritize the various watersheds. The area under very high and high erosion category is to be treated for which costs have to be borne by the project proponents. In the proposed catchment, there is no area under very high erosion categories. The area under high erosion category is 8048 ha for which treatment measures have been suggested. The biological as well as engineering measures are suggested. A provision of Rs. 20.67 million has been earmarked for Catchment Area Treatment.

7. RESERVOIR TREATMENT PLAN

The main objective behind the Reservoir Rim Treatment action plan is to check the sedimentation in the reservoir caused by the loose debris on critical slopes, landslides and for stabilizing the foundations of the dwelling structures along the reservoir rim in due course of time. biological and engineering measures have been suggested which includes CAT plan, fencing etc.

8. FOREST PROTECTION PLAN

It is recommended that project proponents can compulsorily ask the contractor to make semi-permanent structures for their workers. These structures could be tin sheds. These sheds can have internal compartments allotted to workers. The labour camp site shall have electricity and ventilation system, water supply and community latrines. It will be mandatory for every contractor involved in project construction to provide supply of fuel to their labourers, so that trees are not cut for meeting their fuel demands. Jal Power Corporation Limited (JPCL) in association with the state government of Sikkim should make necessary arrangements for distribution of kerosene oil and LPG.

9. WILDLIFE CONSERVATION PLAN

To minimize indirect impacts due to congregation of labour population, it is recommended to develop appropriate surveillance measures. It is recommended to develop two check posts be installed near major construction sites and labour camps.

10. MUCK MANAGEMENT PLAN

About 11.80 Mm³ of muck is to be generated in this project due to various activities. About 50% of the excavated rock is likely to be utilized after crushing of as aggregate/sand. A part of the muck can be used for construction of the building. Various activities proposed as a part of the management plan are given as below:

- Land acquisition for muck dumping sites
- Civil works (construction of retaining walls, boulder crate walls etc.)
- Dumping of muck
- Levelling of the area, terracing and implementation of various engineering control measures e.g., boulder, crate wall, masonry wall, catchwater drain.
- Spreading of soil
- Application of fertilizers to facilitate vegetation growth over disposal sites.

11. ENVIRONMENTAL MONITORING PROGRAMME

From the monitoring point of view, the important parameters are water quality, erosion and siltation, landuse, afforestation, etc. The summary of environmental monitoring programmes are given in Tables 1 and 2 respectively.

TABLE-1
Summary of Environmental Monitoring Programme during Project Construction Phase

S. No.	Items to be monitored	Parameters	Frequency	Location
1.	Effluent from STPs	pH, BOD, COD, TSS, TDS	Once every month	Before and after treatment from the SPTs at various labour camps
2.	Water-related diseases	Identification of water related diseases, adequacy of local control and curative measure, etc.	Three times a year	Labour camps and colonies
3.	Air quality	SPM, RPM, SO ₂ and Nox	Once every season	At major construction sites
4.	Noise	Equivalent noise level (L _{eq})	Once in three months	At major construction sites.

TABLE-2
Summary of Environmental Monitoring Programme during Project Operation Phase

S. No.	Items to be monitored	Parameters	Frequency	Location
1.	Water	pH, Temperature, EC, Turbidity, Total Dissolved Solids, Calcium, Magnesium, Chlorides, Sulphates, Nitrates, DO. COD, BOD, Iron, Zinc, Manganese.	Thrice a year	<ul style="list-style-type: none"> • 1 km upstream of dam site • Reservoir water • 1, 2 and 5 km downstream of Tail Race discharge
2.	Effluent from STP	pH, BOD, COD, TSS, TDS	Once every month	<ul style="list-style-type: none"> • Before and after treatment from STP

S. No.	Items to be monitored	Parameters	Frequency	Location
3.	Erosion & Siltation	Soil erosion rates, stability of bank embankment, etc.	Twice a year (Summer & post-monsoons)	-
4.	Ecology	Status of afforestation programmes	Once in 5 years	-
5.	Fisheries	Phytoplanktons, zooplanktons, benthic life, fish composition	Twice a year	<ul style="list-style-type: none"> • 1 km upstream of dam site • Reservoir water • 1, 2 and 5 km downstream of Tail Race discharge
6.	Incidence of water-related diseases	Cause and control measures for various diseases.	Once in a year	<ul style="list-style-type: none"> • Project colony • Settlements within 2-3 km of the project site.
7	Meteorological aspects	Temperature, rainfall, humidity, cloud cover, wind speed and direction	Continuous	<ul style="list-style-type: none"> • Project office
8	Flow monitoring	Discharge in river Rangit	Continuous	<ul style="list-style-type: none"> • Just downstream of dam site

12. COST ESTIMATES

The total amount to be spent for implementation of Environmental Management Plan (EMP) is Rs. 105.25 million. The details are given in Table-3. The cost is excluding of the following costs:

- NPV towards forest land diversion
- Cost of trees in forest area to be diverted

TABLE-3
Cost for implementing Environmental Management Plan

S. No.	Item	Cost (Rs. million)
1.	Sanitary facilities in Labour camps	1.00
2.	Solid waste collection and Disposal system	2.99
3.	Management of Impacts due to construction of roads	0.85
4.	Restoration of Quarry sites	1.61
5.	Restoration and Landscaping of Construction sites	0.30
6.	Greenbelt Development	0.31
7	Compensatory Afforestation	5.28

S. No.	Item	Cost (Rs. million)
8.	Public Health Delivery System	10.51
9.	Construction of settling tanks at construction sites	0.50
10.	Sustenance of Riverine Fisheries	7.50
11.	Catchment Area Treatment Plan	20.64
12.	Reservoir Rim Treatment Plan	4.10
13.	Forest Protection Plan	5.22
14.	Wildlife Conservation Plan	3.97
15.	Resettlement and Rehabilitation Plan	17.50
16.	Muck Management Plan	14.25
17.	Purchase of instruments (Refer Table-4)	0.75
18.	O&M cost (Refer Table-5)	5.32
19.	Environmental Monitoring during construction phase (Refer Table 6)	2.65
	Total	105.25

TABLE-4
Cost for purchasing instruments for meteorological, discharge and noise monitoring

S. No.	Item	Cost (Rs. million)
1.	Meteorological instruments	0.50
2.	Flow monitoring equipment	0.20
3.	Noise meter	0.05
	Total	0.75

TABLE-5
O&M cost for implementing Environmental Management Plan

S. No.	Item	Cost (Rs. million/yr)	No. of years	Total cost (Rs. million) including escalation
1.	Sanitary facilities in labour camps	0.03	6	0.23
2.	Solid waste collection and disposal system	0.09	6	0.69
3.	Management of impacts due to construction of roads	0.026	6	0.20
4.	Health Delivery System	0.29	6	2.26
5.	Quarry stabilization	0.048	6	0.37
6.	Settling tank	0.009	6	0.07
7.	Sustenance of fisheries	0.195	6	1.50
	Total			5.22

TABLE-6
Cost for implementing Environmental Monitoring Programme during project construction phase

S. No.	Item	Cost (Rs. million)
1.	Effluent quality	0.88
2.	Ambient air quality	1.77
	Total	2.65

The cost required for implementation of the Environmental Monitoring Programme during project operation phase is of the order of Rs.0.672 million/year. A 10% annual price increase may be considered for every year. The details are given in Table-7.

TABLE-7
Cost for implementing Environmental Monitoring Programme during project operation phase

S. No.	Item	Cost (Rs. million/year)
1.	Water quality	0.072
2.	Ecology	0.200
3.	Riverine fisheries	0.400
	Total	0.672