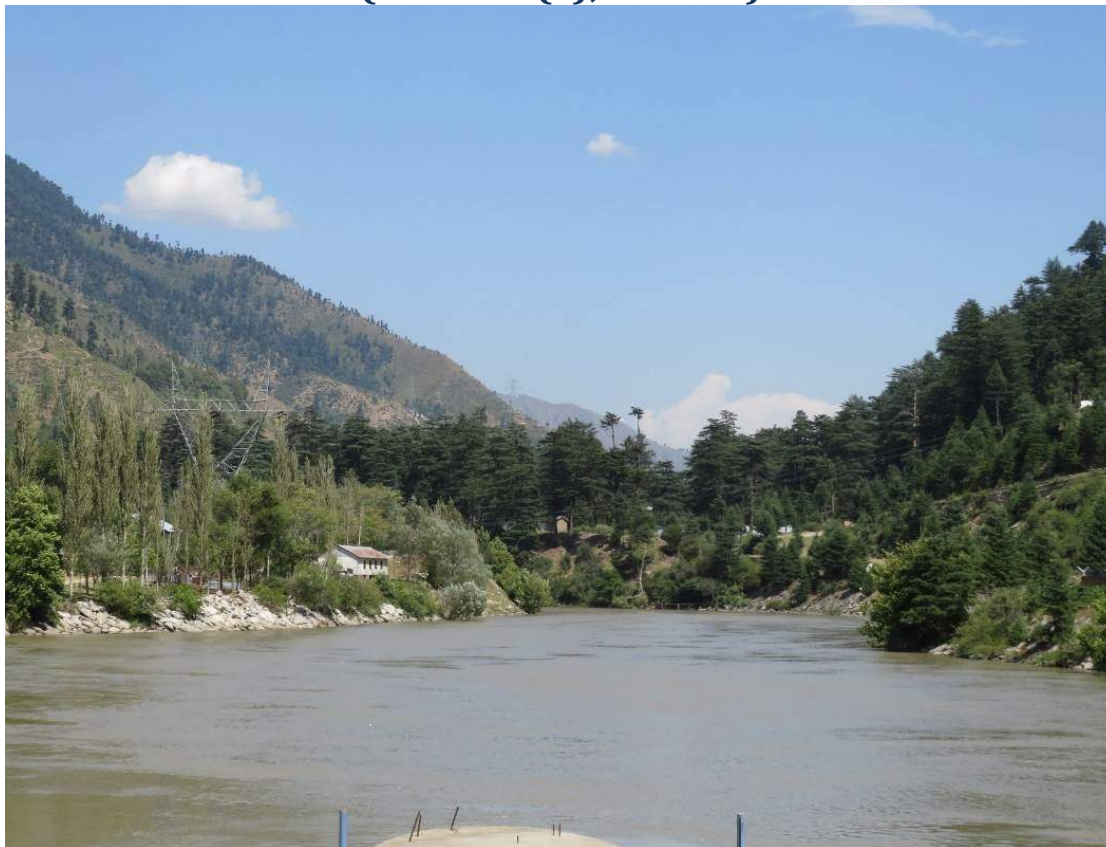


ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
URI-I STAGE-II HYDRO ELECTRIC PROJECT
(240 MW)

(Sector 1(c); Cat "A")



Draft Report
October, 2023

Prepared for:

NHPC LTD.

Prepared by:



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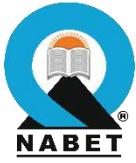
QCI Certificate No. : NABET/EIA/2225/RA 0274

**Laboratory : AGSS Analytical and Research Lab (P) Ltd.
An ISO-9001 : 2015 Accredited Laboratory
(NABL Accredited Testing Laboratory)**

**Baseline Data: Monsoon (September 2021)
Monitoring Period Winter (January 2022)
Pre- Monsoon (May 2022)**



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Certificate of Accreditation

R. S. Envirolinks Technologies Pvt. Ltd., Gurugram

402, Radisson Suites Commercial Plaza, B Block, Sushant Lok 1, Gurugram – 122009

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Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated Jan 10, 2023 and posted on QCI-NABET website.

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Sr. Director, NABET
Dated: Feb 28, 2023

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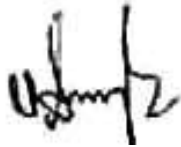
Declaration by Experts contributing to the Draft EIA Report of the Uri-I Stage-II Hydro Electric project (240 MW).

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA.

EIA Coordinator: Ravinder P S Bhatia

Name: Ravinder P S Bhatia

Signature
& Date

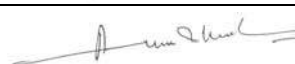


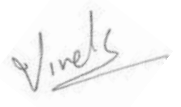
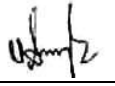
Date-04/10/2023

Period of Involvement: August 2021 – October 2023

Contact Information: 0124-4295383

Functional Area Experts:

S. No.	Functional Areas	Name of the expert/s	Involvement (Period & Task)	Signature
1	AP	Vimal Garg	- Baseline Data Review and Analysis - Impact Assessment - Preparation of Air Management Plan	
2	WP	Ravinder P S Bhatia	- Baseline Data Review and Analysis – Water Quality - Impact Assessment and Management Plan	
3	SHW	Ravinder P S Bhatia	- Impact Assessment - Preparation of Waste Management Plan - Public Health Delivery System - Muck generation analysis and Dumping Plan	
4	SE	Mamta Avinash Bavaskar	- Social Data Collection and Interpretation - Social Impact Assessment - Preparation of R&R Plan	
		Zahoor A Wani		
5	EB	Arun Bhaskar	- Impact Assessment - Preparation of Biodiversity Management Plan - Compensatory Afforestation Plan	
		Vivek Jhaladiyal	Baseline Data Collection, Analysis and Interpretation	
6	SC	Arun Bhaskar	- Baseline Data Review and Analysis - Impact Assessment	

		Vivek Jhaldiyal	• Sampling and Interpretation	
7	AQ	Ravinder P S Bhatia	• Impact Assessment of Air Environment	
8	NV	Ravinder P S Bhatia	• Baseline Data Review and Analysis – Sound levels, Impact Assessment and Mitigation Plan	
9	HG	Vimal Garg	• Impact Assessment	
10	LU	Vimal Garg	• Impact Assessment • Data Review and Analysis	
		Dimple Razdan	• Field Investigation and Data Collection • Sampling and Interpretation • Preparation of Thematic maps	
		Sanjeev Kumar Yadav	• Field Investigation and Data Collection • Preparation of Thematic maps	
11	RH	Harsh Pandya	• Risk Assessment	
12	GEO	Trilochan Singh Kaith	• Geological & Geotechnical Investigations	
Team Member				
1	WP SC	Parshant Tomar	• Baseline data collection, Analysis and Interpretation	

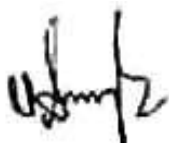
Declaration by the Head of the Accredited Consultant Organization/ authorized person

I, Ravinder P S Bhatia, hereby, confirm that the above-mentioned experts prepared the Draft EIA Report of Uri-I Stage-II Hydro Electric Project (240 MW). I also confirm that the consultant organization shall be fully accountable for any mis-leading information in this statement.

Signature:

Name: Ravinder P S Bhatia

Designation: Director



Name of the EIA Consult Organization: RS Envirolink Technologies Pvt. Ltd.

NABET Certificate No. & Issue Date: NABET/EIA/2225/RA 0274, 28 February 2023

S.No.	Functional Areas	Complete name of the Functional Areas
1	AP	Air Pollution Prevention, Monitoring & Control
2	WP	Water Pollution Prevention, Control & Prediction of Impacts
3	SHW	Solid Waste and Hazardous Waste Management
4	SE	Socio-Economics
5	EB	Ecology and Biodiversity
6	SC	Soil Conservation
7	AQ	Meteorology, Air Quality Modeling & Prediction
8	NV	Noise/ Vibration
9	HG	Hydrology, Ground Water & Water Conservation
10	LU	Land Use
11	RH	Risk Assessment & Hazard Management

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ANNEXURES

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Annexure II: Compliance to Term of Reference (TOR)

Annexure IIIa: Metrological Data

Annexure IIIb: Windrose Data

Annexure IV: Cost norms provided by the office of Chief Conservator of Forests, Kashmir vide Letter No. 421/CCF(K)/Plg/2023-24/871-72 dated 19/07/2023

Annexure V: Summary of Emergency Action Plan/ Disaster Management Plan, Uri-I Stage-II HEP

APPENDIX

Appendix-I: Undertaking by Project Proponent

Appendix-II: NOC from Directorate of Geology and Mining, UT of J&K

Appendix-III: NOC from Archaeological Survey of India

**Chapter
1****INTRODUCTION****1.1 PURPOSE OF THE REPORT**

Environment Impact Assessment (EIA) study of proposed 240 MW Uri-I Stage-II Hydroelectric Project has been carried out with a view to assess the impacts of project on the surrounding area. The purpose of the EIA document is to inform the decision-makers and the public of the environmental consequences of implementing a proposed project and therefore an EIA document is considered as a technical tool that identifies, predicts, and analyses impacts on the physical, biological environment, as well as social, cultural, and health impacts.

Therefore, the EIA document of Uri-I Stage-II HEP was prepared to present the baseline status of various environmental parameters in project surrounding, to assess the impacts of the project on the surrounding area and to suggest mitigation and management measures to minimize such impacts. EIA study for such projects is mandatory as per EIA Notification of September 2006, which describes the environment clearance procedure.

1.2 IDENTIFICATION OF PROJECT AND PROJECT PROPONENT

Uri-I Stage-II Hydro Electric (HE) Project is an extension of Uri-I Power Station (Uri-I Stage-I/ Uri-I HE Project). The Uri-I HE Project was allotted to M/s NHPC Ltd. Environmental Clearance for Uri-I HE Project (480 MW) was accorded by Department of Science and Technology (DST), Govt. of India, in favour of Central Electricity Authority (CEA) on 27.06.1980. Forest Clearance for diversion of 54.70 ha forest land for construction of Uri-I HE Project was accorded by Ministry of Environment, Forest & Climate Change (MoEF&CC), erstwhile Ministry of Environment and Forest (MoEF) on 21st May 1986.

Uri-I HE Project (Uri-I Power Station) commissioned in the year 1997 by NHPC Ltd. consists of 21.5m high barrage (from deepest foundation level), desilting basin, open channel, 10.63 km long Head Race Tunnel (HRT), Pressure Shaft, an underground powerhouse, & 02 km long Tail Race Tunnel (TRT) with outfall at the Bandi village.

The general layout of the proposed Project, size and diversion of various components/structures have been based upon built-in structures of Uri-I Power Station. The existing structures like barrage, the surface water conveyance system consisting of Head regulator upto HRT intake of Uri-I Project shall be utilized for Uri-I Stage-II HEP. The construction of underground structures like 10.472 km long HRT, 17m dia. surge shaft, pressure shaft of dia. 5m, an underground powerhouse complex and 2.28 km long TRT are proposed for Uri-I Stage-II HE Project.

NHPC Ltd. has signed Memorandum of Understanding (MoU) with the Government of Jammu & Kashmir for execution of Uri-I Stage-II HE Project (240 MW) on Build, Own, Operate & Transfer (BOOT) basis for a period of 40 years.

NHPC Ltd., (formerly known as National Hydroelectric Power Corporation) was incorporated on 7th November 1975 as Central Govt. Enterprise for development of Hydro

Power in Central Sector. NHPC is a Schedule 'A' Enterprises of Govt. of India with Miniratna status since 2008 under the Ministry of Power, Govt. of India.

RS Envirolink Technologies Pvt. Ltd. has been entrusted with the preparation of the EIA and EMP report for Uri-I Stage-II HEP to meet the requirement of environmental clearance process. RS Envirolink Technologies Pvt. Ltd., Gurgaon is a category 'A' NABET accredited consultant for 'River Valley Projects'. NABET certificate is enclosed in the report.

1.3 BRIEF DESCRIPTION OF NATURE, SIZE, LOCATION OF THE PROJECT AND ITS IMPORTANCE TO THE COUNTRY, REGION

1.3.1 Brief Description of Nature of the Project

Uri-I Stage-II HE Project is the second stage of already commissioned Uri-I Power Station of 480 MW on river Jhelum in Baramulla district of UT of Jammu & Kashmir. This project is planned as per provision kept in the DPR of Uri-I Power Station. The provision for second stage has been kept in the design of surface water conveyance system from head regulator and up to the Intake of HRT keeping the diversion structure of Uri-I Power Station i.e. Barrage same for Uri-I Stage –II H.E. Project. Accordingly, some of the structures of Uri-I Power Station i.e. Barrage, Head regulator, desilting basins, open channel and Boniyar Nallah intake constructed for Uri-I Stage-II HE Project during execution of Uri-I Power Station shall be utilized.

Uri-I Stage-II HE Project shall utilize diverted (additional) waters available after electricity generation from Kishanganga Power Station located near Bandipore in Kashmir Valley. Kishanganga Power Station is a run of the river scheme which involves transfer of water of Kishanganga River in Gurez valley to Bonar nallah, which is tributary of Jhelum River in Kashmir valley. Bonar Nallah joins Madhumati nallah D/s of tail race outlet of the powerhouse of Kishanganga Power station. Madhumati nallah discharges into Wullar lake located on main Jhelum River. Kishanganga Power Station was commissioned by NHPC in the month of May-2018. The drainage map of Jhelum basin showing location of Power station on River Jhelum and its tributaries is shown at **Figure 1.1**.

Therefore, the proposed Uri-I Stage-II HE Project envisaged the construction of 10.472 km long HRT with 6.50 m diameter horseshoe shape, surge shaft, pressure shaft, an underground powerhouse complex and one 6.5 m dia. horseshoe shaped, 2.28 km long TRT.

1.3.2 Sector Classification

As the proposed project envisages hydroelectric power generation, therefore, it gets covered in the Schedule of EIA Notification, 2006 at item 1(c), Category 'A' i.e. >100 MW installed capacity.

1.3.3 Size of the Project

As earlier stated, the proposed Uri-I Stage-II HEP (240 MW) is an extension of Uri-I HE Project (Uri-I Power Station) of 480 MW. The Uri-I Stage-II HEP shall utilize the existing structure and surplus water of Uri-I Power Station. Uri-I Power station is ROR (run-of-the-

river) scheme. There is no live storage in Uri-I reservoir, while the gross storage of Uri-I Power Station at FRL is 0.2371 MCM and the barrage height is 21.5m (from deepest foundation level).

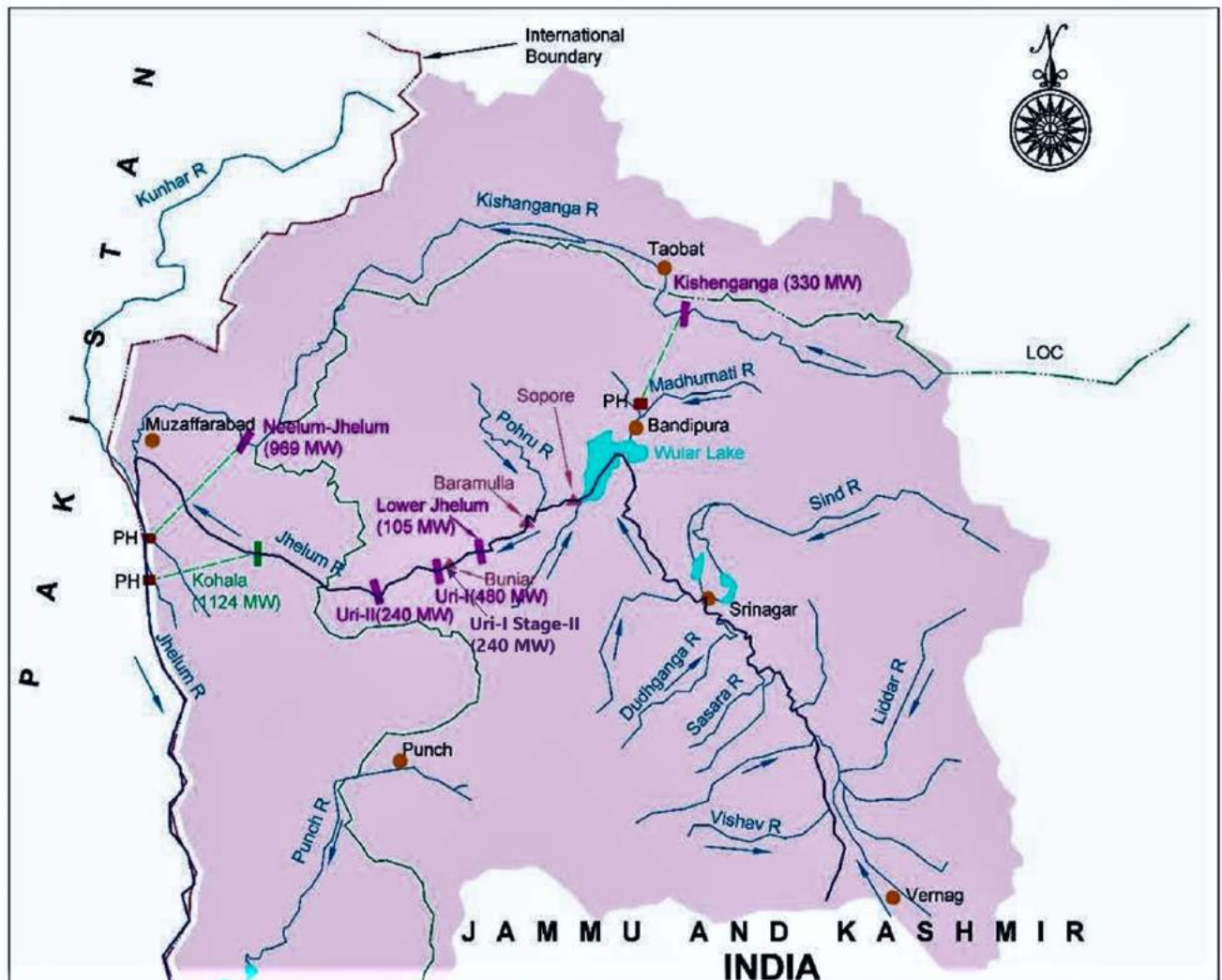


Figure 1.1: Drainage Map of Jhelum basin showing important Hydro Electric Projects

1.3.4 Location

The project is located on Jhelum River in Uri tehsil of Baramulla district in Union Territory of Jammu & Kashmir. The barrage site is about 2 km from Boniyar (block headquarter) and about 30 km from Uri town (tehsil headquarter). The district headquarter at Baramulla is about 28 km from barrage site.

The nearest railhead is Udhampur Railway Station. The distance from Udhampur to the project site is about 265 km. The nearest airport at Srinagar is about 88 km. Project site is 347 km from Jammu.

1.3.5 Importance to the Country, Region

The implementation of the proposed Uri-I Stage-II HEP (240 MW), will contribute to meeting the power and energy demand in the Northern Region which comes under the purview of the Northern Eastern Western and North- Eastern (NEWNE) grid and will displace electricity that would otherwise have to be produced through the construction of

fossil fuel-based thermal power plants. Uri-I Stage-II HEP will help in harnessing the potential of river Jhelum by generating electricity and bring benefits of renewable energy to state and country. The proposed project has therefore been considered in the context of power shortage in the Northern region in general and in the country as a whole.

1.3.6 Cascade Development Plan

Uri-I Power Station is a run of the river type scheme across the Jhelum River, in the UT of Jammu and Kashmir near Boniyar. At the barrage site, the river drains a catchment of 12750 Km².

Jhelum River Basin: Jhelum river is a river in northern India and eastern Pakistan. It passes through the Kashmir valley. The different hydropower project on this river basin are: Lower Jhelum with installed capacity of 105 MW is located in near Warikhah of Baramulla district. The Upper Sindh-I (22.6 MW), Ganderbal HEP (15 MW) and Upper Sindh-II (105 MW) located on Sindh River a right bank tributary of Jhelum River in Gangerbhal district. Pahalgam Mini Power Project of 4.5 MW in district Anantnag. Karnah SHEP (2 MW) is in Karnah village of district Kupwara and Kishanganga HEP (330 MW) located on Kishanganga River in Bandipore district.

Uri-I Power Station harnesses the hydropower potential of Jhelum River between Lower Jhelum HEP and Uri-II Power Station. All three projects are run-of-the-river (RoR) schemes.

Cascade Development plan of Jhelum River w.r.t to Uri-I Stage-II HEP (2x120 MW) showing upstream and downstream project and free flowing river stretch between FRL and TWL of these projects is given at **Figure 1.2**.

The upstream project, Lower Jhelum HEP (105 MW) operated by Jammu and Kashmir State Power Development Corporation Limited (JKSPDCL) was commissioned between 1977-78. The Lower Jhelum HEP is comprise of diversion weir with Full Supply Level (FSL) at EL 1564 m asl, open channel, balancing reservoir, surface power and TRT at EL 1497 m asl.

The Uri-I Project (Stage-I & II) (4 x 120 MW & 2 x 120 MW) is located between FRL at 1491 m to TWL at 1241 m.

Uri-II Power Station is a run-of-the-river scheme with an installed capacity of 240 MW (4 X 60 MW) is downstream project of Uri-I Power Station commissioned in the year 2013-14. The project comprised of 52 m high dam with FRL at EL 1241 m. The Tailrace water level of Uri-II Power Station is at EL 1111 m.

1.3.7 International Aspect

The Indus system of rivers comprises of three Eastern Rivers (Ravi, Beas & Sutlej and their tributaries) and three Western Rivers (Indus, Jhelum & Chenab and their tributaries). The Jhelum is one of the principal rivers forming part of the Indus basin. The waters of this basin are shared between India and Pakistan in accordance with the provisions of "The Indus Water Treaty, 1960".

Uri-I Stage-II HE Project is planned as purely run-of-river scheme as an extension of Uri-I Power Station in which water of Jhelum river shall be utilized both for Uri-I PS and Uri-I Stage-II with existing diversion structure (Barrage) of Uri-I Power Station which is operating as per the provisions of The Indus Water treaty, 1960.

Uri-I Stage-II HE Project also utilizes diverted (additional) waters available after generation of Kishanganga Power station. Kishanganga Power station is a run-of the river scheme which involves transfer of water of Kishanganga River in Gurez valley to Bonar nallah, which is tributary of Jhelum River in Kashmir valley. Bonar Nallah joins Madhumati nallah D/s of tail race outlet of the powerhouse of KGHP. Madhumati nallah discharges into Wular lake located on main Jhelum River. The parameters of the project have been planned in accordance with the provision of the Treaty.

According to Indus water Treaty 1960, no storage as well as Power storage is provided on the main Jhelum River. Uri-I PS is constructed and operating as per provision of IWT and URI-I Stage-II HE Project is the extension of Uri-I PS.

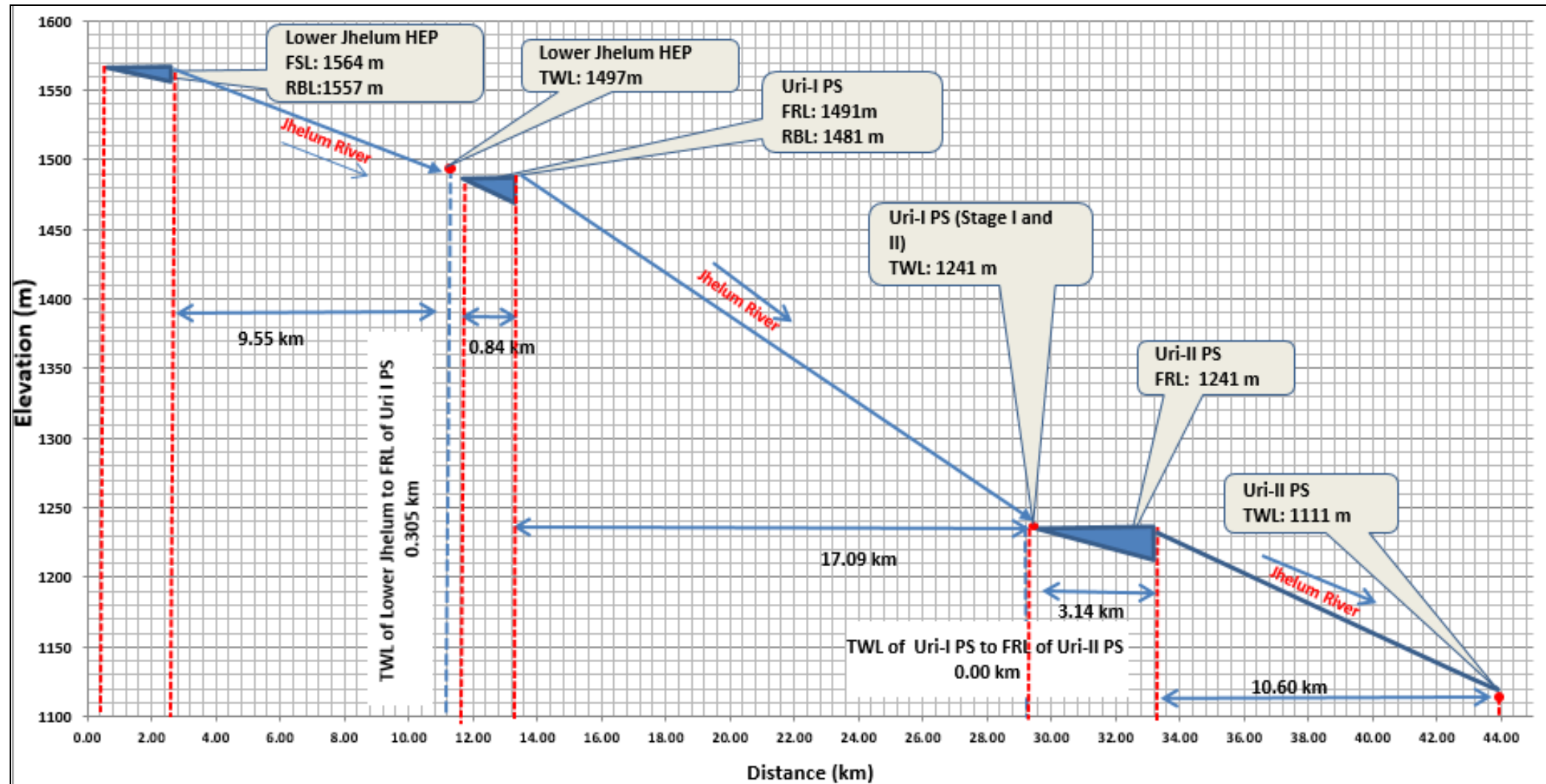


Figure 1.2: L-section of Jhelum River showing Uri I (Stage-I & II) Project along with U/s and D/s Projects

According to Indus water Treaty 1960, no storage as well as Power storage is provided on the main Jhelum River. Uri-I Stage-II HE Project is planned as purely run-of-the-river scheme similar to Uri-I Stage-I (URI-I Power Station) in which water of Jhelum River shall be utilized both for Uri-I Power Station and Uri-I Stage-II HEP as per the provisions under the Indus Water treaty, 1960. The parameters of the project have been planned in accordance with the provision of the Treaty.

NHPC vide letter NH/PID/Uri-I(Stg-II) HEP/2023/1537 dated 27.03.2023 had submitted the proposal for clearances under Indus Water Treaty for proposed Uri-I Stage-II HE Project (240 MW).

1.4 SCOPE OF THE STUDY

The project was discussed by the Expert Appraisal Committee (EAC) in its 10th meeting held on 15th April 2021 where scoping clearance was recommended. Scoping clearance letter was issued by MoEF&CC vide letter no. J-12011/08/2021-IA-I dated 10th June 2021 for 240 MW installed capacity (refer to **Annexure I**).

EAC recommended the scoping clearance with Standard TOR along with the following additional conditions:

- i. EIA report for the proposed expansion project Uri-I Stage-II should be prepared keeping in view the cumulative impact of existing Uri-I HE Project and proposed Uri-I Stage Stage-II HE Project.
- ii. Three season (Pre-monsoon, Monsoon and Winter Season) baseline data of all the environmental attributes including biological environment as mentioned in the standard TOR shall be collected for preparation of EIA/EMP report.
- iii. Requisite studies like simulation study for the E-flow shall also be undertaken.
- iv. The project involves diversion of 17ha of forest land. Forest clearance shall be obtained as per the prevailing norms of Forest (Conservation) Act, 1980. Application to obtain prior approval of Central Government under the Forest (Conservation) Act, 1980 for diversion of forest land required should be submitted as soon as the actual extent of forest land required for the project is known, and in any case, within six months of issuance of this letter.
- v. CAT plan, Dam break analysis, Disaster Management Plan and Fisheries Management Plan be prepared along with other EMPs and incorporated in the EIA/EMP report.
- vi. The EIA report should also describe the cumulative environmental effects due to proximity to other existing or planned projects with similar effects, if any.
- vii. All the tasks including conducting public hearing shall be done as per the provisions of EIA notification, 2006 and as amended from time to time. Public hearing issues raised and compliance of the same shall be incorporated in the EIA/EMP report in the relevant chapter.
- viii. An undertaking as part of the EIA report from project proponent, owning the contents (information and data) of the EIA report with the declaration about the contents of the EIA report pertaining to a project have not been copied from other EIA reports.
- ix. Consolidated EIA/EMP report is to be submitted as per the generic structure (Appendix III & IIIA) given in the EIA notification, 2006.

- x. Conservation Plan for the Schedule-I species if any, in the project study area shall be prepared and submitted to the Competent Authority for approval.
- xi. Pre-DPR Chapter viz., Hydrology, Layout map, and Power Potential Studies duly approved by CWC/ CEA shall be submitted.
- xii. Environmental Matrix during construction and operational phase needs to be submitted.
- xiii. Both Capital and Recurring expenditure under EMP shall be submitted.
- xiv. The salient features to be intimated to the Indus water commission.
- xv. Environmental Cost benefit analysis for the proposed project shall be done duly keeping in view the actual cost-benefit of the existing operational Uri-I HE Project and that of proposed expansion of the same.
- xvi. PP shall apply to obtain prior approval of Central Government under the Forest (Conservation) Act, 1980 for diversion of forest land required for such projects will be submitted as soon as the actual extent of forest land required for the project is known to the project proponent, and in any case, within six months of issuance of ToR.

To ensure compliance with the EAC's recommendations, baseline data were collected on physio-chemical and biological parameters covering three seasons. The final EIA study report has been prepared, in compliance with the scoping clearance issued by MoEF&CC. The compliance of TOR with references is given in **Annexure II**.

The project involves diversion of **17.0 ha** of underground forest land only for non-forestry purposes i.e. for the construction of underground project components. No private land is required for the proposed project. The required non-forest land is already under possession of Uri-I Power Station, NHPC.

The requisite 17ha forest land falls in Baramulla Forest Division. The forest land required for construction of underground project components viz. HRT, Surge Shaft, Pressure Shaft, Powerhouse, Tail Race Tunnel and other allied structures. As such, the Uri-I Stage-II HE Project does not involve diversion of any surface forest land and felling of trees.

For diversion of 17 ha of forest land, an online application has been submitted to MoEF&CC vide Proposal No.: FP/JK/HYD/144277/2021 (<http://forestsclearance.nic.in/viewreport.aspx?pid=FP/JK/HYD/144277/2021>).

Chapter 2

PROJECT DESCRIPTION

2.1 TYPE OF PROJECT

Uri-I Stage-II Hydro Electric Project (240 MW) is an extension of Uri-I Power Station (480 MW) which is run-of-the-river (RoR) scheme and is under operation since 1997. As per EIA Notification, 2006, **Uri-I Stage-II Hydro Electric Project** (240 MW) is a Category 'A' project, listed in item 1(c) in the Schedule.

2.2 NEED FOR THE PROJECT

India has been facing electricity shortages despite appreciable growth in electricity generation. The demand for electrical energy has been growing at a much faster rate and is expected to increase further to match the projected growth of the Indian economy. The per capita electricity consumption, which was 18.17 kWh during 1950 has increased to approx. 1255 kWh during the year 2021-22.

The UT of J&K face a peak deficit of power supply. The PEAK LOAD (MUs) and ENERGY (MUs) demand projections study conducted by CEA, the peak demand for power is increased from 19496 MU (FY 2022-23) to 20950 MU by FY 2023-24 (LGBR, CEA 2023-24). The "Load Generation Balance Report (LGBR) 2023-24" published by Central Electricity Authority (March 2023) (https://cea.nic.in/wp-content/uploads/l_g_b_r_reports/2022/LGBR_2023_24.pdf), the hydroelectric power potential of UT of Jammu & Kashmir is about 11839 MW, but only 3360.0 MW have been harnessed so far. The demand of power in UT of Jammu & Kashmir's (J&K) is mostly met by the Central Generating Stations (CGS) and the State's own sources. Keeping in view the future electricity demand central government and the state governments have planned to increase the energy generation in their annual and 5-year plans.

The implementation of the proposed Uri-I Stage-II HEP (240 MW), will contribute to meeting the power and energy demand in the Northern Region which comes under the purview of the Northern Eastern Western and North- Eastern (NEW & NE) grid and will displace electricity that would otherwise have to be produced through the construction of fossil fuel-based thermal power plants.

2.3 LOCATION

The Uri-I Stage-II HE Project is located on Jhelum River, in Uri and Boniyar tehsils of Baramulla district in Union Territory of Jammu & Kashmir. The barrage site is located in Boniyar tehsil, about 2 km from Boniyar tehsil headquarter and powerhouse area lies in Uri tehsil and located about 15 km from Uri town (tehsil headquarter). The district headquarter at Baramulla is about 30 km from project site. The Project is well connected by road, all the project components are located along the National Highway 1 (NH1). NH1 connect the border area of Uri tehsil of Baramulla district to rest of India. The project is 347 km from Jammu and 85 km from Srinagar. The nearest railhead is Udhampur Railway Station. The distance from Udhampur to the project site is about 265 km. The nearest airport at Srinagar is about 88 km. The location of the project is shown in **Figure 2.1**.

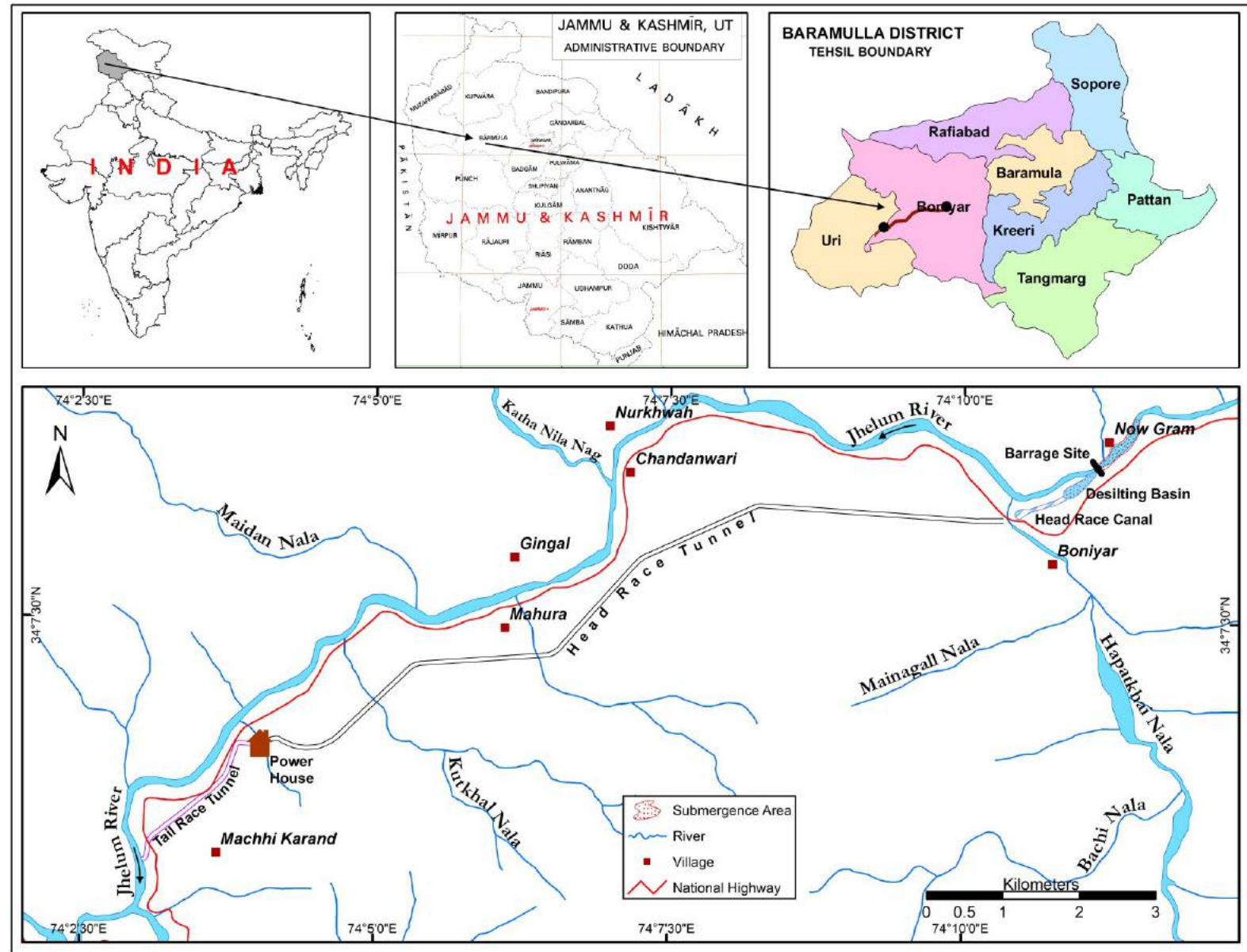


Figure 2.1: Location Map of Uri-I Stage-II HEP

2.4 SIZE OR MAGNITUDE OF OPERATION

The proposed Uri-I Stage-II HEP is planned as per provision kept in the DPR of Uri-I Power Station. Thus, the already existing structure like barrage, the surface water conveyance system consisting of Head regulator upto intake of Uri-I Power Station shall be utilized for Uri-I stage-II HEP.

Therefore, the proposed Uri-I Stage-II HEP envisage construction of new Head Race Tunnel (HRT), Surge Shaft, Pressure Shaft, an underground Powerhouse complex, surge galleries and Tail Race Tunnel (TRT).

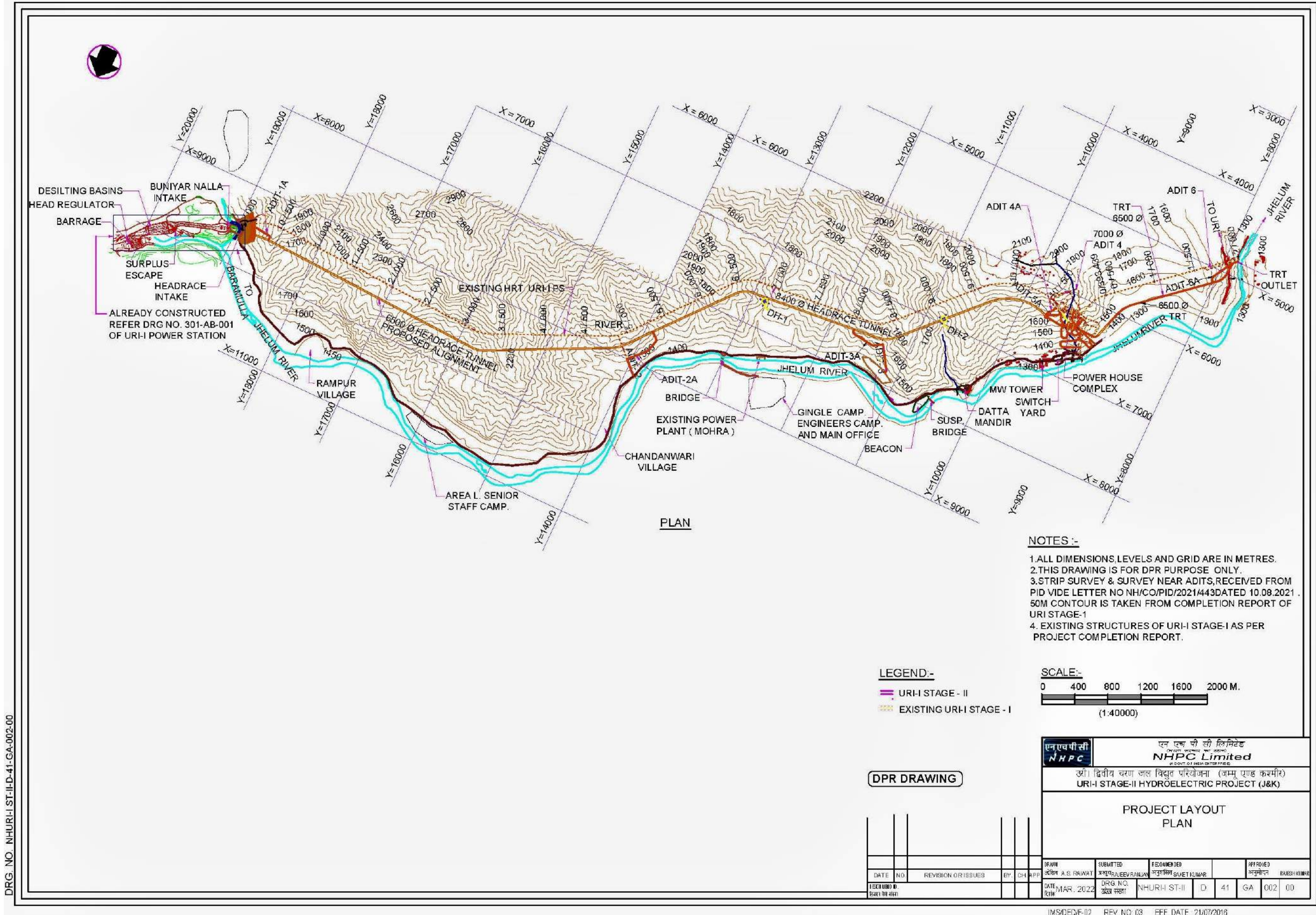
Following are the major project components of existing Uri-I Power Station :

- Uri-I Power Station Barrage of 95m long at top of barrage and 21.5m high from its deepest foundation level. The full supply water level upstream of the barrage is EL 1491.00m and barrage top is at EL 1495.50m. Spillway consisting of 6 bays and 3 no. under sluice bays.
- A fish way is provided between bay no. 6 and bay no. 7. It is about 150m long with the inlet at EL 1489.0 and the outlet at EL 1475.50.
- Head regulator of 34m length, Headrace canal of about 665m length and 12m width, intake forebay at the downstream end of the canal of 195m, a siphon type surplus escape at a water level of EL 1491.30m and Boniyar Nalla Intake, culvert and tunnel intake of total length about 250.0m.

Proposed structures (Uri-I Stage-II H.E. Project)

- Horseshoe shape HRT of 10.472 km length and 6.50 m diameter in left bank and parallel to existing HRT in valley side.
- 1 no. 5m dia. steel lined pressure tunnels/shafts and 2 no. 3.25m dia. steel lined penstocks.
- Underground powerhouse cavern housing 2 no, units of 120 MW each.
- Transformer cavern located d/s of powerhouse cavern.
- Draft tube gate operation cavern further d/s of Transformer Cavern, 1 no. main TRT of size 6.5m horseshoe shape having tailrace surge galleries.
- To facilitate the construction and operation of the project components, suitable adits and access tunnels have been proposed.
- A 6.5 dia. 2.28 km long horseshoe shaped TRT of Stage-II is aligned on valley side and running parallel to the existing Stage-I TRT. The TRT is located on left bank of Jhelum River with TRT out fall near Bandi Village.

The salient features and Layout map and Index map of proposed Uri-I Stage-II HEP are given in **Figure 2.2** and **Table 2.1**, respectively.



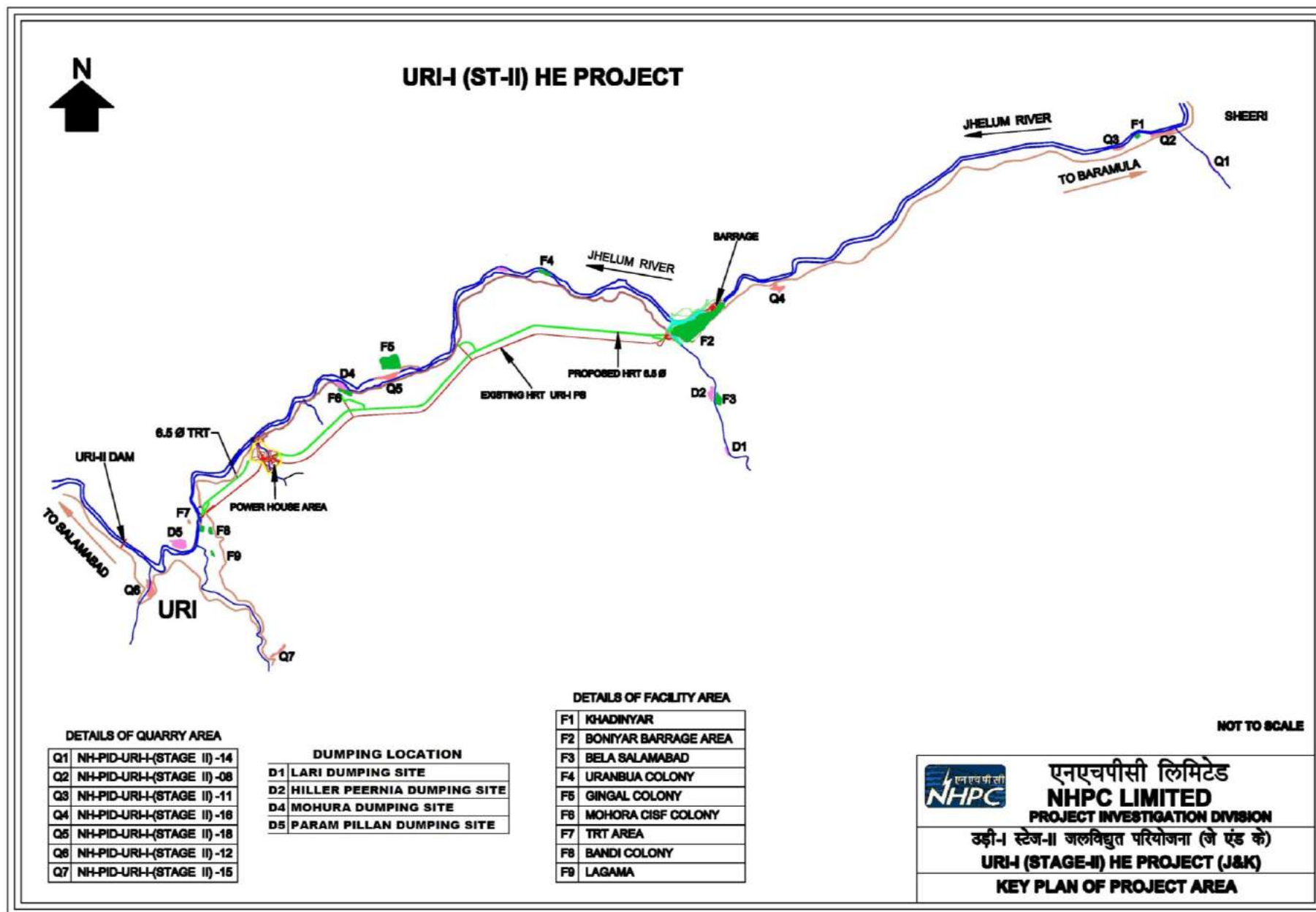


Figure 2.3: Index map of Uri-I Stage II HEP

Table 2.1: Salient features of Uri-I Stage-II HEP

PROJECT LOCATION		
1	State/UT	Jammu & Kashmir
2	District	Baramulla
3	River	Jhelum
4	Latitude	Barrage 34°08'00" N Power House 34°05'00"N
5	Longitude	Barrage 74°11'00" E and Powerhouse 74° 03'00" E
6	Nearest Rail head	Udhampur
7	Nearest Airport	Srinagar
HYDROLOGY		
1	Catchment area up to Barrage site	12,750 Km ²
2	Annual rainfall in the catchment area	1104 mm (1992-2019)
3	Reservoir Capacity	23.71 Ham
4	Minimum average 10-daily flow in	41.3 Cumecs
5	Max. observed discharge at Barrage	1675 Cumecs
6	Design Flood	2264 Cumecs
DIVERSION TUNNEL		Not Applicable
COFFER DAM		Not Applicable
RESERVOIR		
1	Full Reservoir Level (FRL)	El 1491.0 m
2	Maximum Water Level	El 1491.0 m
3	Min. Drawdown Level	El 1491.0 m
4	Gross Storage at FRL/FSL	23.71 Ham
5	Live Storage	Nil (ROR Scheme)
6	Annual Sediment Load	3.11 Million tons per year
ALREADY CONSTRUCTED STRUCTURES		
BARRAGE		
1	Top Elevation	El.1495.50 m
2	FRL Elevation/Pond level	El 1491.0 m
3	Dam height (from riverbed level/ deepest foundation level)	14.5m / 21.5 m
4	Length of Barrage	95.0 m
5	Type of foundation	Concrete cut off at u/d floor of barrage, Barrage foundation and in stilling basin
SPILLWAY		
1	Design Flood/ Check Flood	2264 cumecs
2	Type	Gated, Crest Spillway
3	Crest Elevation	
a	Upper Level	1483.75
b	Lower level	1483.00
4	No. and Size of Spillway Opening	
	Lower Level	
a	Number	3 nos.
b	Size (WxH))	8m(W) x 8.25m(H)
	Upper Level	
a	Number	6 nos.
b	Size (WxH)	8m(W) x 7.5m(H)
5	Energy Dissipation Type	Stilling Basins
6	Total Length of Spillway Blocks	112.5 including Silting Basins

Construction Sluices/ River Sluices/ Upper Sluices/ Silt excluder		
1	Number	6 nos.
2	Size	4 nos. 1m x 1.6m & 2 nos. 0.8m x 1.6m
3	Invert level/ Cistern level	Basin 1 to 6 Bottom El. 1471.0 Basin 7 to 9 Bottom El. 1470.0
4	Stilling Basins	63m length (total floor length upto end of sill 78 m)
5	Type of Gate	Radial
Head Regulator (Already Constructed)		
1	Nos of bays	2
2	Width	16m each
3	Design discharge	521 cumecs
Cut and cover section		
1	Length of culverts	188m/ 207 m
2	No. of barrels	4 nos.
3	Design Discharge	521 cumecs
4	Type of Gates	Radial
5	Design Head (m)	5.6m
Desilting Chambers/ Basins		
1	Nos of basins	2
2	Size	Length of desilting basin is 300 m Width of basins varies from 44m to 66 m Side slope 1.0V: 1.5H
3	Inlet Discharge	521 cumecs
7	Normal flushing discharge	68 cumecs
Surplus Escape		
1	Syphon	6 nos 8m(W)
2	Crest level	El 1491.0m
3	Capacity	500 cumecs at El. 1491.3
Head Race Canal		
1	Length of canal, including forebay	665m
2	Width of invert	12.0m
3	Side slope	1.0V: 1.5H
4	Elevation of invert	El.1483.0 m
5	Design Discharge	453 cumecs
Power Intake		
	Buniyar nala intake structure	
1	Size of intake gate	7.0 (W)x 9.0m(H)
2	Sill Level	El 1469.5m
3	Trash Rack	
a	Dimension (WxH)	33.4m(W) x 15.8m(H)
b	Number	1
4	Length of Culvert	177m
5	Shape of Culvert	Octagonal
6	Cross Sectional area	104 sqm
7	Design Discharge	453 cumecs
8	Type of Gate	Vertical lift fixed wheel type
9	Design Head (m)	21.5 m
HRT Intake Structure		
1	Number	02 (One no for URI-I PS & other for URI-I Stage-II)
2	Size of intake gate	7.0 (W)x 9.0m(H)

3	Invert Level	EL 1462.5 m
4	Design Discharge	453 cumecs
5	Design Discharge (per intake)	226.5 cumecs per intake
6	Invert level	El. 1462.5 m
7	C/L at Intake	1465.75 m
8	Type of Gate	Vertical Lift fixed wheel type
9	Design Head	28.5 m
PROPOSED STRUCTURES		
Head Race Tunnel (HRT)		
	No. diameter & Shape	1 No., Horseshoe
	Size (dia.)	6.5m dia.
	Length	10472 m
	Design Discharge	117.15 cumecs
	Velocity	3.34 m/s
	Bed Slope	0.2817% (1 in 355)
HRT Adits		
1	Nos.	4
2	Size	6.5 m D-shape
3	Length	
a	Adit 1A length	330m
b	Adit 2A length	550m
c	Adit 3A length	450m
d	Adit 4A length	150m
Surge Arrangement in U/S of PH		
1	No. & type	1 no. Surge Shaft, Underground
2	Size (Diameter)	17m
3	Height	93.5m (from operating floor level)
4	Top Level	El. 1532.5m
5	Bottom level	El. 1439m
6	HRT invert below surge shaft	El. 1433m
7	Maximum Up-surge Level	El. 1531.0m
8	Minimum down-surge Level	El. 1444.0m
9	Adit to Surge shaft top (Adit-4B)	
a	Size	7.0 m D-shape
b	Length	175m
10	Surge Gallery Details	Nil
a	Type of Gate	Vertical lift fixed wheel type of size 6mx6m (WxH), 01 No.
b	Design Head (9m)	58m
	Butterfly Valve Chamber	Not Applicable
Pressure shaft/ Penstock		
	Pressure shaft	
1	Number & Type	1 No., circular steel lined
2	Diameter	5m
3	Length	Length (top horizontal) 230m, Vertical shaft 220m
4	Design Discharge	117.15 cumecs
5	Velocity (Pressure Shaft)	5.97 m/s
	Penstock	
1	No., Dia. & Shape	2 nos. Underground circular steel lined
2	Diameter	3.25m dia.

3	Length	PS-1=30m, PS-2=40m
4	Design Discharge (each Penstock)	58.58 cumec
5	Velocity (Penstock)	7.06 m/s
6	Adit to Pressure shaft Top	
a	Size & Length	7.0 m D-shape, 170m
7	Adit to Pressure shaft Bottom	
b	Size & Length	7.0 m D-shape, 332m
Powerhouse		
1	Type and Size	Underground; 91m(L) x 20m(W) x 42.8m(H)
2	No. of Unit and	2 Nos.
3	Type of Turbine	Francis
4	Unit Installed capacity	240 MW (2x120MW)
5	Unit Discharge	58.58 cumecs
6	Net Head/ Rated Head	227m
7	Head loss all units/ one unit)	23m
8	Normal TWL	El. 1241.00 m
9	Minimum TWL	1241.00 m
10	Maximum TWL	1241.00 m
Transformer Cavern		
1	Type and Size	Underground; 109m (L) x 16.6m(W) x 26.5m (D)
2	Number	1
3	Transformer details	52 MVA, 13.8/ 400/√3 kV, Single Phase, 50 Hz
Draft Tube Gate Hall Size		
1	Size	50m(L) x 7.5m (W) x 19m (D)
2	Type of Gate	Vertical lift fixed wheel type
3	Gate Opening Size	6m (W) x 6m (H)
4	Design Head (m)	40m with increased stresses
Surge Arrangement downstream Powerhouse		
1	Number & Type of gate	2 nos. Surge tunnels
2	Size (LxWxH)	7m dia Horseshoe shape each
3	Surge Gallery Details	1no. 7m dia. Horseshoe inclined gallery with invert at El. 1224.0m to El 1264.0m in slope 1 in 11; 1no. 7m dia. Horseshoe horizontal gallery of length 260m with invert at El.1233m
4	Max. Upsurge level at gate shaft	El. 1264.0m
5	Max. upsurge level at Surge gallery	El. 1264.0m
6	Min. down-surge level at gate shaft	El. 1233.5m
Tail Race Tunnel (TRT)		
1	No. & Type,	1no., Underground,
2	Diameter & Shape	6.5m dia. Horseshoe type
3	Design Discharge	117.15
4	Length	2280m
5	Adit to HRT	6.5m D-Shape, 340m
6	No. of Gates and their size	1 No., 6.0m (W) x 6.0m (H)
7	Type of Gate	Vertical lift fixed wheel type
8	Sill level	El. 1232m
9	Design Head (m)	9m
Tail race outlet structure		
1	Nos	1 no.
2	Invert Level	EL 1235.00 m

3	Normal TWL	EL 1241.00 m
Project Cost		
1	Total Project cost at Dec' 2022 PL	Rs. 2189.61 Cr
2	1 st year Tariff (Completion Level)	Rs. 3.46 per KWH (Combined Tariff)
3	Levellised Tariff (Completion Level)	Rs. 3.96 per KWH (Combined Tariff)
4	1 st year Tariff (As per CERC)	Rs. 6.15 per KWH (Standalone Tariff)
5	Levellised Tariff (As per CERC)	Rs. 5.99 per KWH (Standalone Tariff)

Source: DPR of Uri I Stage-II HEP

2.4.1 Land Requirement

The total land requirement for Uri-I Stage-II HEP is estimated as 114.0335 ha, out of which, 97.0335 ha is non-forest land and 17.0 ha is forest land (for underground project structures). At present required 97.0335 ha of non-forest land is in possession of NHPC that will be utilized for various components of the proposed project. It is proposed to utilize same for various above ground components of Uri-I Stage-II HEP. However, 17 ha of afresh underground forest land is required to be diverted for proposed project.

Therefore, no revenue land (private/ government) is required for the proposed project, no acquisition of private or community assets is required and hence, displacement of the population/ persons is not involved. The details of required forest land and available non-forest land for various components of proposed project is given below in **Table 2.2**.

Table 2.2: Land availability of existing Uri-I Power Station and Land requirement for Uri-I Stage-II HEP

S. No.	Components	Afresh Underground Forest Land (Ha)	Non-Forest Land under Uri-I PS (to be utilized)		Non-Forest Land under Uri-II PS (to be utilized)		Area to be utilized for Uri-I Stage-II HEP (Ha)
			Unit in Kanal & Marla	Unit in Ha	Unit in Kanal & Marla	Unit in Ha	
1	Approach Roads (Includes Existing project Roads and some widening or up gradation)	-	111 Kanal 1 Marla	5.6175	-	-	5.6175
2	Quarry area including Crusher plants area	-	162 Kanal 16 Marla	8.2353	54 Kanal 11 Marla	2.7371	10.9724
3	Muck Dumping area	-	147 Kanal 9 Marla	7.457	186 Kanal 14 Marla	9.4442	16.9012
4	Job facility area/ Construction Facility Area	-	1108 Kanal 17.75 Marla	57.1779	-	-	57.1779
5	Magazine area	-	125 Kanal 16.33 Marla	6.3645	-	-	6.3645
A	Sub-total (Non-Forest Land)	-	-	84.8522	-	12.1813	97.0335
6	Powerhouse (Underground)	7.31	-	-	-	-	7.31
7	HRT (Underground)	7.77	-	-	-	-	7.77
8	TRT (Underground)	1.92	-	-	-	-	1.92
9	TRT Outfall		-	-	-	-	

S. No.	Components	Afresh Underground Forest Land (Ha)	Non-Forest Land under Uri-I PS (to be utilized)		Non-Forest Land under Uri-II PS (to be utilized)		Area to be utilized for Uri-I Stage-II HEP (Ha)
			Unit in Kanal & Marla	Unit in Ha	Unit in Kanal & Marla	Unit in Ha	
	(Underground)						
B	Sub-total (Forest Land)	17.00	-	-	-	-	17.00
TOTAL (A+B)		17.00	-	84.8522	-	12.1813	114.0335

2.4.2 Aggregate Processing Plant and Batching & Mixing (BM) Plant

The peak requirement of concrete and raw aggregates has been estimated to decide the plant capacities for Aggregate Processing (APP) and Batching & Mixing (BM). Total requirement of aggregate for the production of the concrete for the project shall be about 5.5 lacs m³. Since no external source of aggregate supply is available nearby to cater this requirement for the project, it is proposed to install one (1) no. of Aggregate processing Plants of capacity 240 TPH for crushing, screening and washing of coarse and fine aggregate. A major part of the requirement is expected to be met from the excavated rocks. **Table 2.3** shows the number and capacities of aggregate processing and concrete batching & mixing plants.

Table 2.3: Size and location of the aggregate processing and batching plants

S. No.	Site	Nos.	Capacity
1	Aggregate Processing Plant (APP)	01	240 TPH
2	Batching & Mixing (BM) Plant	02	90 Cum/hr

Source: DPR of Uri I Stage-II HEP

Two no. batching plants have been proposed. So, aggregate shall be transported from APP to Batching plant. Storage of suitable capacity shall also be required to be developed near the batching plant. Single centralized cement storage facility can be used for both the Batching Plants.

2.4.3 Quarry Areas

The total requirement of coarse and fine aggregate for the construction of the project has been estimated to be around 3.60 lakh Cum and 1.80 lakh Cum, respectively. To cater the requirement of construction material seven different sites were identified as construction material sources.

Among the seven identified sources, 3 are river shoal or terrace deposits sites, 2 nos. of Rock quarry sites and 2 sites viz. HRT & Powerhouse from where the excavated material will be utilized as construction material. The identified sites with the available quantity is given in **Table 2.4**.

Table 2.4: River Shoal Deposit & Rock Quarries Identified for Construction material.

S. No.	Name of Deposit	Index No.	Distance from site in km		Total Available Quantity (Lakh cum)	Usable Quantity (Lakh Cum)	Remarks
			HRT	PH			
1	Sheeri Shoal Deposit	UR-I St-II G-1	15	35	1.80	1.10	To be used
2	Salamabad nalla shoal deposit	UR-I St-II G-2	21	10	1.6	1.0	To be used

S. No.	Name of Deposit	Index No.	Distance from site in km		Total Available Quantity (Lakh cum)	Usable Quantity (Lakh Cum)	Remarks
			HRT	PH			
3	Naushera Rock Quarry	UR-I St-II R-1	8	24	7.0	4.5	To be used
4	Hajipeer Rock Quarry	UR-I St-II R-2	25	10	5.0	3.0	Reserve
5	Excavated Muck Material of HRT	UR-I St-II R-3	10	10	1.50	1.8	Usable
6	Excavated Muck Material of Powerhouse cavern	UR-I St-II R-4	10	0	1.50	1.0	Usable
7	Mohura P/H Terrace Deposit	UR-I St-II G-3	10	8	1.25	0.80	Reserve

Source: DPR of Uri I Stage-II HEP

- i. **Sheeri village shoal deposit (UR-I St-II G-1):** This deposit is situated about 15 km upstream of Intake site on left bank of Jhelum River along with tributary Mundari nala and is connected with road network. The area of the deposit site is 6.0 ha. This deposit comprises of fragments of angular to sub-rounded boulders, cobbles, pebbles, gravel and sand. Total quantity of material likely to be available from this deposit has been estimated to be 1.80 lakh cum including natural sand out of which 1.10 lakh Cum is usable.
- ii. **Salamabad nala shoal deposit (UR-I St-II G-2):** This deposit is situated about 10 km downstream of PH site on left bank of Jhelum River at confluence of Salamabad nala and is connected to road network. This deposit comprises mainly fragments of angular to sub-rounded boulders, cobbles, pebbles, gravel and sand. Total quantity of material likely to be available from this deposit has been estimated as 1.60 lakh Cum including natural sand out of which 1.0 lakh Cum is usable. However, due to replenishment, the total quantity likely to be available from this deposit may increase. The area of the deposit is 5.4181 ha.
- iii. **Mohura P/H Terrace deposit (UR-I St-II G-3):** This deposit is situated about 10 km downstream of Intake on right bank of Jhelum River and is not connected with road network. This deposit comprises fragments of angular to sub-rounded boulders, cobbles, pebbles, gravel and sand. Total quantity of material likely to be available from this deposit has been estimated as 1.25 lakh Cum including natural sand out of which 0.78 lakh Cum is usable. The area of the deposit is 4.1708 ha.
- iv. **Naushera Rock Quarry (UR-I St-II R-1):** This quarry is situated at the left side of Jhelum River above the National Highway & presently no approach road is available for this rock quarry. This rock quarry contains Meta-volcanic. It is estimated that material available from the quarry shall be 7.0 lakh Cum. The area of quarry is 3.8880 ha.
- v. **Hajipeer Rock Quarry (UR-I St.-II R-2):** This rock quarry is situated on the right bank of Hajipeer nala and presently well connected with road network. This rock quarry contains compacted silt stone/ sandstone. It is estimated that 5.0 lakh Cum of material shall be available from quarry. As material required for the construction of the project is available in nearby source, therefore this source is kept reserved. The area of quarry is 3.4496 ha.
- vi. **Excavated Material from HRT (UR-I St-II R-3):** The excavated material from HRT will be utilized as concrete aggregate. This rock quarry contains Quartzitic schist. It is estimated

about 6.00 lakh Cum total excavated muck will be generated, out of which around 1.80 lakh cum of usable quantity shall be available.

- vii. **Excavated Material of Powerhouse Cavern (UR-I St-II R-4):** Suitable excavated material from powerhouse cavern will be utilized as concrete aggregate. Powerhouse is located on the left side of Jhelum River and presently well connected with road network. Excavated material of powerhouse contains Meta volcanics rocks. It is estimated about 3.50 lakh Cum total excavated muck will be generated, out of which around 1.00 lakh Cum of usable quantity shall be available.

2.4.4 Muck Disposal Areas

The proposed Uri-I Stage-II HE Project (240 MW) is the extension of Uri-I Power Station (480 MW). Uri-I Power Station is a run-of-river project, which was commissioned in 1997 by NHPC Ltd. and has been operating successfully since then. Uri-I Stage-II HEP is planned as per the provision kept in the Detailed Project Report (DPR) of Uri-I Power Station. A parallel separate HRT is proposed to be constructed for Uri-I Stage-II HEP along with surge shaft, pressure shafts and a separate underground powerhouse (near the existing underground powerhouse of Uri-I Power Station) and TRT.

The construction would involve about 11.58 Lakh Cum excavation mainly in rock (Table 2.5). About **2.80 Lakh** of rock received from excavation shall be used for producing coarse and fine aggregate for concrete. Remaining Excavated material would have to be disposed in designated muck disposal areas. Total quantity of 8,78,300 Cum of excavated muck (soil and rock) would have to be disposed in designated muck disposal area, which shall be landscaped after completion of the construction.

Table 2.5: Detail of Muck Generated

S. No.	Location	Quantity (Cum)
A	Quantity of Muck excavated	
1	HRT & Adits	655800
2	TRT, Surge Galleries & Adits	217500
3	MAT and other Adits	49500
4	Surge shaft and construction Adits	48500
5	Pressure Shaft	24400
6	Powerhouse Carvens	162600
	Total	11,58,300
B	Quantity to be utilized	2,80,000
C	Quantity of Muck to be Disposed off	8,78,300

Source: NHPC Ltd.

Keeping the above requirement and vicinity of the excavation sites in view, excavated muck is to be dumped in 4 pre-identified sites with a total area of 16.90 ha and capacity has been worked as 21,11,976 cum (Table 2.6). The 4 pre-identified muck dumping sites are under possession of NHPC Uri-I Power Station & Uri-II Power Station, and these are previously designated for disposal of muck generated during construction of Uri-I Stage-I Project (Refer Figure 2.2). At present all sites designated for disposal of Uri-I Stage-I Project are well restored.

Table 2.6: Detail of Muck disposal sites for Uri-I Stage-II HEP

S. No.	Dumping Yard	Location	Area (Ha)	Capacity (Cum)
1	D1	Lari dumping site	0.85	67,984.0
2	D2	Hiller Peernia dumping site	2.37	1,18,370.0
3	D4	Mohura dumping site	4.24	5,08,992.0
4	D5	Param Pillan dumping site	9.44	14,16,630.0
Total Area			16.90	21,11,976.0

Source: NHPC Ltd.

2.4.5 Explosive Magazine

Explosives are mainly required for open and underground rock excavation. Daily requirement of explosive during peak working month has been worked out as 1.00 MT per day. It will be stored at Explosive Magazine of 60 MT capacity at Kitchama. This Explosive magazine was earlier used by Uri-I and Uri II Power station during construction and can be used for this project as well. The site is located 20 km away from the barrage complex of Uri-I Power Station. It is sufficiently away from the human habitat and working areas as per the explosive and other relevant laws of Indian Explosive Act and rules. One (1) nos. of 10T Explosive van is proposed to be deployed either by hiring from local agencies/ suppliers of explosives or owned by the contractor for transporting explosives from supply depot. Further, on site explosive storage can be made at Barrage complex for HRT works, Adit-1 & 2. Bandi location can serve TRT Adit 6A and Powerhouse location. Explosives are envisaged to procure explosives ex-Jammu, UT of Jammu & Kashmir

All safety codes and regulations prescribed by the central and state government in this respect will be followed and magazines will be suitably guarded round the clock. As laid down in the Explosive Rules, 2008, safe distance will be maintained from public roads, etc.

2.4.6 Construction Material

- i. **Coarse and Fine Aggregate:** For the construction of various project components approximately 3.10 Lakh m³ of coarse aggregate, 1.80 Lakh m³ of fine aggregate is required (**Table 2.7**). As the proposed site is a hard-rocky terrain, excavated material from the project sites will also be used for construction purposes. However, the required balance quantity, if any will be procured from nearby identified Quarry.

Table 2.7: Total requirement of Construction materials for the Project

Construction Material	Unit	Quantity	Source
Aggregates			
Coarse Aggregate	(Lakh Cum)	3.60	Shoal deposit/ Rock quarry and muck excavated from HRT & TRT
Fine Aggregate	(Lakh Cum)	1.80	
Steel	MT	0.13 lacs MT (approx.)	it is envisaged to procure Steel ex-Jammu, UT of Jammu & Kashmir
Cement	MT	1.51 lacs MT (approx.)	it is envisaged to procure cement ex-Jammu, UT of Jammu & Kashmir

2.4.7 Manpower Requirement

About 500 workers (labour and staff) would be engaged temporarily during the peak construction period. It is expected that 20% of the total workforce shall be available from the UT of Jammu & Kashmir. After completion of the project only a staff of about 120 persons shall be permanently required for the operation of the project.

2.4.8 Water Requirement

Water for construction will be drawn from the Jhelum River. Water tanks of adequate capacity will be constructed at each work location and water will be pumped from the river to water tanks. Water tanks of adequate capacity will be constructed near aggregate processing and batching plants to meet the requirement of plants.

2.4.9 Construction Power Requirement

The construction power shall mainly used at Powerhouse, Adits of HRT & TRT, Surge Shaft & Pressure Shaft. Since the Colony of Uri-I Power Station will be used during construction stage, no power will be required for residential, non-residential building and street lighting at the project site. All the project components, construction facility sites and colonies are within a distance of 30 Km.

The power requirement for construction works, lighting of works, office and camp lighting, etc. has been worked out as 4.937 MW.

For various construction activities 11kV supply line to various locations is augmented from 33/11kV Sub Station at Mohura and 33/11kV Sub Station at Buniyar of KPDCL. To provide uninterrupted supply and considering the economy of operating DG sets for varying loads the DG sets of different capacity were also used during construction. The details of the proposed power augmentation at different construction sites through distribution line and DG sets are given in **Table 2.8**.

Table 2.8: Details Construction Power System for Proposed Project

S. No.	Description	Unit	Quantity
1	27 KM (Tentative), 11 KV Transmission line from KPDCL Grid at Vill-Mohura and Boniyar Baramulla-Uri Highway	KM	27
2	5 MVA, 33/11 KV Substation at Mohura	Set	1
3	Total 11/0.415 KV Substation		8
	(a) 01 No, 3MVA, 11/0.415 KV Transformer	No.	1
	(b) 01 No, 2 MVA, 11/0.415 Transformer	No.	1
	(c) 04 No, 1 MVA, 11/0.415 Transformer	No.	4
	(d) 02 No, 500 KVA, 11/0.415 Transformer	No.	2
4	415V Distribution systems including street lighting and underground cabling at Uri-I Stage-II various Sites	LS	LS
5	DG Sets		
	(a) 1x2000KVA & 1x1000KVA, 11KV DG Sets including Control boards synchronizing for Powerhouse locations	Set	2
	(b) 2x1000KVA, 11KV DG Sets including Control boards synchronizing for Surge Shaft & Pressure Shaft locations	Set	2
	(c) 3x1000KVA, 11KV DG Sets including Control boards synchronizing for Adit 1A, Adit 2A & Adit 3A locations	Set	2
	(d) 2x500KVA, 11KV DG Sets including Control boards synchronizing for Adit 6A and TRT outlet locations	Set	2

Source: DPR Uri-I Stage-II HEP

2.5 PROPOSED SCHEDULE FOR APPROVAL AND IMPLEMENTATION

Once the draft EIA report is ready it will be submitted to J&K Pollution Control Board along with the Executive Summary for conducting Public Hearing at the site. The final EIA report

will be prepared after incorporating the feedback received during the public hearing. The final EIA report will be submitted to MoEF&CC for obtaining environmental clearance.

Power Potential for Uri-I Stage-II HEP was accorded by Central Electricity Authority (CEA) vide letter no. File No.CEA-HY-12-20/3/2021-HPA Division dated 20.03.2021. It is proposed to complete the project and commission the two units of 120 MW within 44 months.

2.6 TECHNOLOGY AND PROCESS DESCRIPTION

The proposed project is extension of Uri-I Power Station, it is a Run-of the River hydropower project that envisages the construction of 10.472 km long HRT with 6.50 m diameter, surge shaft, pressure shaft, an underground powerhouse complex and 2.28 km long TRT with one 6.5 m dia.

The construction cost and time depend to a great extent on the technology and methodology adopted to carry out the construction work. As there are several alternative methods/ equipment, due care must be exercised in the selection of the most efficient construction method/equipment to optimize construction cost and time. A balanced approach will be followed to optimize construction cost and construction period after comparative evaluation of price escalation and interest during construction versus lost benefits due to delay in completion. Mechanized construction has been planned for almost all types of construction activities to achieve consistent quality at a faster progress rate. The sequencing of construction activities, wherever possible, has been attempted in such a way that equipment from one activity, on its completion can be shifted to the other. This way, the total requirement of equipment at a time would be reduced and enough utilization of equipment on the project would be ensured.

2.7 PROJECT DESCRIPTION

Project description has already been covered in detail in section 2.4. Details of infrastructure facilities which were not covered in section 2.4 are provided in ensuing paragraphs.

2.7.1 Approach to the Project

The project site is located near Boniyar Town which is well connected by road i.e. located on National Highway 1 (NH1) connecting Uri, district Baramulla, J&K to rest of India via. Jammu and Srinagar. All the operational barrage and reservoir and Powerhouse site is located along the left bank of Jhelum River adjacent to NH1.

The nearest airport is located in Srinagar. The nearest rail head is Udhampur located about 265 km from Barrage complex near Boniyar Town. However, as on date operational rail network to connect the UT of J&K is to rest of the country is up to Katra from Jammu and from Banihal to Baramulla. The construction work of train route from Katra to Banihal is in progress. The Jammu-Baramulla line railway track is being laid to connect the Kashmir valley in the Indian Union territory of Jammu & Kashmir railway station and then to the rest of the country. The 356km railway track will start from Jammu and reach to Baramulla.

2.7.2 Project Roads and Bridges

The Uri-I Stage-II HEP utilizes the existing barrage, water conveyance system consisting of Head regulator upto HRT intake located on the left bank of Jhelum River are well connected to parallel to NH1. Similarly, the adits of Uri-I Stage-I HE Project are planned as such to utilize during construction of HRT of Uri-I Stage-II are also well connected to road network. The proposed powerhouse and TRT outlet are located alongside of Uri-I Stage-I HE Project powerhouse and TRT outlet which also approachable through existing project road connected to NH1. Therefore, no additional road construction is envisaged for the development of Uri-I Stage-II HEP.

2.7.3 Infrastructure Facilities

2.7.3.1 Medical Facilities

Medical facilities are available at Boniyar and Uri-Town. The district hospital at Baramulla is about 30 km from the project area. NHPC Hospital at Gingal Colony under Uri-I Power Station is also functional.

In addition to this the medical care and emergency needs during construction period workers, it is proposed to establish a well-equipped medical Clinic/ First Aid post to take care of any construction-related injuries, common sickness, and medical emergencies, under the charge of a Medical Officer of NHPC Hospital at Gingal Colony supported by sufficient support staff. Well-equipped ambulances shall also be provided near construction sites.

2.7.3.2 Sanitation and Sewage

The existing facilities like offices, workshops, laboratories, and other work-occupied buildings will be provided with toilets, water supply, and regularly maintained septic tanks of Uri-I Power Station will be utilized during Uri-I Stage-II HEP construction and operation period.

The contractor camp sites will be provided with a properly maintained and operated sewage system including septic tanks and sewage disposal facilities. Facilities for washing clothes will be provided and linked to the sewage system. Adequate sanitary installations and portable toilets and sewage treatment arrangements will be provided in the main camp as well as in the labour camps. Adequate arrangements shall be provided for water storage and piped water supply to the temporary camps and various activity centers.

2.7.3.3 Project Colonies

a) Permanent Colony: No new permanent colony and additional infrastructure is required to execute the proposed Uri-I Stage-II HE Project. The existing offices, residential colony, field hostels, transit camps of Uri-I Power Station shall be utilized by NHPC staff during construction and operation of Uri-I Stage-II HE Project.

b) Temporary Camps and Accommodation: Based on manpower requirement, temporary camps and other accommodation has been planned for contractor's establishments. The contractor provides facilities like labour camps, community mess, recreation center,

community common amenities like toilets, bathrooms and washing space, etc. for executives and non-executives. The land within possession of NHPC near Construction site shall be utilized for temporary accommodations.

2.7.3.4 Telecommunication Facilities

Presently, telecommunication facilities at Project area are very good. Multiple operators such as BSNL, Airtel, Vodafone, Jio are providing telephone/ Mobile services in the project area. Apart from these, EPBX facility and walkie talkie are also available in the project area.

2.8 MITIGATION MEASURES INCORPORATED INTO THE PROJECT

- i. **Minimizing Loss of Flora:** For the construction of Uri-I Stage-II a total of 114.0335 ha land will be required. Out of which, required 97.0335 ha non-forest land is in possession of NHPC. The proposed project envisaged diversion of afresh 17.0 ha underground forest land for construction of HRT, powerhouse, pressure shaft, surge shaft, surge galleries and TRT. Therefore, loss of vegetation cover has not been envisaged due to the land acquisition and construction activities.
- ii. **Minimizing loss of agricultural land and No Displacement:** The 97.0335 ha non forest land required for the project is already in possession of NHPC, therefore there is no loss of agriculture land or human displacement due to construction of the project.
- iii. **Sedimentation of the Reservoir:** The existing reservoir and water conductor system upto HRT intake including desilting basins of Uri-I Power Station is utilized for proposed Uri-I Stage II HE Project. The reservoir is under operation since 1997 and no changes are envisaged due to construction of stage-II project. The problem of siltation will not be serious as the incoming sediment during monsoon when enough water is available will be regularly sluiced to downstream through spillway.

To minimize the inflow of sediments into the reservoir, engineering as well as bio-engineering measures are proposed under Catchment Area Treatment Plan.

- iv. **Seismicity & Earthquake:** The Uri-I Power station area falls under Seismic Zones IV as per seismic zoning map of India published by Bureau of Indian Standards [IS 1893 (Part I):2016]. Seismic design parameters for the Uri Power station were evaluated by DEQ-IIT Roorkee and the project was constructed as per the recommended seismic design parameters. Uri-I PS had sustained a strong earthquake of magnitude 7.4 that occurred in October 2005 without any damage.

Seismic safety of Uri-I Power Station Barrage is being continuously monitored through SMAs installed at barrage area. The accelerographs are connected with the Real Time Seismic Data Centre (RTSDC) established at NHPC Corporate Office, Faridabad for real time recording and monitoring of the Earthquake events taking place in the vicinity of the project. In addition, as per norms of CWC, safety inspections of Uri-I Power Station Barrage have been carried out by NHPC biannually (in pre-monsoon and post-monsoon) since commissioning. Moreover, detailed dam safety review panel was also conducted as per DSRP norms in 2019-20 after completion of twenty years of successful operation of the

project. No seismicity related issue has been reported in the project by the review panel even after occurrence of devastating Muzaffarabad Earthquake of 2005 in close proximity.

In the proposed project, Head Race Tunnel, Underground Powerhouse and Tail Race Tunnel shall be designed considering the seismic factors as per existing provisions.

2.9 ASSESSMENT OF NEW & UNTESTED TECHNOLOGY FOR THE RISK OF TECHNOLOGICAL FAILURE

Hydropower projects are based on tested technology and there is no risk of technology failure in this project.

Chapter 3

DESCRIPTION OF THE ENVIRONMENT

Environmental Impact Assessment assess the potential physical, biological, and socio-economic impact of the proposed project in a manner that allows for a logical and rational decision to be made about the proposed action. Environmental baseline data is basic requirement to define, understand and assess the potential impacts of a project on physical, biological, and social environment in the immediate vicinity of the project as well as in the area around the project and its components.

Environmental Baseline data is collected to serve two purposes in the EIA study. First, it helps us understand the current environmental conditions of the area, and how the project needs to be implemented considering these conditions. Second, and most importantly, it helps us assess and predict the possible environmental changes that could occur, once the project is underway.

The parameters have been selected according to the approved Terms of Reference (ToR) issued for this project by Expert Appraisal Committee (EAC) of the Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India as part of scoping clearance vide letter no. J-12011/08/2021-IA-I dated 10th June 2021 for 240 MW installed capacity (refer to Annexure I).

Environmental components are described based on the primary and secondary data collected during the study period and discussed in the ensuing text.

3.1 STUDY AREA, PERIOD, COMPONENTS & METHODOLOGY

3.1.1 Study Area

The study area for the collection of data on various baseline environmental parameters has been defined as per the Terms of Reference (TOR) issued by EAC, MoEF&CC, Govt. of India as part of scoping clearance.

The Uri-I Stage-II HE Project is the extension of Uri-I HEP. The project study area is delineated as the area within a 10 km radius of major project components like exiting Barrage site, proposed Powerhouse, Head Race Tunnel and 10 km downstream of the Tailwater discharge point of Uri-I Stage-II HEP (refer to **Figure 3.1**).

3.1.2 Study Period

The field surveys for the collection of primary data were conducted between September 2021 and May 2022 covering monsoon, winter, and pre-monsoon/summer seasons to collect data/ information on terrestrial ecology and physical environment. Entire baseline data collection work was carried out ensuring social distancing and following government Covid-19 directives. The details of the sampling schedule is given in **Table 3.1**.

During the survey ground-truthing was carried out for refining land use/ land cover maps. For this purpose, various attributes such as land features, rivers, forests, and vegetation types were observed on the ground.

Table 3.1: Sampling schedule for various Environmental Parameters

Parameters	Monsoon	Winter	Summer/ Pre-Monsoon
Soil	September 2021	January 2022	May 2022
Air Environment	September 2021	January 2022	May 2022
Noise & Traffic	September 2021	January 2022	May 2022
Water Quality	September 2021	January 2022	May 2022
Vegetation	September 2021	January 2022	May 2022
Fauna surveys	September 2021	January 2022	May 2022
Socio-economic survey of Project affected villages	May 2022		

3.1.3 Study Components

The baseline data presented in this chapter has been prepared from primary data collected during field studies which were then supplemented with data/information gathered during interaction with concerned persons of various government departments, available literature and reports published by various institutions and organizations. The baseline data collected during study include:

- **Physical Environment:** It covers land, air, and water environment. It includes a description of physiography, drainage, geology, land use/ land cover, meteorology, soil, ambient air quality, noise/ sound levels and average daily traffic, water quality (surface as well as groundwater), and groundwater development.
- **Biological Environment:** It covers both floral and faunal components, terrestrial and aquatic. It describes forest type, floristics as well as faunal diversity, the occurrence of RET species if any, and the presence of sensitive ecosystems like any notified Protected Areas in the vicinity of the proposed project.
- **Socio-economic Environment:** It provides the overall socio-economic profile of the villages located in the study area and the district/s in which the project is located. It also describes the socio-economic status of project-affected villages. It covers aspects like demography, social structure, literacy, working population, infrastructure, amenities, educational and health facilities, presence of any archaeological and/or religious sites, etc.

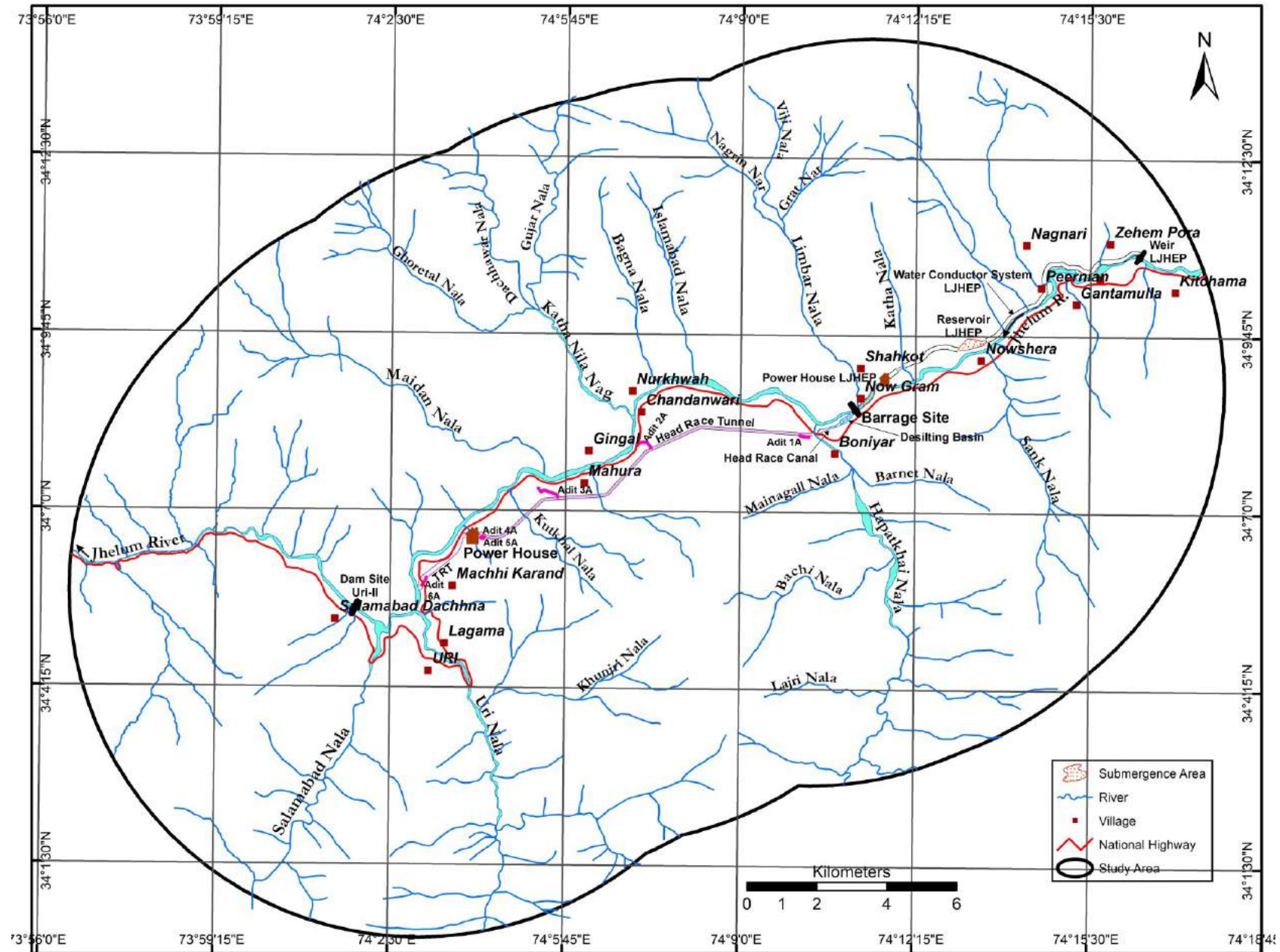


Figure 3.1: Map showing the study area of Uri-I Stage-II HEP

3.1.4 Methodology

Baseline data on environmental parameters were collected at two levels - primary and secondary. Primary data generated from sampling done during field surveys for physical and chemical attributes of soil, surface as well as ground water quality, ambient air quality, noise, and traffic and sampling and surveys for collection of data on floral and faunal elements covering terrestrial as well as the aquatic environment. In addition to primary surveys conducted as mentioned above, substantial secondary data was also collected through interaction with various state and project officials and sourced from published reports and literature. The sources for secondary data so collected have been mentioned below:

- Soil map has been digitized and produced using soil maps collected from National Bureau of Soil Survey & Land Use Planning, Regional Centre, New Delhi.
- For the preparation of land use/ land cover map of the study area, digital data on land use/land cover thematic maps prepared by National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO) of Dept. of Space, Govt. of India with Ecology, Environment & Remote Sensing, Govt. of J&K as partner under Natural Resource Census (NRC) project of National Natural Resource Repository (NRR) programme was used.
- Landsat 8 data for the generation of FCC and the refinement of Land use/Land cover.
- Meteorological data for Temperature, Relative Humidity, Rainfall, Wind Speed, and Wind Direction were downloaded from <https://www.worldweatheronline.com> for the last 10 years (reference year 2012-2021).
- 'A Revised Survey of the Forest Types of India' by Champion and Seth (1968) was used for forest type classification of forests in the study area
- Office of Divisional Forest Officer, Forest Working Plan, Jhelum Valley Forest Division, Union territory of Jammu & Kashmir for documentation of flora and fauna in the study area.
- For Conservation status of flora and fauna reported from the area, IUCN ver. 2022-2, BSI published RED data book of Indian Plant and IWPA (1972) has been consulted.
- National Ambient Air Quality Series: NAAQMS/36/2012-13, Guidelines for the measurement of Ambient Air Pollutants.
- Water Quality Criteria of Central Pollution Control Board (<http://www.cpcb.nic.in/WaterQualityCriteria.php>).
- For describing the socio-economic profile of the study area, the primary data was supplemented with secondary data like District Statistical Handbook, District Baramulla (2018-19), Village Amenity Directory (2018-19) District Baramulla, District Census Handbook (2011), Baramulla, Series -2, Part-XIIA & B published by Directorate of Census Operations, Union territory of Jammu & Kashmir were consulted.
- Hydrology and Geology section of the report was supplemented by data available in Detail Project report (DPR) of Uri-I Stage-II HEP (240 MW), prepared by NHPC Ltd.

3.1.4.1 Physical Environment

a. Soil

To assess the soil fertility at different locations in the study area the soil sampling locations/ sites were selected using land use/land cover map prepared as above and

accordingly soil samples were collected from 6 locations (refer **Table 3.2** and **Figure 3.2**) covering different land uses like the forest, scrub land, plantation, and fallow land, etc. The sampling site locations on the map are given later in the chapter under the section on soil describing soil characteristics. Soil samples were collected with help of *Khurpi* from a depth of 15cm below from the surface after removing the grasses and litter, foreign material like roots, stones, pebbles, and gravel. Samples were collected in a polythene bag and were brought to the laboratory for analysis for physical and chemical characteristics at the AGSS Analytical and Research Lab Pvt. Ltd., Delhi (NABL accredited Lab.). These parameters were analysed as per the standard procedures given by Bureau of Indian Standards (BIS).

Table 3.2: Soil sampling locations

Site Code	Sampling Location	Land Use
S1	Near Masjid Shareef Jawing Nowshera	Forest Area
S2	Near Barrage Site	Plantation Area
S3	Near Boniyar Nalla-Jhelum River confluence	Forest Area
S4	Muck dumping Site near Mahura (Mohra) Village	Fallow Land
S5	Near Powerhouse Site	Forest Area
S6	Near TRT Site	Scrub Area

The following parameters were analysed for soil

Texture - Sand (%), Silt (%) and Clay (%)	Calcium (mg/kg)	Nitrogen (kg/ha)
Porosity (%)	Magnesium (mg/kg)	Salinity (ppt)
Bulk Density (g/cc)	Alkalinity (mg/l)	Sodium (mg/kg)
Water Holding Capacity (%)	Chloride Content (mg/kg)	Organic Carbon (%)
pH	Potassium (kg/ha)	Phosphorus (kg/ha)
Electrical Conductivity (μ S/cm)	Sodium Adsorption Ratio	

b. Air Environment

The ambient air quality monitoring sites were selected based upon the wind roses in different seasons (given later in the chapter) and was done at 6 locations in the study area (refer to **Table 3.3** and **Figure 3.2**), during the Monsoon, Winter and Pre-monsoon seasons by the RSET team with the help of a team of NABL accredited Laboratory (AGSS Analytical and Research Lab Pvt. Ltd., Delhi).

Ambient air quality monitoring was carried out for Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO₂), PM₁₀, and PM_{2.5}. Air quality monitoring was carried out conforming to the National Ambient Air Quality Standards (2009) for Industrial Residential, Rural & Other Areas, and Ecologically Sensitive Areas. The location of the monitoring station was finalized keeping in view the proposed construction area, wind direction, and villages in the vicinity.

Table 3.3: Sites for ambient air quality monitoring in the study area

Site Code	Monitoring Location	Remarks	Co-Ordinates
AQ1	Army Camp near Limber Village	Residential area	34° 8'55.04" N 74°11'58.27" E
AQ2	Barrage Site	Residential area	34° 8'39.57" N 74°11'12.07" E
AQ3	Chandanwari Village	Residential area	34° 8'42.92" N 74° 7'9.87" E
AQ4	NHPC Complex (Gingal Village)	Residential area	34° 7'49.90" N 74° 6'6.50" E
AQ5	Powerhouse Site	Residential area	34° 6'51.17" N 74° 4'1.80" E
AQ6	Gurudwara near TRT Site	Residential area	34° 5'41.85" N 74° 2'59.35" E

c. Sound Levels & Traffic Monitoring

Sound levels were monitored during the studies at various locations in the study area. Monitoring locations were selected keeping in view the project activity area along the roadside and the location of receptors. The monitoring was carried out during Day time (7.00 am to 10.00 pm) and Night-time (from 10.00 pm to 12.00 am and from 5 am to 7 am). The exercise was carried out for 6 to 8h in the said time frame of day and night. All the monitoring sites are located along the roads and names of monitoring sites are given in **Table 3.4** and **Figure 3.2**.

Table 3.4: Sites for Sound and Traffic monitoring in the study area

Site Code	Monitoring location	Co-Ordinates
NT1	Gantamulla Payeen - National Highway-1A	34° 9'2.39" N 74°12'29.12" E
NT2	Near Boniyar Town- National Highway-1A	34° 8'11.00" N 74°10'36.80" E
NT3	Near NHPC Conly at Gingal Village- Village Road	34° 7'48.73" N 74° 6'24.14" E
NT4	Near Powerhouse Site- National Highway-1A	34° 7'2.08" N 74° 4'25.73" E
NT5	Near Gurudwara (Param Pilla)- Village Road	34° 5'36.10" N 74° 3'2.53" E
NT6	Machhi Karand Village - National Highway-1A	34° 5'24.53" N 74° 3'24.63" E

Traffic volume data was recorded by physically counting the number of different types of vehicles passing through a point in a fixed time interval. In some major villages along the road, towns were considered as nodes for monitoring the movement of traffic. The analysis of traffic counts provides an estimate of average daily traffic (ADT). To convert recorded vehicles into a common scale, the passenger car units (PCUs) equivalent factor as per IRC: 64 -1990 was adopted.

d. Water Environment

The data on water quality has been collected to evaluate surface water quality of Jhelum River and its tributaries and ground water quality in the study area.

i. Surface Water Quality

The sampling for water quality and aquatic ecology parameters was done at the locations given in **Table 3.5** and shown in **Figure 3.3**.

Table 3.5: Sampling Sites for Surface Water Quality and Aquatic Ecology

Site Code	Sampling Location	Co-Ordinates
SW1	Jhelum River Upstream of Reservoir area	34° 9'0.59"N 74°12'2.97"E
SW2	Jhelum River: Reservoir area near Barrage Site	34° 8'42.40"N 74°11'9.01"E
SW3	Boniyar Nalla: Downstream of Barrage site	34° 8'13.24"N 74°10'25.62"E
SW4	Jhelum River: Near Gingal Village	34° 7'46.00"N 74° 6'32.00"E
SW5	Jhelum River: Downstream of Tailrace Outfall	34° 5'48.63"N 74° 3'4.81"E

ii. Groundwater Quality

For assessing Groundwater samples were collected from spring water in the study area. The location of the sampling points is given in **Table 3.6** and **Figure 3.3**.

Table 3.6: Sampling Sites for Ground Water Sampling

Site Code	Sampling Location	Source	Co-Ordinates
GW1	Near Mahura (Mohra) Village	Spring Water	34° 7'44.50"N 74° 6'30.90"E

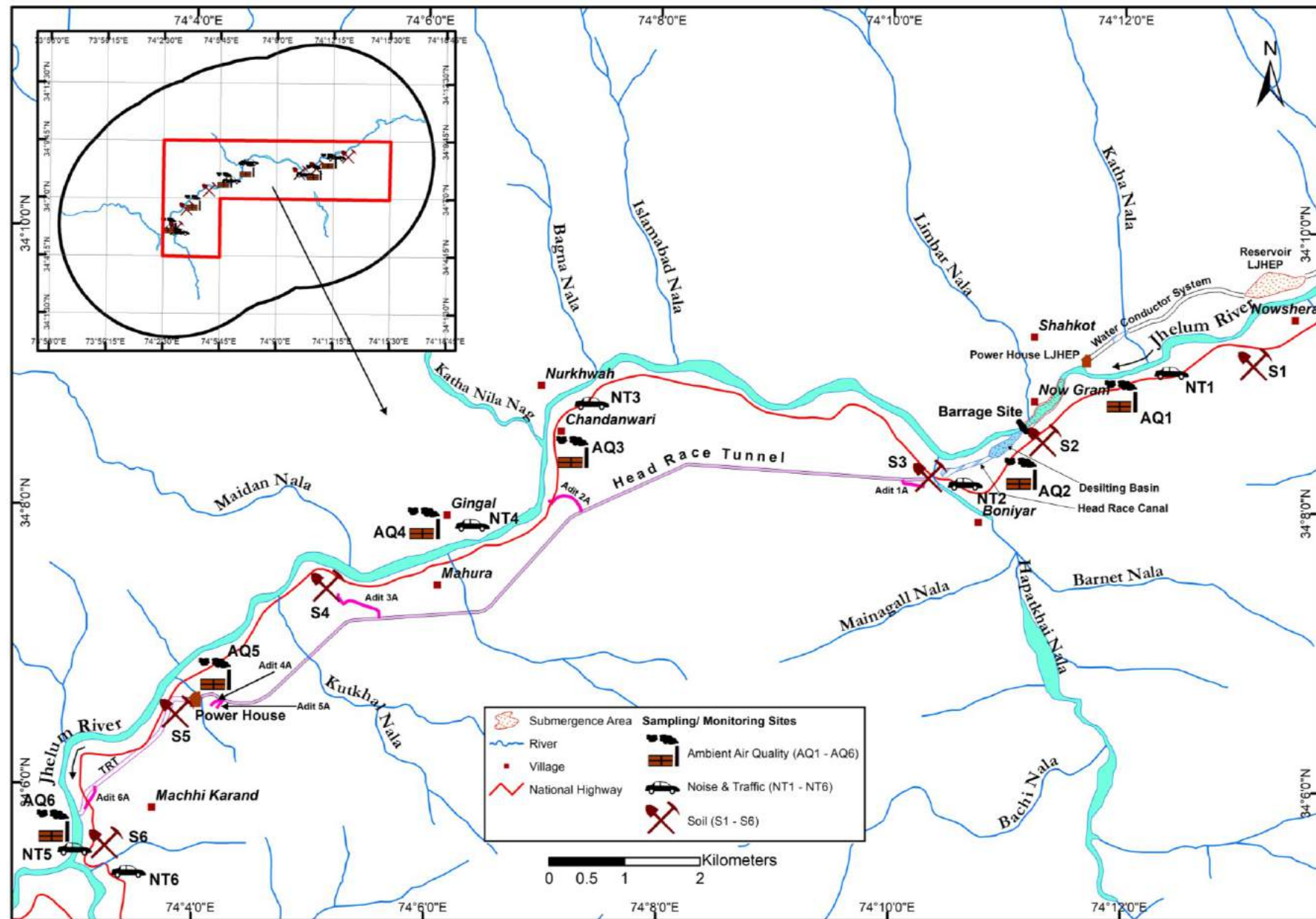


Figure 3.2: Map Showing Sampling/Monitoring Locations of Soil, Ambient Air Quality and Noise & Traffic

Sampling Parameters

Water temperature, hydrogen ion concentration (pH), Electrical Conductivity (EC), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), and Turbidity were recorded in the field. Phoenix Professional Waterproof pH Meter for pH and Temperature Probe Backlight Built with Automatic Compensation (Model pH-035) for temperature while EC and TDS were measured using probes of Hanna instruments (Model HI 98130) and Lutron PDO-520 Dissolved Oxygen Meter was used for Dissolved Oxygen. Turbidity was measured using Secchi disc. The water samples were collected in polypropylene bottles from the different sampling sites and brought to the laboratory for further analysis after adding formalin as a preservative. The turbidity was measured with the help of the Digital Turbidity meter and other parameters such as total alkalinity, total hardness, chloride, nitrate, phosphate, and silica were analyzed at the AGSS Analytical and Research Lab Pvt Ltd, Delhi (NABL accreditation of the Lab). These parameters were analysed as per the standard procedures given by Adoni (1980) and APHA (1992) and Bureau of Indian Standards (BIS): IS 3025 (1983): Indian Standard: methods of sampling and test (physical and chemical) for water used in industry (2007).

3.1.4.2 Biological Environment

The sampling for vegetation and faunal elements was carried out mostly around various project component areas. For vegetation, traditional quadrat sampling was used and for mammals and birds transect surveys were conducted.

a) Phyto-sociological Studies

Phyto-sociological studies were undertaken to understand the community structure i.e., species composition, their density, abundance, dominance, and diversity at different locations in the study area in three seasons.

i. Sampling Site Selection

The study has been conducted covering the locations of proposed project components. Vegetation sampling was done to cover different land use/ land cover categories like Forest, Scrubland, fallow/abandoned land, etc. Phytosociological surveys of the vegetation were conducted at 6 sampling locations. The selection of sampling sites for vegetation analysis was based on the land use pattern in the study area. A list of sampling locations is given in **Table 3.6 and Figure 3.3**.

Table 3.7: Sampling Locations for Vegetation Sampling

Site Code	Sampling Location
V1	Near Gantamulla village, left Bank of Jhelum River
V2	Around Barrage Site of Uri-I Power Station
V3	Downstream area of Barrage site: Left Bank of Jhelum River
V4	Near Gingal Village: Left Bank of Jhelum River
V5	Near Powerhouse site: Left bank of Jhelum River
V6	Downstream of Uri-I Power Station Tail Race Outfall



ii. **Sampling Methodology**

Standard methods of vegetation sampling were used for quantitative analysis of community structure. The quadrats (a sampling unit) of different sizes were used depending upon the habitat. For sampling of trees at each sampling location 10 quadrats were laid with a quadrat size of 10m x 10m. In the case of shrubs quadrats of 5m x 5m were laid while for herbs quadrat size of 1m x 1m was used. For shrubs and herbs, 10 quadrats were laid at each sampling site. At each site, an area was demarcated where the quadrats were laid randomly to ensure maximum possible representative coverage of the vegetation of the area. In each quadrat laid for trees, shrubs, and herbs, individuals of each plant species present were counted.

The data thus obtained was compiled in tabular form and analysed for different attributes like density, frequency, and basal cover (basal area).

The density was calculated as follows:

$$\text{Density} = \frac{\text{Total no. of individuals of a plant species recorded from all quadrats}}{\text{Total number of quadrats laid}}$$

$$\text{Abundance} = \frac{\text{Total no. of individuals of a plant species recorded from all quadrats}}{\text{Total number of quadrats of occurrence of a species}}$$

$$\text{Frequency (\%)} = \frac{\text{Number of quadrats of occurrence of a species}}{\text{Total number of quadrats laid}} \times 100$$

A/F Ratio was calculated to understand the dispersion pattern of tree species in the area following Cottam and Curtis (1956). A/F ratio <0.025 indicates regular distribution, between 0.025 and 0.05 indicates random distribution while >0.05 indicates clumped or contagious distribution.

Calculation of Dominance & Diversity Indices

Dominance: For calculation of dominance, Total Basal area/cover of trees was calculated by measuring the 'dbh' (the circumference at breast height) of each individual tree belonging to different species, which was then converted into the basal area using the formula as follows:

$$\text{Basal area} = \pi r^2$$

where r value was calculated from dbh using the formula $\text{dbh} = 2 \pi r$

The data on density and basal cover obtained above was then converted into per ha.

The **Importance Value Index (IVI)** for trees was determined by following per Curtis, 1959, and has been calculated by following formula.

$$\text{IVI} = \text{Relative density} + \text{Relative Frequency} + \text{Relative Basal Cover}$$

A/F Ratio was calculated to understand the dispersion pattern of tree species in the area following Cottam and Curtis (1956). A/F ratio <0.025 indicates regular distribution, between 0.025 and 0.05 indicates random distribution while >0.05 indicates clumped or contagious distribution.

Species diversity (H') of the vegetation was calculated by using the Shannon-Wiener Diversity Index (1963).

The species diversity was computed by using the Shannon-Wiener Diversity Index as:

$$H' = - \sum (n_i/n) \times \ln (n_i/n)$$

Where ' n_i ' is the individual density of a species and ' n ' is the total density of all the species.

$$\text{Evenness Index (E)} = H' / \ln(S)$$

Where, H' is Shannon-Wiener Diversity index; S is number of species in a quadrat.

b) Faunal Surveys

The faunal survey was carried out for the species of Mammals, Birds, Herpetofauna, and butterflies. The study area was divided into different strata based on topography and vegetation cover. The coverage of the study area was hampered by the inaccessibility of certain areas due to inaccessible terrain. Sampling for habitat and animals was done in same location selected for floral sampling. Coordinates of sampling trails used for faunal surveys are given in **Table 3.6 and Figure 3.3**. The normal systematic transects for mammals and birds were not possible in this study area due to difficult terrain, so maximum numbers of smaller trails were used for faunal sampling.

For the preparation of the checklist of faunal species, the Forest Working Plan of the Jhelum Valley Forest Division, UT of J&K was consulted. In addition, data was compiled from published literature like Prater (1998) for mammals, Daniel (2002) for reptiles, and Ali & Ripley (1983) for birds.

i. Sampling Methodology & Constraints

A systematic field visit was carried out in the study area during day hours. The survey of wild animals was conducted by using 10x50 prismatic field binocular and handheld GPS 72 in different locations. The presence of wildlife was also confirmed by the local inhabitants depending on the animal sightings and the frequency of their visits in the catchment and study area. In addition to these, secondary sources mainly literature was also referred for preparing checklists and other analysis in the study of animals and wildlife in the region.

c) Aquatic Ecology

The samples for aquatic ecology sampling were collected from same five locations (SW1-SW5) from where samples for physico-chemical parameters were collected (**Table 3.5**). Among the aquatic organisms sampling for phytoplankton (periphyton), phytobenthos, zooplankton, and macro-invertebrates were undertaken during the field surveys in three seasons in the Jhelum River and its tributaries.

Sampling Methodology

i. Phytoplankton (Periphyton) and Zooplankton

For the quantification of 'plankton' both Phytoplankton (periphyton) and zooplankton water samples were collected as follows. For each community at each site separately 50 liters of water was filtered by using a plankton net made up of fine silk cloth (mesh size 25 μm). Repeated the process three times at each site and pooled the samples as a composite

sample. Collected the filtrates in separate sample bottles for phytoplankton and zooplankton and adding 1% Lugol's Iodine solution to the samples as a preservative.

ii. Phytobenthos and Zoo-benthos

For phytobenthos sampling was performed across the width of the river at the depth of 15-30 cm. Took grab samples from the accessible banks only. Picked pebbles (64 - 128 mm size) about 4-5 in number, from the riffle and pools, in different flows such as stones above and below gushing waters, swift flow, and slow flow conditions to obtain a representative sample. Collected samples of benthic diatoms samples by scraping the pebbles with a brush of hard bristles to dislodge benthos from crevices and minute cavities on the boulder surface from an area of 3 x 3 cm², using a sharp-edged razor. Collected the scrapings from each cobble in 25μ mesh and transferred them to storage vials. Preserved samples of phytobenthos separately in 1% Lugol's Iodine solution.

Collected samples for Macro-invertebrate samples from a 1 sqft area by the lifting of stones and sieving of substratum from the wide able portion of the river. Sieved the material through a 125 μm sieve and preserved in 70% ethyl alcohol. Collected samples in three replicate and pooled them for further analysis.

iii. Identification of Phytoplankton & Zooplankton

For preparing permanent mounts from the treated samples, smeared the slide first smeared Mayer's albumen. Agitated the sample to render it homogeneous. Placed a drop of known volume (0.04 ml) of the processed material on the slide quickly and heated it gently till it dried. Dehydrated it using 95% and 100% alcohol, consecutively. Transferred the dehydrated material to Xylol twice before finally mounting in Euparal.

Analysed the permanent mounts under a phase-contrast binocular microscope using an oil immersion lens of x 100 magnification. For identifying the various diatom species, varieties, and forms, used morphological characteristics like length, width (μm), number of striae, raphe, axial area, central area, terminal, and central nodules. Identification was done using standard literature (Schmidt 1914 - 1954, Hustedt 1943, Hustedt 1985, Krammer & Lange - Bertalot 1986, 1991, 1999, 2000 a & b, Lange - Bertalot, H. Krammer, K. 2002, Metzeltin & Lange - Bertalot 2002, Krammer 2000, 2003, Lange Bertalot *et al.* 2003, Werum & Lange - Bertalot 2004., Metzeltin *et al.*, 2005). For Oriental species consult Sarode & Kamat (1984), Prasad (1992), and Gandhi (1998).

Took the help of laboratory at CISMHE, the University of Delhi for the slide preparation and identification of phytoplankton as well as zooplankton and adequately store the permanent mounts there. **The taxonomic classification and nomenclature of algal species (Phytoplankton) were done as per <http://www.algaebase.org/>.**

The identification of Zooplankton was done with the help of Ward and Whipple (1959) and Battish (1992) and was classified as per <https://www.itis.gov/>.

iv. Calculation of Density of Phytoplankton and Zooplankton

After the removal of supernatant plankton free water, the settled phytoplankton and

zooplankton were separately enumerated by the 'Sedgewick-Rafter Counting Chamber' method. Identification of zooplankton species was performed under the microscope by using keys and monographs of standard references like Ward and Whipple (1959) and Battish (1992).

For samples that were preserved in 1% Lugol's Iodine solution, acid treatment was done according to Reimer (1962) method adopted earlier by (Nautiyal & Nautiyal 1999, 2002) to process the samples for light microscopy. The treated samples are washed repeatedly to remove traces of acid. Samples were treated with hydrogen peroxide with high organic content to clean the diatom frustules. The permanent mounts were prepared in Naphrax for further analysis. They were examined using a BX-40 Trinocular Olympus microscope (x10 and x15 wide field eyepiece) fitted with a Universal condenser and PLANAPO x 100 oil immersion objective under bright field using appropriate filters to identify the species.

The density of different taxa was calculated as follows:

- a) Density of phytoplankton (cells/lit)
- b) Density of phytobenthos (cells/cm²)
- c) Density of zooplankton (Indiv./lit)

$$\frac{\text{No. of individuals in 1 ml} \times \text{Sample volume (ml)}}{\text{Volume of water filtered (liters)}}$$

Total count of cells × cover glass size/length of the visual field of microscope × counted rows × total sample volume (ml)/observed sample / sampled area

Species Diversity Index (Shannon-Wiener 1963): The Shannon diversity indices are determined based on counts (500 - 600 valves).

Shannon-Wiener Diversity Index H' = $-\sum (ni/n) \times \ln (ni/n)$

'Where ' ni ' is the individual density of a species and ' n ' is the total density of all the species

v. Identification of Macro-invertebrates (Zoo-benthos)

The organisms collected and preserved during site visits were counted after identifying them up to the family and genus level. Standard keys were used for the identification of macro invertebrate samples (Pennek 1953; Edmondson 1959; Macan 1979; Edington and Hildrew 1995). The classification of macro-invertebrates was followed as per <https://animaldiversity.org/>.

vi. Fish Fauna

To understand the fish diversity in the study, experimental fishing was carried out at different locations in Jhelum River and its tributaries within the study area. In addition to primary data collection, secondary data were also gathered from villagers and owners of fish hatchery located along Boniyar River. Department of Fisheries and published literature were also consulted regarding fish and fishereis in Jhelum River and its tributaries in the study area.

3.2 ESTABLISHMENT OF BASELINE FOR VALUED ENVIRONMENTAL COMPONENTS

A. Physical Environment

The description of physical environment deals with geomorphology, hydrology, meteorology, soil characteristics, ambient air, noise, and traffic monitoring, and water quality.

3.2.1 Physiography

Physiography is one of the important characteristics to realize the landscape of any area. To understand the topography of the study area, the Digital Elevation map, Relief map, and Slope map were prepared from the Digital Elevation Model (DEM) of Shuttle Radar Topography Mission (SRTM) 3 Arc-Second Global Digital Terrain Elevation Data (DTED). Data was downloaded from <https://earthexplorer.usgs.gov/> from which mask of the study was extracted to prepare above mentioned thematic maps.

Accordingly, Digital Elevation Model (DEM) was generated from SRTM data and the same is given in **Figure 3.4** and according to it, the study area lies between EL 1116m and EL 3893m elevation.

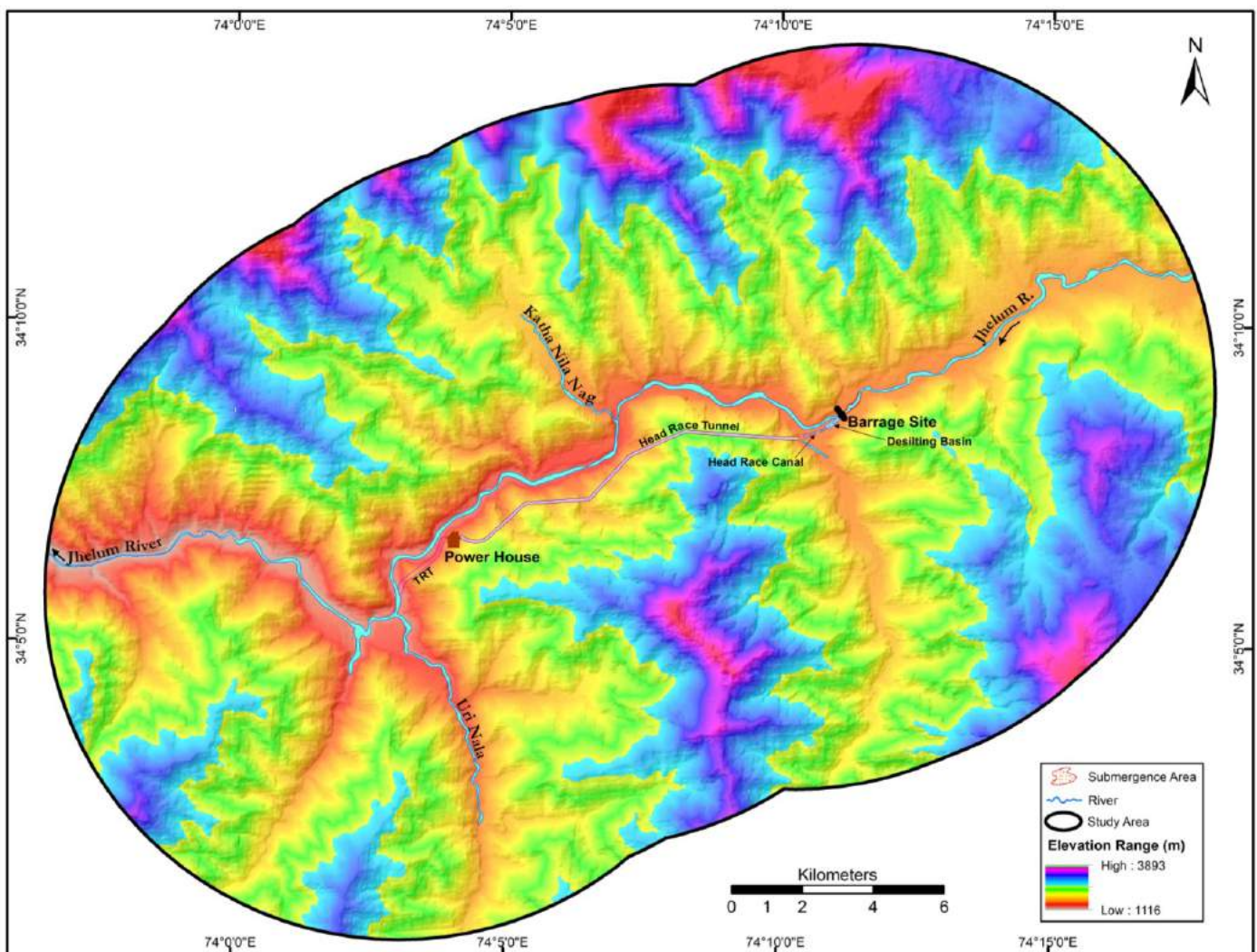


Figure 3.4: Digital Elevation Map of the Study Area

From the DEM, then relief map of the study area was prepared. The data on relief is given in **Table 3.8** and **Figure 3.5**. The majority of the study area lies in the EL 1500m to EL 3000m elevation band.

Table 3.8: Area under different elevation bands in the Study area

S. No.	Elevation Range (m)	Area (sq km)	Area (%)
1	Upto 1500	40.50	6.57
2	1500 - 2000	181.78	29.51
3	2000 - 2500	210.45	34.16
4	2500 - 3000	137.63	22.34
5	3000 - 3500	40.94	6.65
6	Above 3500	4.74	0.77
	Total	616.04	100.00

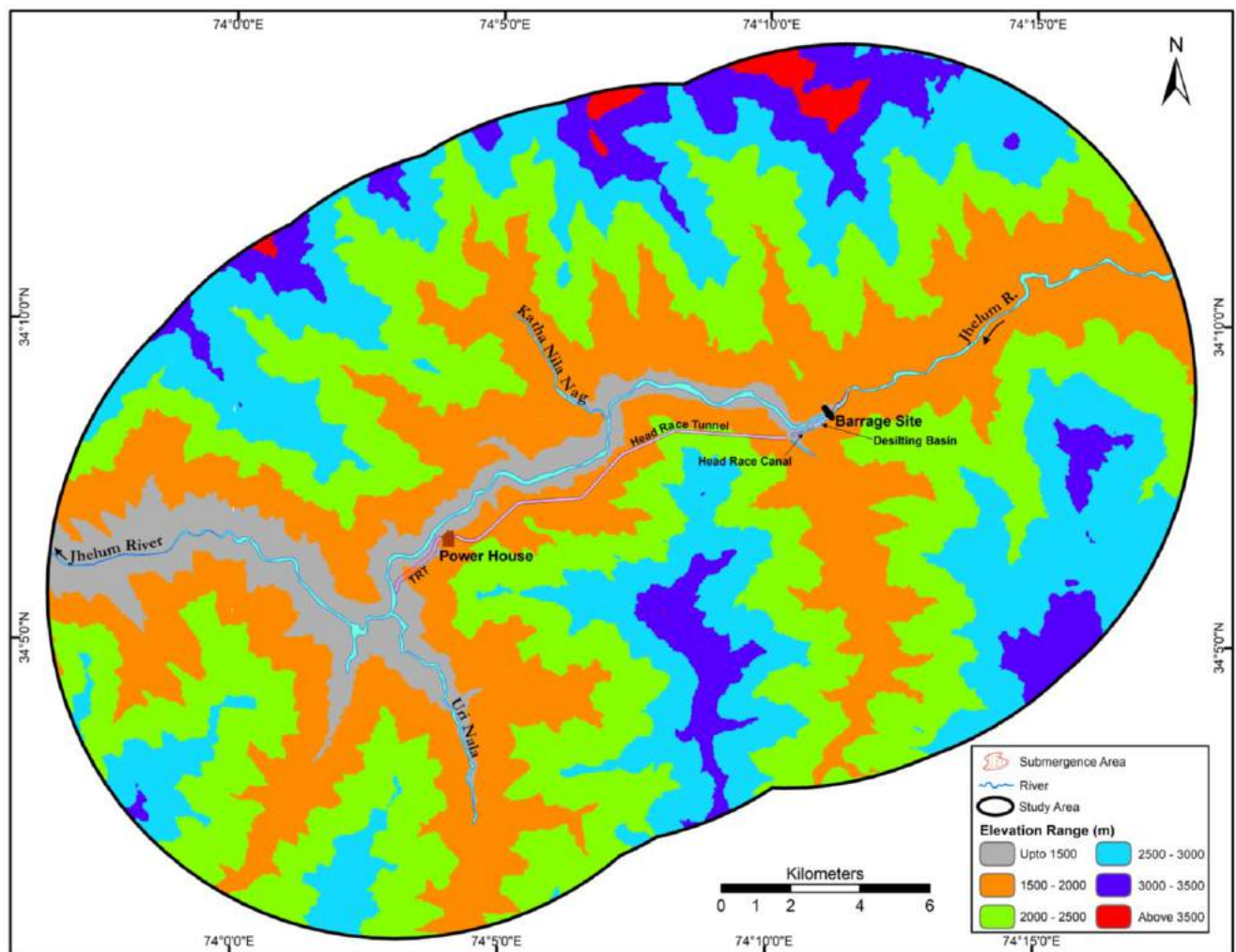


Figure 3.5: Relief Map of the Study Area

The slope map of the study area and data are given in **Table 3.9** and **Figure 3.6** shows that predominantly the study area is moderately sloping. As seen from the map and the table that around 44.7% of the study area falls under the steep category.

Table 3.9: Area under different slope categories in the Study Area

S. No.	Slope Category (Degree)	Area (sq km)	Area (%)
1	Gently Sloping (Upto 2)	4.10	0.67
2	Moderately Sloping (2 – 8)	23.85	3.87

S. No.	Slope Category (Degree)	Area (sq km)	Area (%)
3	Strongly Sloping (8 - 15)	45.41	7.37
4	Moderately Steep (15 - 30)	222.73	36.16
5	Steep (30 – 45)	275.40	44.70
6	Very Steep (45 – 60)	43.58	7.07
7	Extremely Steep (60 – 70)	0.95	0.15
8	Escarpment (Above 70)	0.04	0.01
	Total	616.04	100.00

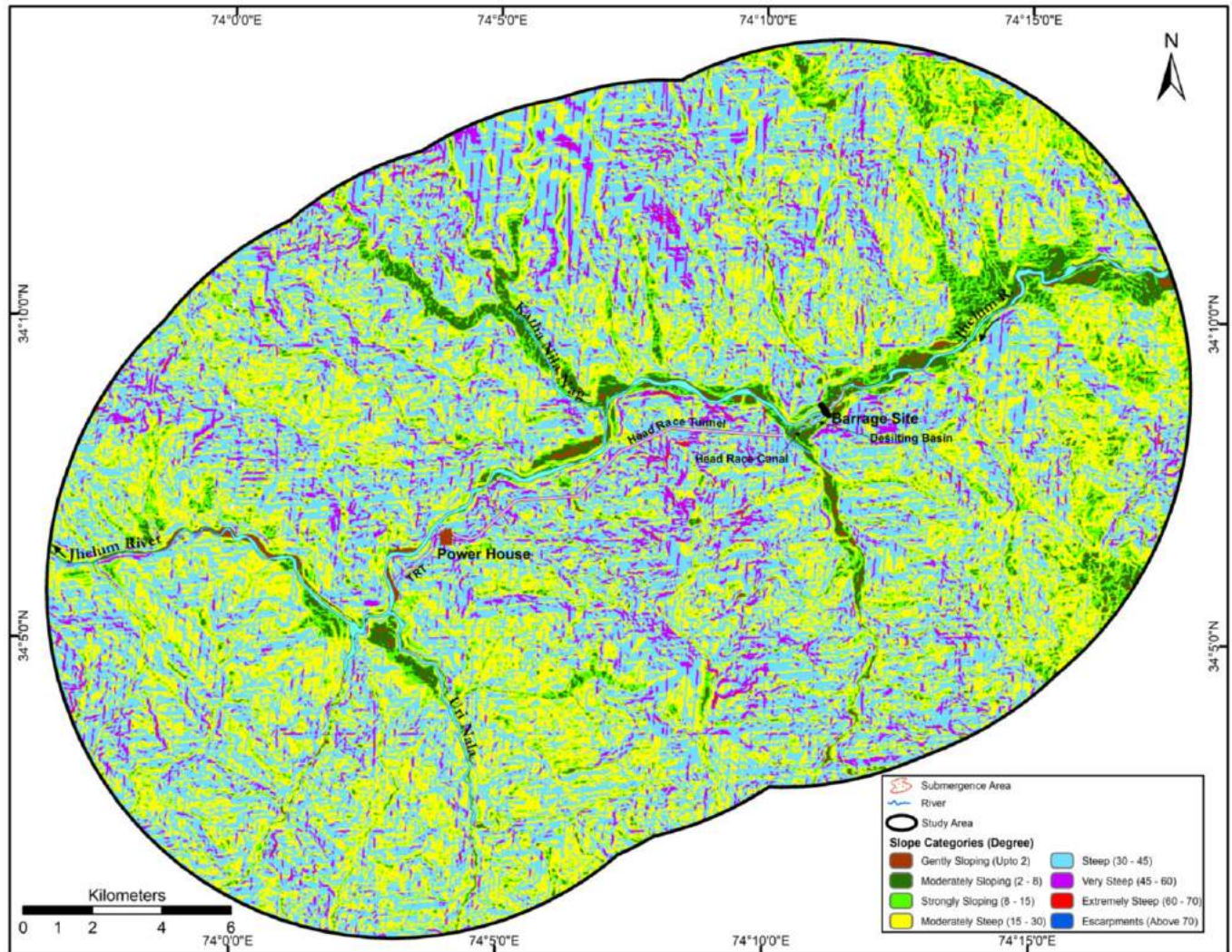


Figure 3.6: Slope map of the Study Area

3.2.2 Land use and Land cover

For the preparation of land use/ land cover map of the study area, digital data on land use/land cover thematic maps prepared by National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO) of Dept. of Space, Govt. of India with Ecology, Environment & Remote Sensing, Govt. of J&K as partner under Natural Resource Census (NRC) project of National (Natural) Resource Repository (NRR) programme was used. The land use /land cover classes are based upon the classification criteria of NRSC/ISRO's land use criteria document. However, the data was refined using information from False Colour Composite (FCC) generated using bands 3, 4 and 5 of LANDSAT 8 digital satellite data of Path 149 and Row 36 dated 2nd December 2021 (**Figure 3.7**), ground truth collected during field surveys and latest imagery of the study area on Google Earth Pro.

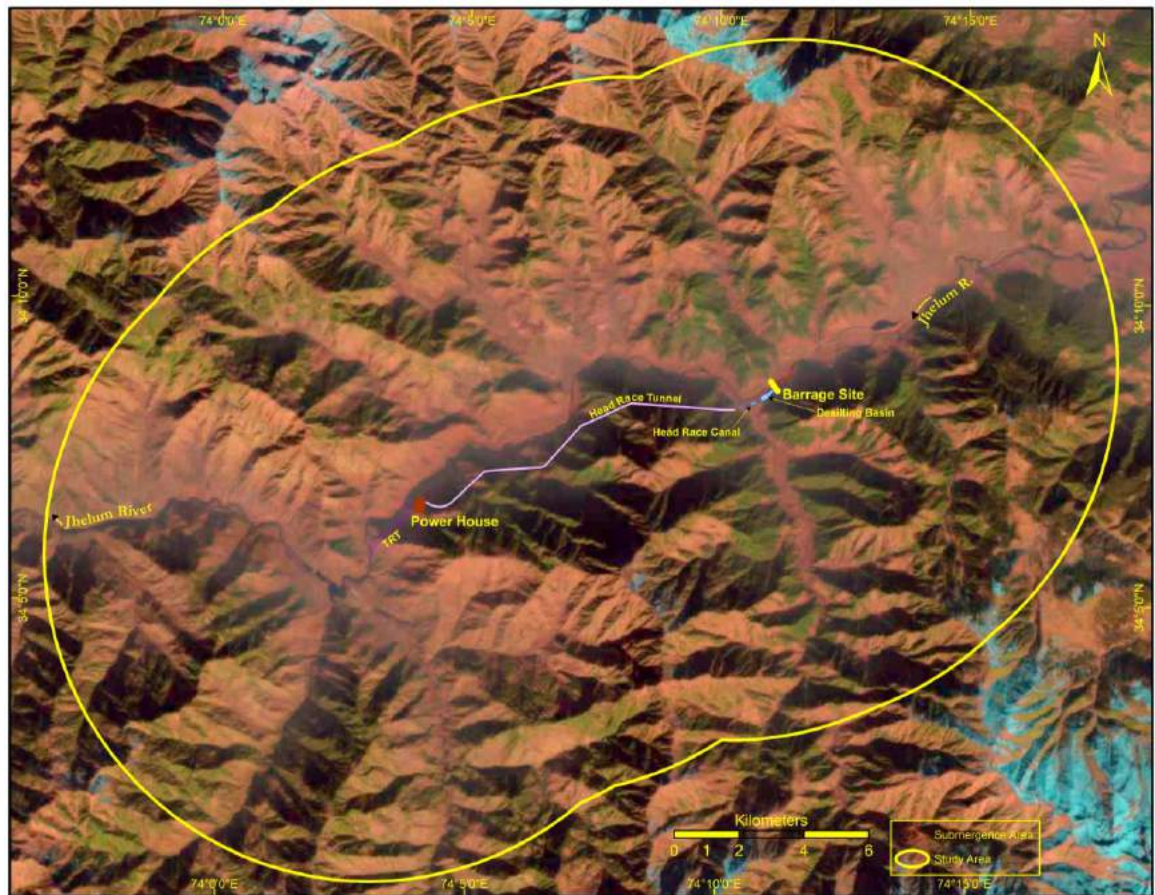


Figure 3.7: FCC generated from Satellite imagery of the study area

The land use/land cover classes were followed as per the NRSC classification. The land use/land cover map of the study area is shown in **Figure 3.8**. The land use/land cover of the study area is classified into 9 different classes. Evergreen/ Semi-Evergreen Forest constitutes predominant land use in the study area (about 45.0%), followed by scrub forest which constitute about 21.0% of the total study area (see **Figure 3.8** & **Table 3.10**). Scrub land covers around 19.0% of the study area. Water body covers around 1.17% and Snow/Glacier is comprised of 0.60%. of the study area.

Table 3.10: Area under different land use/ land cover classes in the Study Area

S. No.	Landuse/ Landcover Class	Area (sq km)	Area (%)
1	Evergreen/ Semi Evergreen Forest	277.26	45.01
2	Scrub Forest	135.14	21.94
3	Grazing Land	6.92	1.12
4	Scrub Land	118.02	19.16
5	Baren Rocky	31.1	5.03
6	Agricultural Land	30.96	5.03
7	Settlement	5.76	0.94
8	Snow/ Glacier	3.69	0.6
9	Waterbodies	7.19	1.17
	Total	616.04	100.00

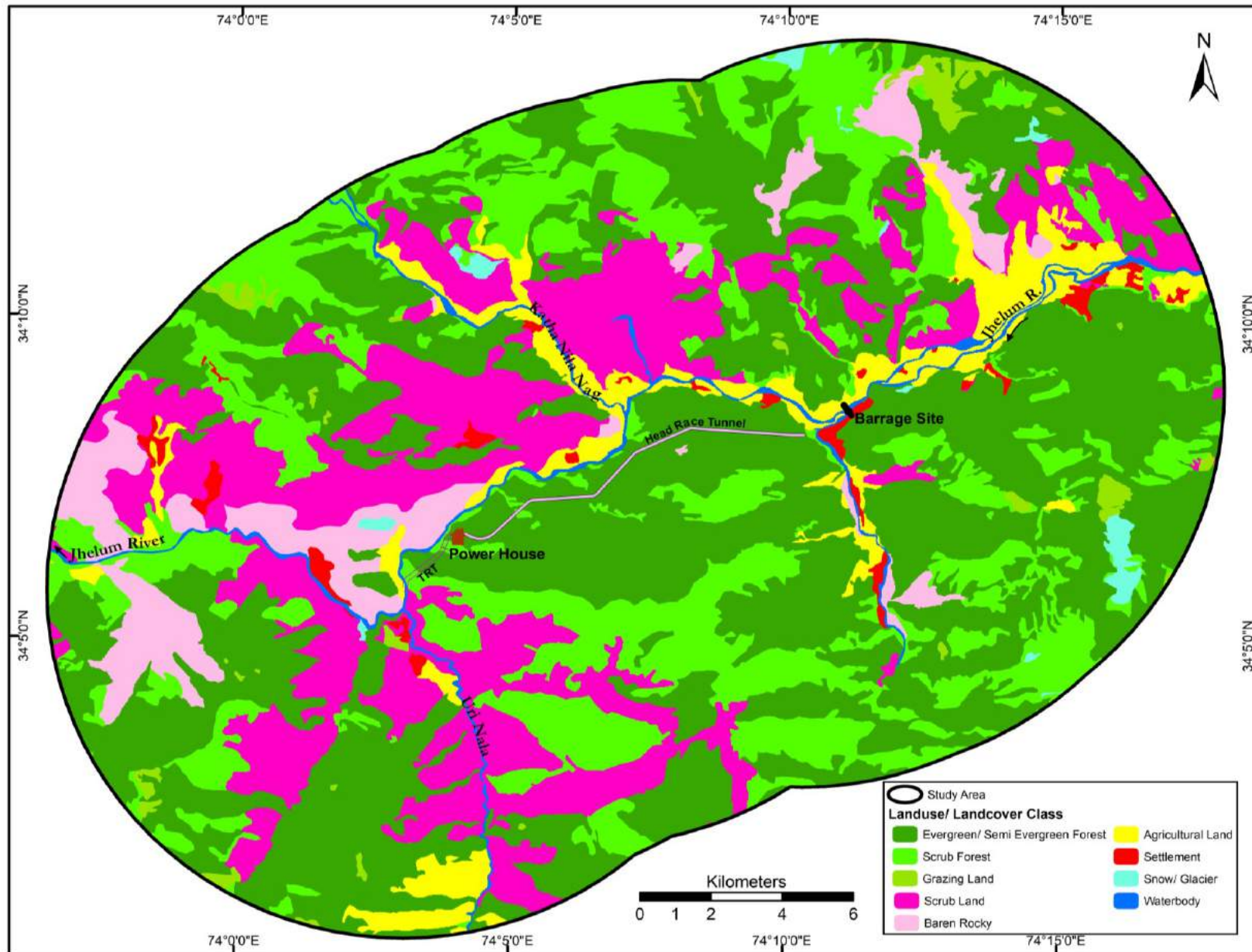


Figure 3.8: Land Use/ Land Cover map of the study area

3.2.3 Geology

The project area comprises of variety of rock formation ranging in age from Precambrian to recent alluvium. Uri-I Stage-II Hydroelectric Power project is an extension of Uri-I Power Station is located on the eastern part of the Kashmir syntaxial bend of the northwest Himalaya where the arcuate ridges are aligned nearly along NESW. The project area lies in Survey of India Toposheet No. 43 J/4 and is bounded between latitude 34°06' to 34°09' and longitude 74°03' to 74°12'. Regional geological map of project area has been prepared from the Geological survey of India online portal "bhokosh.gsi.gov.in" and appended as **Figure 3.9**.

Geologically, the area exposes rocks of Salkhala Formation, Dogra Group, Pir Panjal Group, Kazinag Granite, Palaeozoic basics, Subathu Formation, Murree Group, Karewa Group and undifferentiated Quaternary deposit. Jhelum River flanked on either side by the rocks of Dogra ($\equiv$ Boniyar) Group with faulted contact in the north and thrust contact (Chhulan Thrust) in the south, which is concealed under Quaternary sediments. The stratigraphic succession around project area (After D.N. Wadia) and progress report no. 1 of the preliminary geological investigations for Uri Hydel Project, Baramulla Distt. J & K, Field Season 1973-74, which is given as under.

Stratigraphic Succession of Kashmir Valley.

Formation	Litho Units	Age
Jhelum fill	Silt, sand, riverine / Fluvio glacial deposits	Quaternary
Murree Group	Interbedded sandstone, siltstone and shales	Oligo-Miocene
-----Murree Thrust-----		
Nummulitic Group	Shale, Limestone	Eocene
-----Panjal Thrust-----		
Wuyah/khrew Khunamuh Group	Limestone outlier	Triassic
-----Sheared / Faulted Contact (CT)-----		
Panjal volcanics	Vesicular & compact basalt	Permian
-----Sheared / Faulted Contact (CT)-----		
Tanawal Group	Quartzitic Schist, Quartzite, Phyllite	Proterozoic

3.2.3.1 Geology of the project area of Uri-I Stage-II HEP

During the investigation and construction stage of Uri-I Stage-I Project, rock types of quartzitic schist, metavolcanics, limestone & shale intercalations have been encountered in HRT, TRT & Powerhouse area. The quartzitic schist and metavolcanics are metamorphosed with well-formed foliation planes as Joint Set-1. The rocks are steeply dipping at 65° to 85° and also show reversal of dips at places.

3.2.3.2 Geology of Head Race Tunnel (HRT)

Proposed HRT alignment is expected to negotiate bedrock of predominantly quartzitic schist with metavolcanics sills in the initial reaches up to RD $\pm$ 6000 M. From RD $\pm$ 6000M onwards up to Surge shaft, the entire HRT will be negotiated through bedrock of metavolcanics in fair to good rock mass. The quartzitic schists are thinly to moderately foliated whereas metavolcanics are thinly foliated in nature. The rock mass is dissected by four joint sets viz S1:350/80°, S1A:270/80°, S2: 220-240/70°, S3: 060°/70°, S4: 130-150°/25° and few random joints.

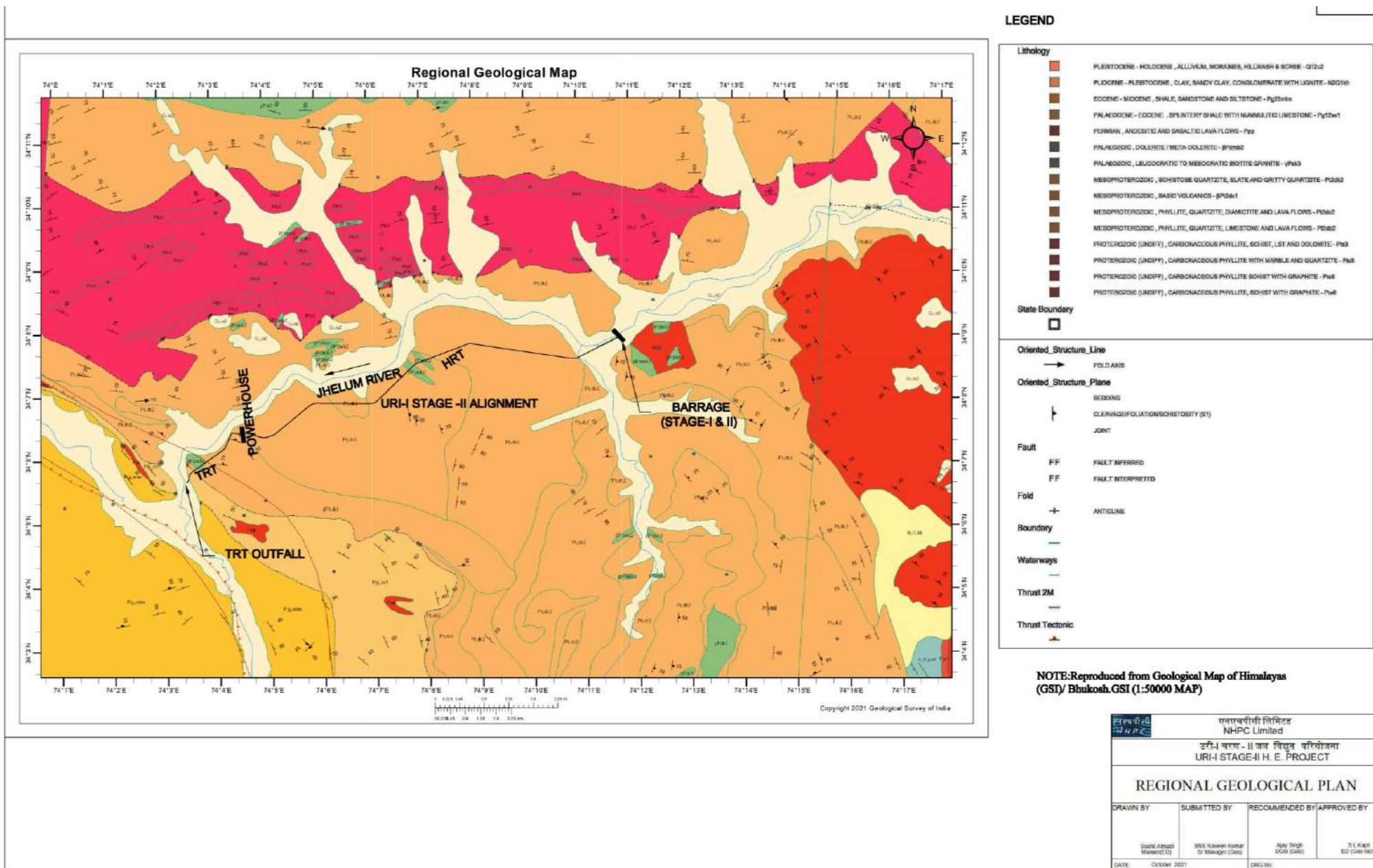


Figure 3.9: Geological Map of Project Area

3.2.3.3 Geology of Underground Powerhouse

Main powerhouse cavern (Machine Hall) is proposed adjacent to existing stage-I Powerhouse at distance of 40m. The average vertical cover above the proposed and existing cavern is 275m. Entire cavern will be excavated in hard and competent bedrock of metavolcanics. The bedrock is moderately jointed and strong to very strong in nature. The rock mass is dissected by predominantly foliation planes and three other joints sets. Major foliation plane (S-1) observed in the powerhouse area is $350^{\circ}/65-80^{\circ}$, while other joint sets observed were S-2: $220-240^{\circ}/65-80^{\circ}$, S-3: $155^{\circ}/25^{\circ}$, S-4: $060-080/25$, and other random joints viz. $060/70$, $300/80$ $210^{\circ}/30^{\circ}$. The longer axis of the cavern (N 347°) has been oriented orthogonally (88°) with respect to the strike of foliation and has been kept at a reasonably low angle (37°) w.r.t the direction of maximum principal stress direction (N 310°).

3.2.3.4 Geology of Tail Race Tunnel

The proposed 6.5 dia, 2.25 Km long horseshoe shaped TRT of stage-II is aligned on valley side and running parallel to the existing stage-I TRT. The TRT is located on left bank of Jhelum River with TRT out fall near Bandi Village. TRT would be negotiating rock types like metavolcanics, limestone, phyllites/schists, graphitic schist and variegated shales. The rock mass is dissected by four joint sets viz. S1: $010/35-70^{\circ}$, S2: $240/70^{\circ}$, S3: $060^{\circ}/80^{\circ}$, S4: $300^{\circ}/80^{\circ}$. In the initial stretch from RD 0M to RD ± 500 M, strong to very strong thinly foliated metavolcanics rock will be encountered. The reach from RD ± 500 M to ± 800 M will negotiate weathered rock mass of graphitic schist with intermittent bands of metavolcanics. The rock mass relatively improves from RD ± 800 m to RD ± 1150 m with the occurrence of mainly metavolcanics rocks with intermittent bands of schist. The strong competent rock mass of metavolcanics is interpreted from RD ± 1150 m to RD ± 1500 m. From RD ± 1500 m to RD ± 1800 m the tunnel would be expected to negotiate the fractured and sheared rock mass of metavolcanics and limestone/ schist/ shale intercalations. Beyond ± 1800 m, the tunnel will be negotiating entirely in weak to medium strong, weathered rock mass of variegated shales.

3.2.3.5 Seismicity

The Uri-I Power station area falls under Seismic Zones IV as per seismic zoning map of India published by Bureau of Indian Standards [IS 1893 (Part I):2016]. Seismic design parameters for the Uri Power station were evaluated by DEQ-IIT Roorkee and the project was constructed as per the recommended seismic design parameters.

Seismic safety of Uri-I Power Station Barrage is being continuously monitored through shape memory alloys (SMAs) installed at barrage area. The accelerographs are connected with the Real Time Seismic Data Centre (RTSDC) established at NHPC Corporate Office, Faridabad for real time recording and monitoring of the Earthquake events taking place in the vicinity of the project. In addition, as per norms of CWC, safety inspections of Uri-I Power Station Barrage have been carried out by NHPC biannually (in pre-monsoon and post-monsoon) since commissioning. Moreover, detailed dam safety review panel was also conducted as per DSRP norms in 2019-20 after completion of twenty years of successful operation of the project. No seismicity related issue has been reported in the project by the review panel even after occurrence of devastating Muzaffarabad Earthquake of 2005 in close proximity.

In the current proposal existing diversion structures of Barrage complex and already built HRT intake will be used for Stage-II also and the proposed HRT, TRT and powerhouse are located within the same regime of existing similar structures commissioned in 1997. Hence, further additional studies are not required.

3.2.4 Hydrology

3.2.4.1 Catchment Area

Uri-I Hydroelectric Project, a runoff the river scheme, is situated on river Jhelum in Uri Tehsil of Baramulla district of UT of Jammu & Kashmir. The Jhelum is the principal water-way of Kashmir originate from a spring called Verinag. The Jhelum is joined by numerous small mountain streams from the Pir Panjal Range separating the Kashmir valley from the plains in the southwest and by some tributaries from the Great Himalayas in the northeast. From Sangam to Srinagar, the Romshi draining western ranges & Watalara & Arapal tributaries draining eastern ranges join river Jhelum. Downstream of Srinagar, the Sindh flowing from the east joins river Jhelum on its right bank opposite Shadipur. The Sindh River drains the north-eastern ranges of Pir Panjal from Amarnath Cave to Zojila and Ganderbal. Doodh Ganga & Shali Ganga drain the western ranges south of Gulmarg. They also drain partially through supplementary flood channel to river Jhelum downstream of Srinagar. Finally, these nallahs drain into Wular Lake. Ningli nallah drains the hill side to the north of Gulmarg. It meets river Jhelum on the left bank after it emerges from Wular Lake.

From its junction with the Sindh River, the Jhelum River continues its north-easterly course upto the Wular lake situated towards the north end of the valley of Kashmir. Wular Lake lying between Bandipora and Sopore is the largest freshwater lake in India. The surface area of lake varies between about 175 km² at highest water stage (EL 1580 m) down to 60 km² at low-water stage in wintertime. After leaving Wular Lake, the Jhelum River flows in a south-westerly direction to Baramulla, receiving midway the waters of Pohru river, the drainage of the north Kashmir valley. From Baramulla to Muzaffarabad, the valley is narrow and confined by the spurs of two mountain ranges. The river Jhelum follows a westerly course and at Domel near Muzaffarabad, the Kishanganga, falls into it.

The catchment area of the Jhelum River at the Uri-I Barrage is fan shaped and has an area of 12,750 km². About 20 percent of the catchment lies downstream of Wular Lake. The highest peaks in the Jhelum catchment reach above EL 5000 m, but most of the area is located between elevation EL 1400 and EL 4000 m. Catchment Map of Jhelum Basin up to Uri-I Barrage Site has been placed as **Figure 3.10 & Figure 3.11**.

3.2.4.2 Water Availability

The water availability series from 1994-95 to 2019-20 (26 years) has been approved by CWC Hydrology (N) Directorate vide their file no. T-11025/1//2021-HYD(N) Dte, dated 15-03-2021. The average annual yield for the series Jun-94 to May-20 is computed as 8080 Mcum (i.e. 633.7 mm).

3.2.4.3 Submergence

The 21.5 m high barrage is a run-off the river scheme having reservoir extending about 950m along river Jhelum. The present gross storage capacity & surface area of reservoir are 23.71 Ham & 6.19 Ha at FSL after 22 years of operation as per latest post Monsoon 2018

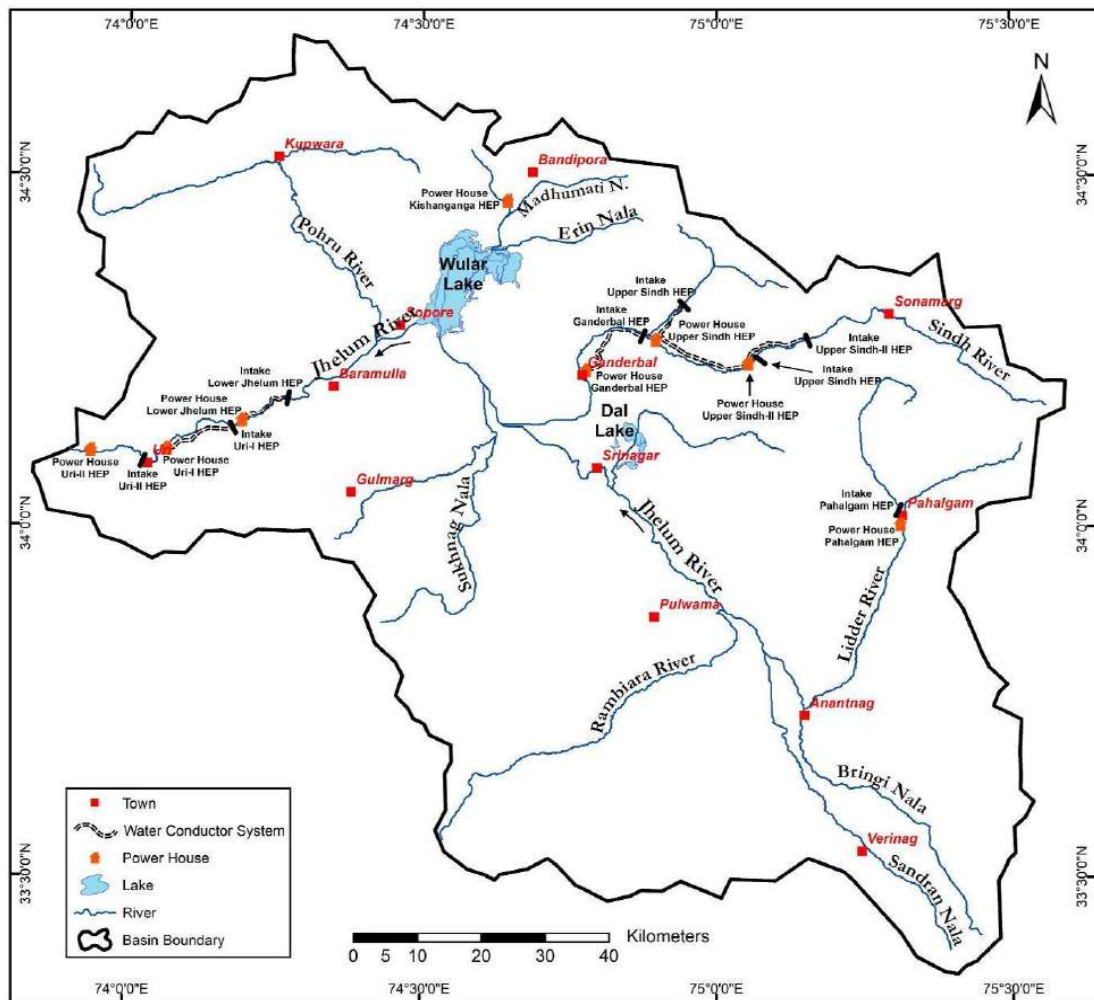


Figure 3.10: Drainage map of Jhelum Basin

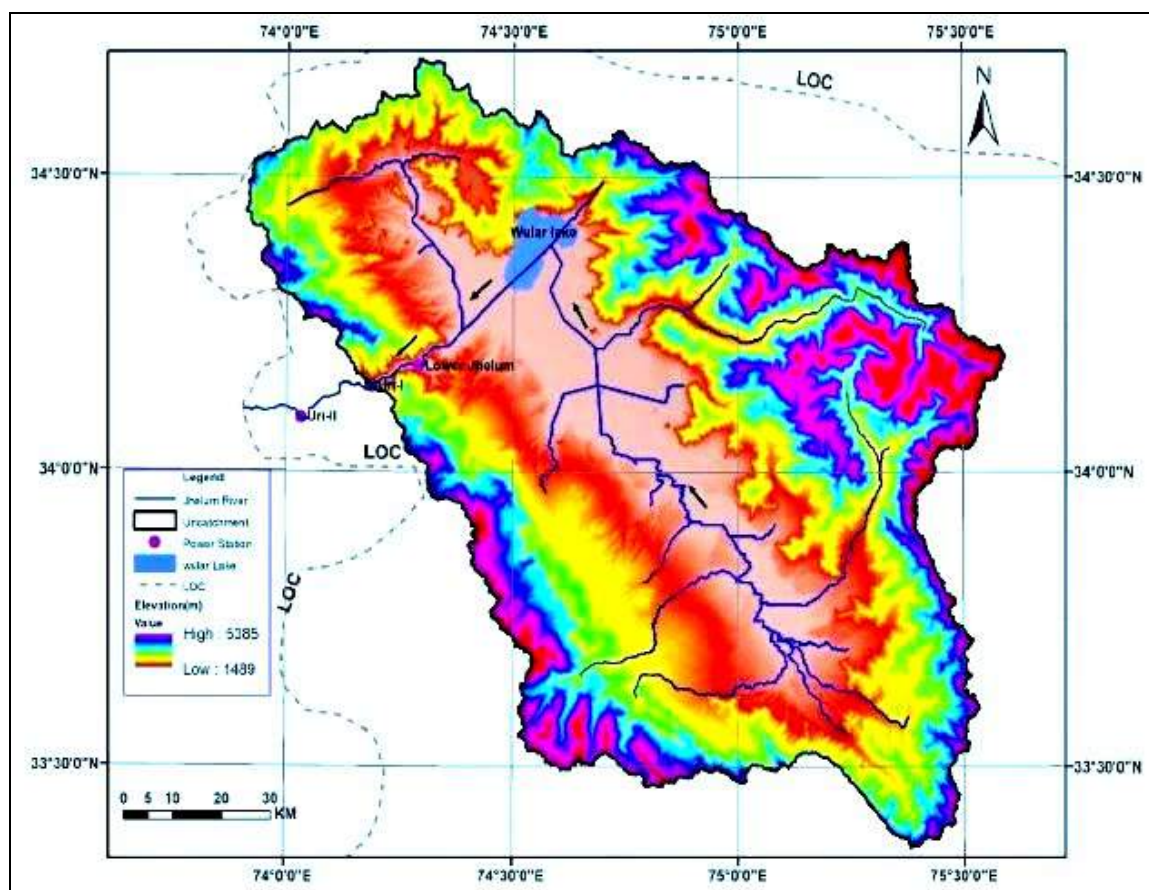


Figure 3.11: Map showing elevation range of Jhelum basin catchment

reservoir survey. The reservoir is under operation since 1997 and no changes are envisaged due to construction of stage-II project. In the reservoir area, river Jhelum flows generally in NE-SW direction. The immediate slopes on both banks of the reservoir are gentle to moderate and occupied by thick pile of riverine / fluvioglacial material and slope wash material. However, the upper slopes are steep with rock cliffs. Bedrock of quartzitic schist, and schistose quartzite are exposed in the vicinity of reservoir periphery.

3.2.4.4 Reservoir Area Elevation Capacity Curve

Full Supply Level (FSL) of the reservoir is at EL 1491 m. The initial gross storage capacity and surface area of reservoir were 35.97 Ham & 8.69 Ha at FSL. The present gross storage capacity & surface area of reservoir are 23.71 Ham & 6.19 Ham at FSL as per latest post monsoon 2018 reservoir survey. The live capacity of the reservoir is Nil. The reservoir of Uri-I power station is around 950 m long at FSL.

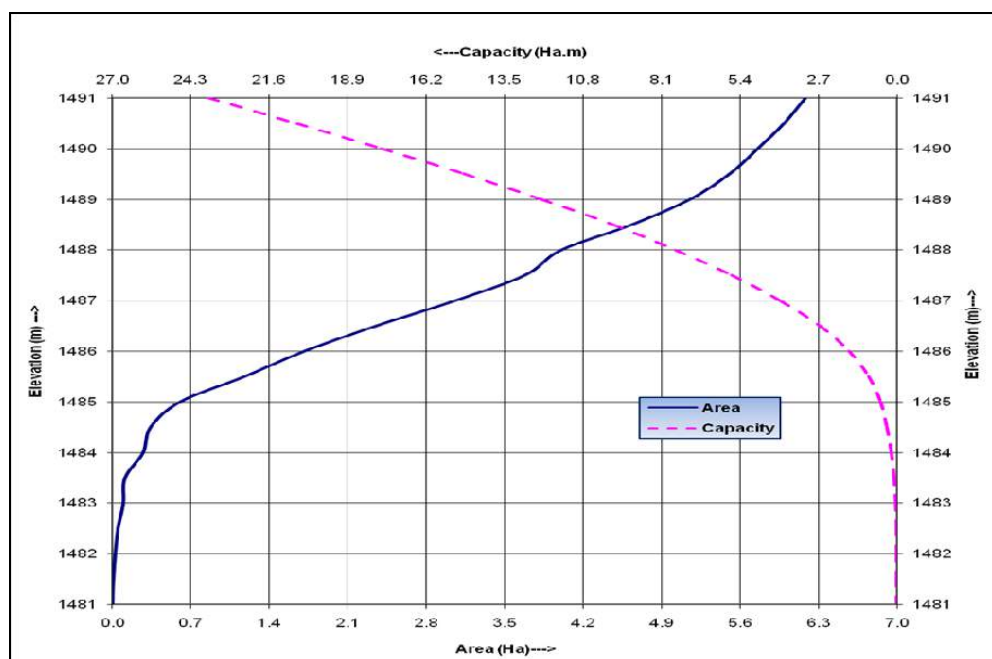


Figure 3.12: Reservoir Elevation Area Capacity Curve

3.2.4.5 Fixation Of Storage Levels (Maximum Water Level, Full Reservoir Level, Minimum Drawdown Level), Flood Cushion etc.

Uri-I PS was designed and constructed as purely run off-river scheme with Full Supply Level (FSL) at EL 1491 m with no live storage capacity.

Flood Cushion: No flood storage envisaged in this project.

Life of a Reservoir: Full Supply Level (FSL) of the reservoir is at EL 1491 m. The initial gross storage capacity and surface area of reservoir were 35.97 Ham & 8.69 Ha at FSL during DPR stage in the year 1989. The present gross storage capacity & surface area of reservoir are 23.71 Ham & 6.19 Ha at FSL as per latest post Monsoon 2018 reservoir survey. Reservoir elevation capacity curve/table as per Post Monsoon-2018 reservoir survey is given in Figure 3.10. It is a runoff the river scheme and project utilize water coming from Lower Jhelum HE Project for power generation after releasing mandated e-flow and remaining water spills over the barrage as there is no live capacity in the reservoir. The reservoir has no significant

changes over 22 years of operation (i.e. from 1997 onwards) as sediment laden water passes downstream through barrage spillway gates.

Capacities at MWL, FRL, MDDL, etc. At Project Planning Stage and After Different Years of Operation: Full Supply Level (FSL) of the reservoir is at EL 1491 m. The initial gross storage capacity and surface area of reservoir were 35.97 Ham & 8.69 Ha at FSL during DPR stage in the year 1989. The present gross storage capacity & surface area of reservoir are 23.71 Ham & 6.19 Ha at FSL after 22 years of operation as per latest post Monsoon 2018 reservoir survey.

3.2.4.6 Reservoir Rim Stability

In general, the reservoir rim appears to be stable. There are no landslides in the reservoir area and has no implication of any kind whatsoever on the competency of the already operating reservoir. The higher slopes are stabilized by contour drains /step drains suitably connected channelized to the river/reservoir. Both banks of the reservoir rim have also been stabilized by rip rap boulder pitching and other protection measures and are well maintained.

3.2.4.7 Length of the Reservoir

The reservoir of Uri power station is around 950 m length at FSL as per latest Post Monsoon -2018 reservoir survey.

3.2.4.8 Sedimentation

The sediment load at barrage site has also been calculated on the basis of observed sediment data from 2003-2020. Based on this data the average annual sediment (including 8% bed load) works out to be (suspended load of 2.88 + Bed load of 0.23) 3.11 Million tons per year.

3.2.4.9 Ground Water level

As per Ground Water Yearbook 2018-19 UT of Jammu & Kashmir, published by Central Ground Water Board, Northwestern Himalayan Region, Jammu, Majority of the area in Kashmir valley have shown rise in water levels. Rise is shown by 54.55% of the sampling locations of CGWB falls in the range of 0-2 m. 9.09% have recorded rise in the range of 2-4 m bgl and 0 % has shown rise of >4 m., 31.82% have shown fall in the range of 0-2 m, 4.55% have shown fall between 2-4 m, and 0.0% wells have shown fall of >4 m. Overall in Kashmir valley the major parts of all the districts have shown rising trends except at few locations in Baramulla and Anantnag districts where decline is recorded.

3.2.5 Catastrophic Events

District Baramulla has a long history of Disaster. Leaving aside a manmade disaster prevailed in the district because of its locational position, natural disaster also reoccurs in the district.

1. Among manmade Disaster Cross-border Shelling is mostly Prevalent in the District across LOC
2. Natural Disasters which had devastating effect in the district include:
 - a) Earthquake of 2005 which wiped out almost half of the Uri Sub-Division and most of

- the villages of Rafiabad area and Gulmarg Tehsil.
- Thunderstorms and Hailstorms do occur very frequently in the district. A devastating Hailstorm occurred in Rafiabad area of Baramulla district in 2010.
 - Landsliding is the routine problem in the district. Upper areas of Rafiabad, Narvaaw and Wagoora are very prone to Sparce Landsliding.
 - Floods of 2014 had an unforgettable effect on the Low-lying areas of District Baramulla.

3.2.6 Meteorology

The study area of the project lies in the Baramulla district, of UT of Jammu & Kashmir. The southwest monsoon rainfall occurs from June to September in the study area with maximum rainfall occurring between these months. The temperature in the study area starts rising in February and attains its maximum value in May and then decreases. May and January are the hottest and coldest months of the year, respectively. In summer, though the day temperature remains high, nights are colder and pleasant. The meteorological data for Uri Tehsil of Baramulla district was downloaded from the online weather portal <https://www.worldweatheronline.in/>. Monthly averages of data on temperature, rainfall, relative humidity, and wind speed for the last 10 years 2012-2021 are given in **Annexure-IIIa**. A brief account of different meteorological attributes is given in the succeeding paragraphs.

i. Temperature

The temperature of the study area recorded monthly data for the year from 2012 to 2021. In the study area, the average maximum temperature of 33.3°C was recorded in Uri tehsil during June. The average minimum temperature of 2.3°C was recorded during January. The monthly variation of average maximum and minimum temperatures is shown in **Figure 3.13**.

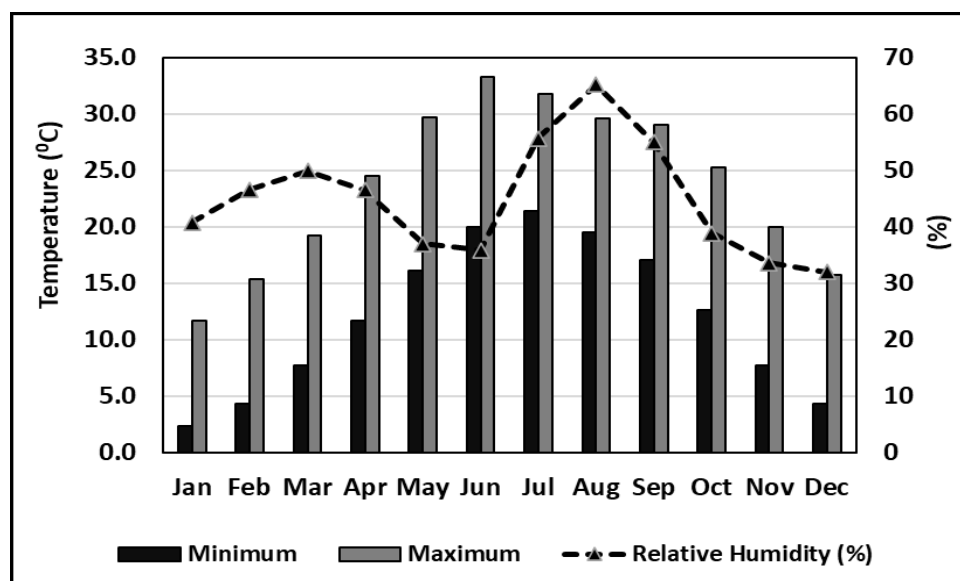


Figure 3.13: Average Monthly Temperature and Relative Humidity in the study area

ii. Relative Humidity

The relative humidity is generally low throughout the year, except during monsoon months when the average humidity in the study area is close to 66% in August. The summer

months are generally the dry months of the year with average humidity as low as 25% in the study area (the reference year 2012-2021). The average monthly variation in humidity is given in **Figure 3.13**.

iii. Rainfall

The area receives maximum rainfall during the southwest monsoon i.e., between June and September (**Figure 3.14**) when about 49.5% of the annual average rainfall is received during monsoon months. The mean annual average rainfall of the Uri tehsil was recorded as 1645.48 mm. Maximum Rainfall in the area was recorded in 2019 with an annual rainfall of 2274.3 mm with 102 rainy days. Minimum annual rainfall was recorded in the year 2016 with an annual average of 1402.11 mm (see **Figure 3.15**).

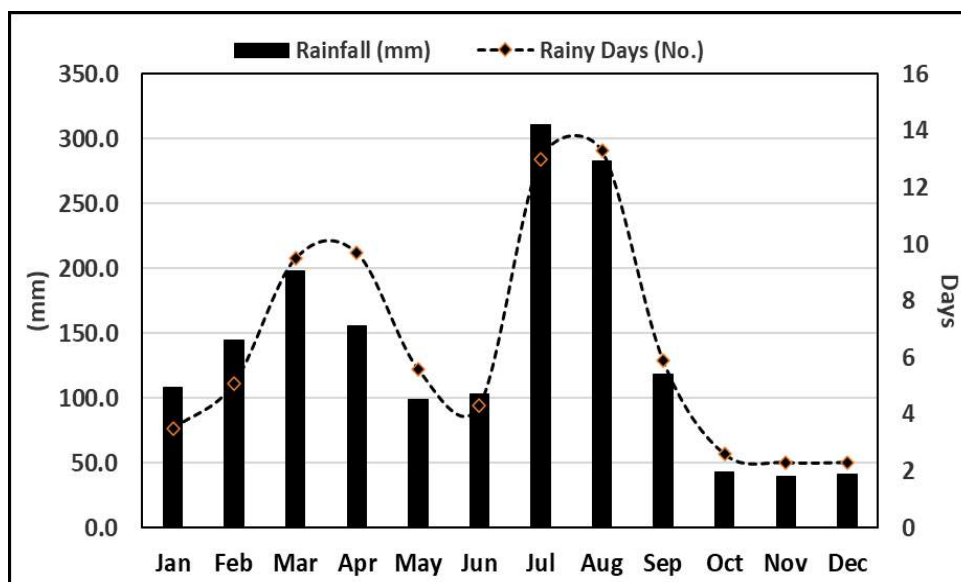


Figure 3.14: Mean Monthly Average Rainfall and Number of Rainy Days in the study area for the Years 2012-2021

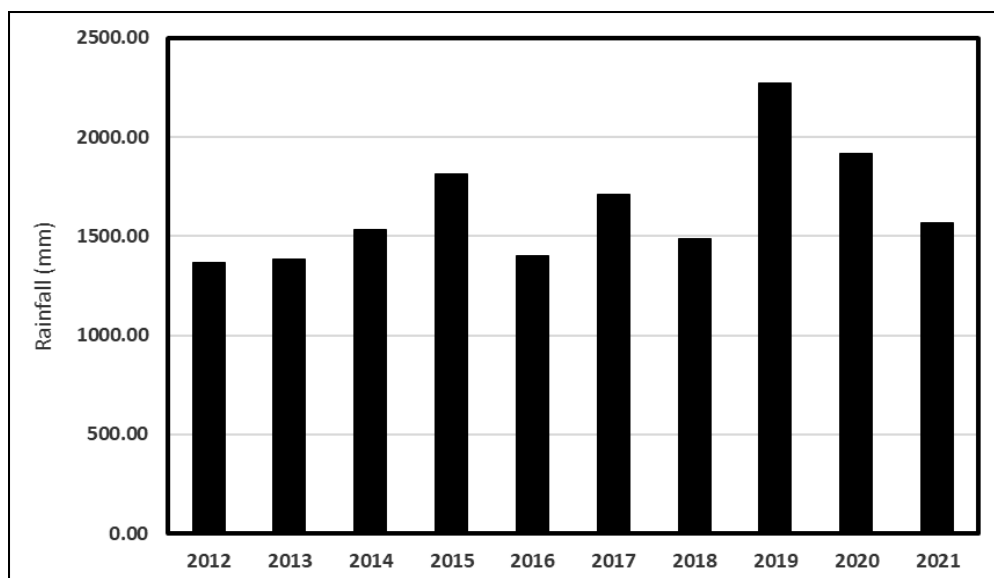


Figure 3.15: Annual Rainfall for the last decade in the study area (reference Years 2012-2021)

iv. **Wind Speed**

The wind speed is higher during the monsoon period as compared to the post-monsoon period. The average maximum wind speed of 4.18 m/s is observed during May. The monthly variation in wind speed during reference years 2012-2021 is given in **Figure 3.16**.

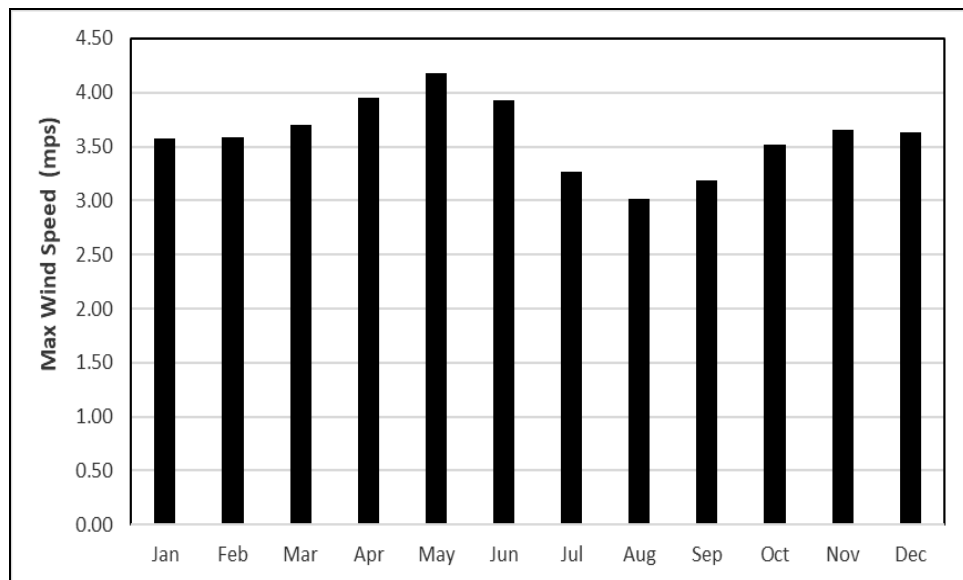
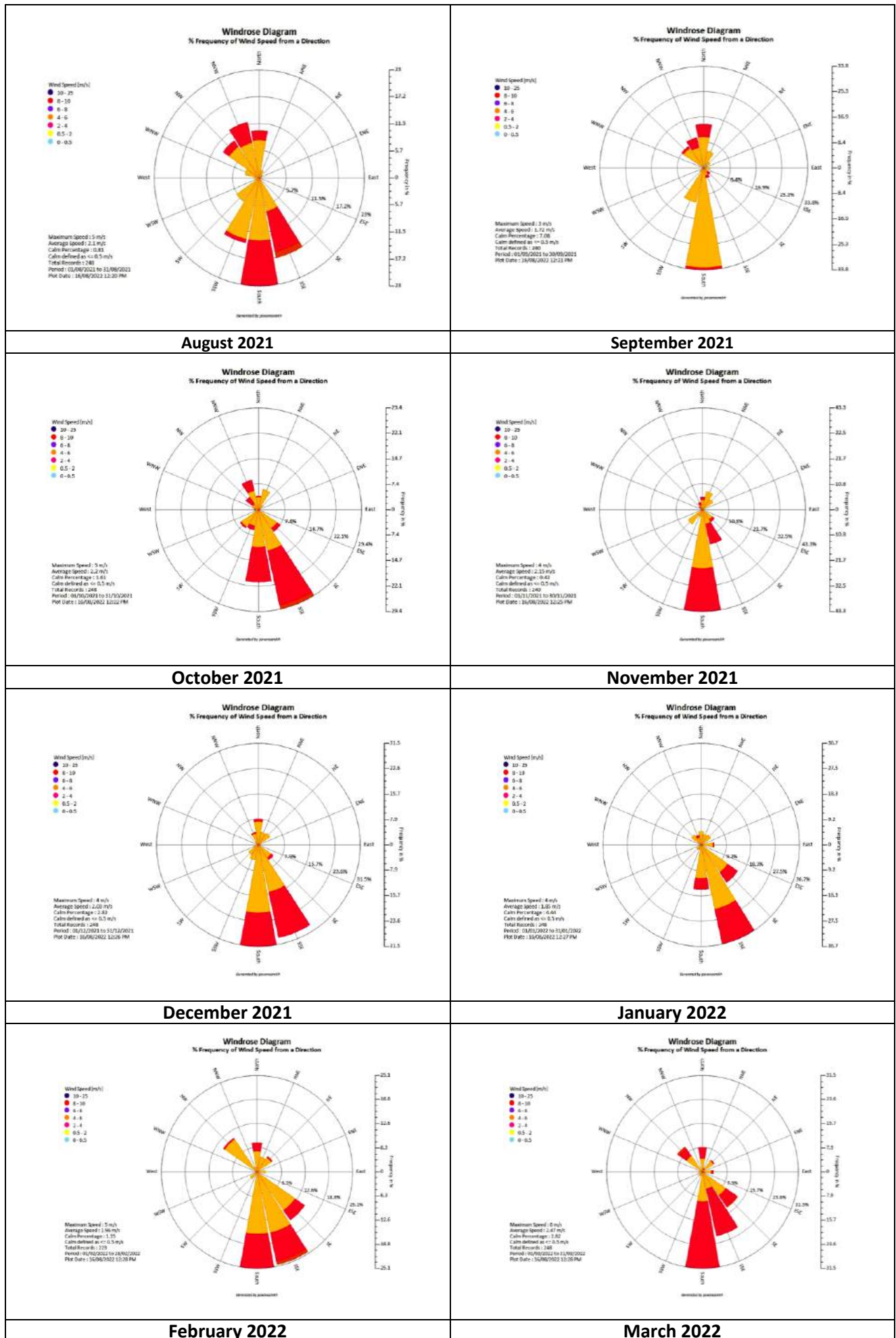


Figure 3.16: Mean Monthly Average Max Wind Speed in the study area

Wind speed and direction data are useful in identifying the influence of meteorology on the air quality of the area. Based on the world weather online meteorological data, wind-rose diagrams i.e., the diagrammatic representation of wind speed and wind direction were generated from August 2021 to July 2022. Wind-rose diagrams of the study are given in **Figure 3.17** and a summary of the same is given in **Table 3.11**. Detailed hourly and daily month-wise data on wind direction is given in **Annexure-IIIb**. The predominant wind direction is from South and South-Southeast as on average 29.9% time it blows in this direction. It remains so from August-September 2021, November- December 2021 and again from February and June 2022.

Table 3.11: Summary of Wind Pattern in the study area during different Months

Month	First Predominant wind Direction	Second Predominant Wind direction	Calm
Aug-21	South (22.99 %)	SSE (17.34 %)	0.81%
Sep-21	South (33.74 %)	North (14.58 %)	7.08%
Oct-21	SSE (29.44 %)	South (20.97 %)	1.61%
Nov-21	South (43.33 %)	NNE (7.92 %)	0.42%
Dec-21	South (31.44 %)	SSE (29.44 %)	2.82%
Jan-22	SSE (36.69 %)	SE (16.54 %)	4.44%
Feb-22	South (25.11 %)	SSE (24.67 %)	1.35%
Mar-22	South (31.45 %)	SSE (21.37 %)	2.82%
Apr-22	South (32.09 %)	SSE (24.58 %)	0.42%
May-22	South (22.58 %)	SE (16.94 %)	1.21%
Jun-22	South (26.66 %)	SSE (17.93)	3.33%
Jul-22	NW (27.82 %)	South (17.74 %)	4.03 %



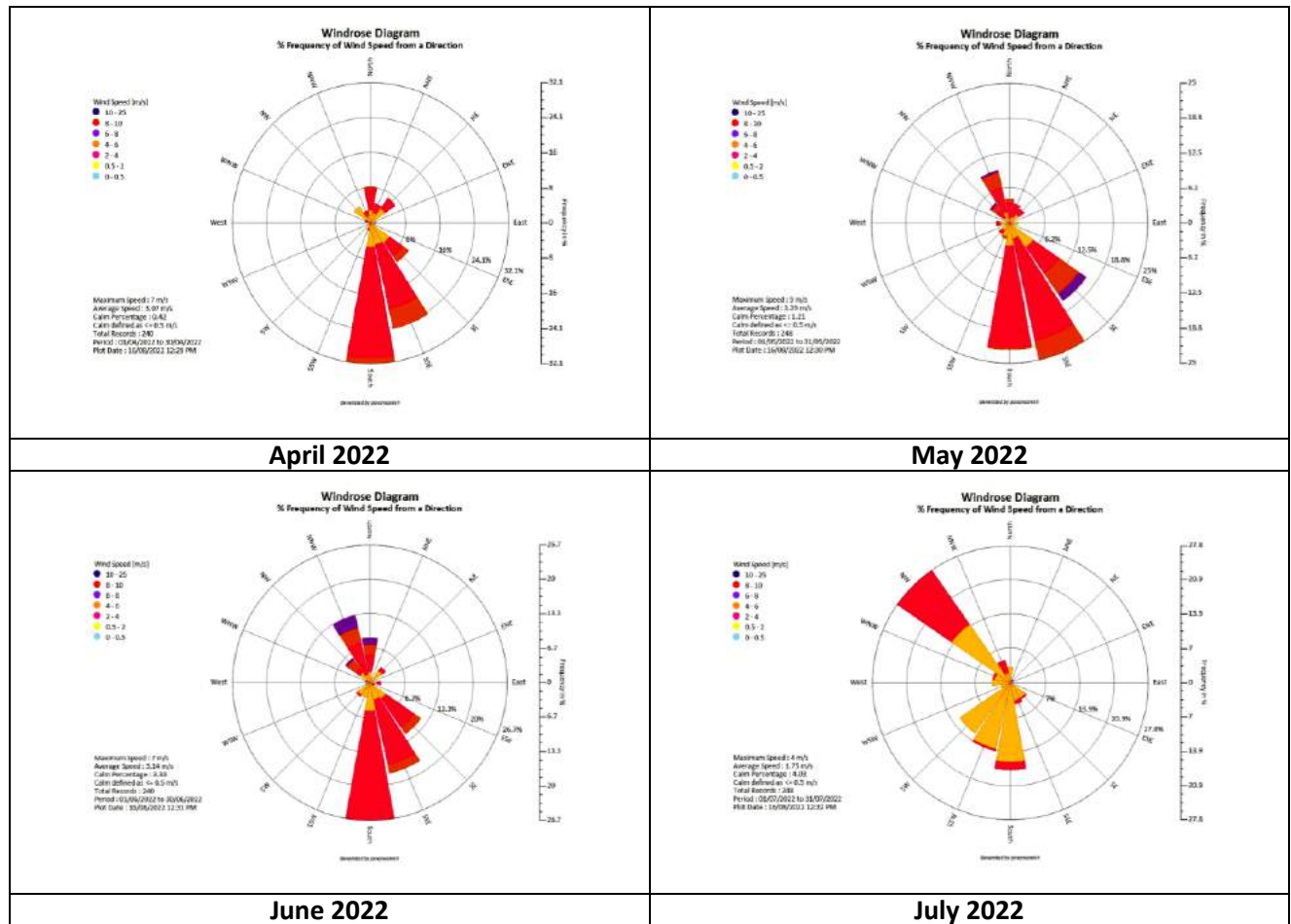


Figure 3.17: Wind Rose diagram

3.2.7 Soil

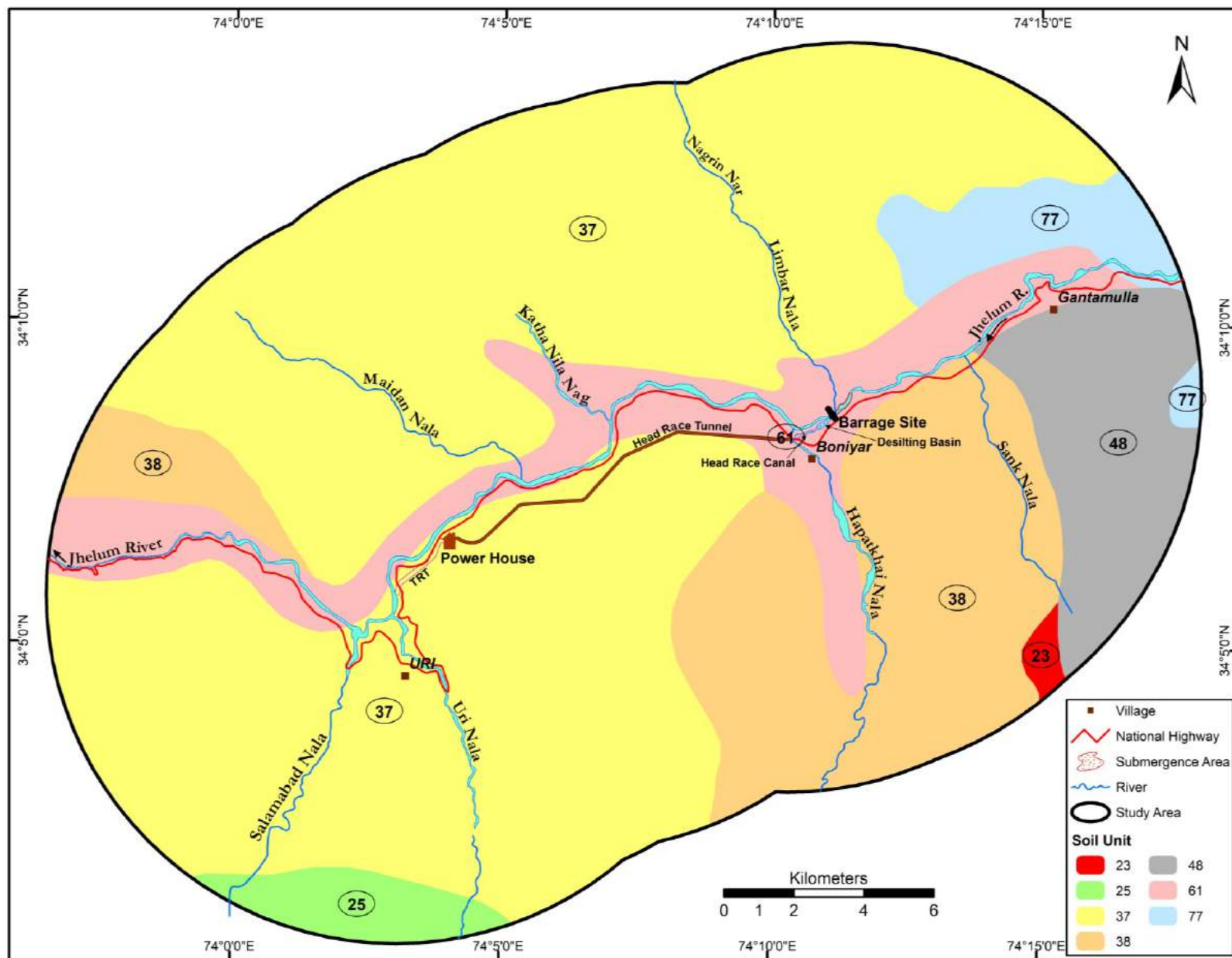
3.2.7.1 Soil Taxonomic Classification

The area under different soil units is given in **Table 3.12** and soil map of the study area is given in **Figure 3.18**. Predominant soil type in the study area was represented by Soil Unit 37 cover 60.61 % of the study area lies under sub-group Lithic Udorthents associated with Typic Udorthents characterized by Shallow, somewhat excessively drained, mesic, loamy-skeletal soils on steep slopes with loamy surface, severe erosion and strong stoniness; *associated with*: Medium deep, somewhat excessively drained, mesic, loamy-skeletal soils on moderately steep soils with loamy-surface, severe erosion and strong stoniness. Soil Unit 38 is second predominant Shallow, somewhat excessively drained, mesic, loamy-skeletal soils on moderately steep slopes with loamy surface, severe erosion and moderate stoniness; *associated with*: Medium deep, well drained, mesic, loamy-skeletal soils on moderately steep slopes with loamy surface, severe erosion and slight stoniness.

Table 3.12: Taxonomic Classification of soils in the study area

Soil Unit	Soil Type		Area (sq km)	Area (%)
23	Dominantly very shallow, excessively drained, fragmental soils occurring on very steep slopes with loamy surface, very severe erosion and strong stoniness; <i>associated with</i> : Rocky outcrops	• Lithic Cryorthents	1.97	0.33
25	Medium deep, well drained, fine-loamy soils on moderately	• Typic	12.47	2.02

Soil Unit	Soil Type		Area (sq km)	Area (%)
	steep slopes with loamy surface, severe erosion and slight stoniness; <i>associated with:</i> Shallow, excessively drained, loamy soils with loamy surface, severe erosion and slight stoniness	Cryorthents • Lithic Cryorthents		
37	Shallow, somewhat excessively drained, mesic, loamy-skeletal soils on steep slopes with loamy surface, severe erosion and strong stoniness; <i>associated with:</i> Medium deep, somewhat excessively drained, mesic, loamy-skeletal soils on moderately steep soils with loamy-surface, severe erosion and strong stoniness.	• Lithic Udorthents • Typic Udorthents	373.36	60.61
38	Shallow, somewhat excessively drained, mesic, loamy-skeletal soils on moderately steep slopes with loamy surface, severe erosion and moderate stoniness; <i>associated with:</i> Medium deep, well drained, mesic, loamy-skeletal soils on moderately steep slopes with loamy surface, severe erosion and slight stoniness.	• Lithic Udorthents • Typic Udorthents	102.04	16.56
48	Medium deep, moderately well drained, mesic, fine-loamy soils on steep slopes with loamy surface and severe erosion; <i>associated with:</i> Deep, somewhat excessively drained, fine soils on steep slopes with loamy surface, severe erosion and slight stoniness.	• Fluventic Eutrochrepts • Dystric Eutrochrepts	39.14	6.35
61	Medium deep, well drained, loamy-skeletal soils on moderate slopes with loamy surface, severe erosion and strong stoniness; <i>associated with:</i> Medium deep, well drained, fine-loamy soils with loamy surface, moderate erosion and moderate stoniness.	• Typic Udorthents • Dystric Eutrochrepts	67.03	10.88
77	Deep, moderately well drained, fine-loamy soils on very gentle slopes with loamy surface and slight erosion; <i>associated with:</i> Medium deep, moderately well drained, calcareous, fine-loamy soils on moderate slopes with loamy surface and moderate erosion.	• Dystric Eutrochrepts • Typic Eutrochrepts	20.03	3.25
	TOTAL		616.04	100.00



3.2.7.2 Physico-chemical Properties of Soil

The location of sampling sites for the soil on the map is given in **Figure 3.2** and results of soil physico-chemical analysis are given in **Table 3.13**.

Bulk density reflects the soil's ability to function for structural support, water and solute movement, and soil aeration. Most of the soils in the study area are Sandy Clayey Loam. The average bulk density of soil is medium due to the presence of clay content varied from 1.25 to 1.44 (g/cc) at various locations in the study. Porosity and water holding capacity are generally low to medium in the area thereby affecting the permeability of the soil as porosity varied between 36.5% and 48.9% while water holding capacity varied between 28.0% and 47.0%. Most of the area has an almost neutral soil reaction. Electrical conductivity varied between 102 and 280 $\mu\text{S}/\text{cm}$ which is a measure of soluble salts i.e., salinity. Soil with EC up to 2000 $\mu\text{S}/\text{cm}$ is considered non-saline soil (see **Table 3.13**).

Table 3.13: Physico-chemical characteristics of Soil

S. No.	Parameter	Season	S1	S2	S3	S4	S5	S6
1	Soil Texture							
i	Sand (% w/w)	M	65	79	69	78	70	72
	Silt (% w/w)		6	5	8	6	5	6
	Clay (% w/w)		29	16	23	16	25	22
ii	Sand (% w/w)	W	66	77	72	75	68	73
	Silt (% w/w)		5	6	7	6	5	6
	Clay (% w/w)		29	17	21	19	27	21
iii	Sand (% w/w)	PM	63	74	70	75	68	70
	Silt (% w/w)		6	4	6	4	6	4
	Clay (% w/w)		31	22	24	21	26	26
2	Bulk Density (g/cc)	M	1.35	1.22	1.32	1.24	1.27	1.26
		W	1.32	1.2	1.27	1.23	1.29	1.26
		PM	1.28	1.18	1.24	1.16	1.26	1.2
3	Porosity (%)	M	30	41	32	38	34	35
		W	30	43	33	41	31	38
		PM	31	40	35	41	33	36
4	Water holding capacity (%)	M	32	24	30	25	28	27
		W	31	23	30	24	28	26
		PM	28.9	22	26	20	28.7	24.5
5	pH	M	7.1	6.92	6.9	6.87	7.2	6.88
		W	7.2	7	7.2	7	7.3	7.1
		PM	6.9	6.9	6.8	6.85	7.1	6.85
6	Electrical Conductivity ($\mu\text{S}/\text{cm}$)	M	330	550	290	280	190	320
		W	310	440	300	280	179	290
		PM	320	590	260	270	180	310
7	Total Alkalinity (mg/l)	M	220	316	190	70	90	150
		W	230	280	210	80	110	158
		PM	240	310	220	110	130	160
8	Chloride Content (mg/kg)	M	67	96	87	120	110	92
		W	65	78	77	100	99	89
		PM	68	80	82	110	105	89
9	Calcium (mg/kg)	M	290	316	190	210	180	240
		W	239	290	210	220	200	250
		PM	280	310	180	198	172	220
10	Magnesium (mg/kg)	M	56	42	76	92	120	80
		W	53	40	56	80	110	78
		PM	50	38	72	88	110	70
11	Available Nitrogen (kg/ha)	M	190	182	220	106	260	220
		W	200	190	230	120	250	224

S. No.	Parameter	Season	S1	S2	S3	S4	S5	S6
		PM	180	185	210	110	240	215
12	Available Phosphorus (kg/ha)	M	32	29	43	26	38	34
		W	35	32	44	30	32	35
		PM	28	30	37	27	30	29
13	Available Potassium (kg/ha)	M	220	330	410	390	290	240
		W	240	310	390	398	310	250
		PM	210	320	380	400	290	260
14	Organic carbon (%)	M	1.2	0.82	0.88	0.69	0.7	1.1
		W	1.21	0.8	0.85	0.7	0.73	1.11
		PM	1.1	0.86	0.88	0.76	0.75	1.01
15	Sodium (mg/kg)	M	290	300	220	290	286	242
		W	260	290	190	267	256	229
		PM	240	270	185	255	250	210
16	Sodium Adsorption Ratio	M	4.1	4.3	3.3	3.8	3.6	3.4
		W	4	4.2	3	3.9	3.6	3.2
		PM	3.5	3.9	2.9	3.8	3.7	3.2
17	Salinity (ppt)	M	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
		W	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
		PM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

M=Monsoon, W=Winter, PM=Pre-monsoon

The soil fertility status of the area was assessed based upon soil test results and based upon Soil Fertility Rating given below in the **Table 3.14**.

Table 3.14: Soil Fertility Rating as per Soil Fertility Book*

Soil Parameter	Low	Medium	High
Organic Carbon (%)	<0.5	0.5 to 0.75	>0.75
Available Nitrogen (kg/ha)	<280	280 to 560	>560
Available Phosphorus (kg/ha)	<10	10 to 25	>25
Available Potassium (kg/ha)	<108	108 to 280	>280

*Source: Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India (2011)

Organic carbon an important indicator of soil health is in the 'Medium' to 'High' range throughout the study area in different seasons (see **Table 3.15**). The soil fertility rating in terms of nitrogen was observed in the 'Low' range in all seasons. Phosphorus is in the 'High' range in all the seasons and Potassium concentrations are in the 'Medium' to 'High' range in all the seasons in the study area.

Table 3.15: Soil Fertility Rating in the study area

Sampling Locations	Season	Parameter/Site			
		Organic Carbon (%)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)
S1	Monsoon	High	Low	High	Medium
	Winter	High	Low	High	Medium
	Pre-Monsoon	High	Low	High	Medium
S2	Monsoon	High	Low	High	High
	Winter	High	Low	High	High
	Pre-Monsoon	High	Low	High	High
S3	Monsoon	High	Low	High	High
	Winter	High	Low	High	High
	Pre-Monsoon	High	Low	High	High
S4	Monsoon	Medium	Low	High	High
	Winter	Medium	Low	High	High

Sampling Locations	Season	Parameter/Site			
		Organic Carbon (%)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)
S5	Pre-Monsoon	High	Low	High	High
	Monsoon	Medium	Low	High	High
	Winter	Medium	Low	High	High
	Pre-Monsoon	Medium	Low	High	High
S6	Monsoon	High	Low	High	Medium
	Winter	High	Low	High	Medium
	Pre-Monsoon	High	Low	High	Medium

Soil Sampling Locations

	
S1: Near Masjid Shareef Jawing Nowshera	S2: Near Barrage Site
	
S3: Near Boniyar Nalla-Jhelum River confluence	S4: Muck dumping Site near Mahura Village
	
S5: Near Powerhouse Site	S6: Near TRT Site

3.2.7.3 Soil Nutrient Index

Based upon Soil Fertility rating overall Nutrient Index (NI) of soils in the study area vis-à-vis NPK was calculated as follows:

$(\text{Percent samples falling in Low category} \times 1) + (\text{Percent samples falling in the 'Medium' category} \times 2) + (\text{Percent samples falling in the 'High' category} \times 3)/100.$

Based upon above Nutrient Index Soil Fertility is assessed as follows:

< 1.67	: Low
1.67 – 2.33	: Medium
> 2.33	: High

- The soil fertility in the study area, in general, is based upon Nutrient Index in terms of NPK as above shows that Nitrogen is in the 'Low' range Phosphorus fertility rating 'Medium' range during monsoon but in pre-pre-monsoon and winter season is in the 'Low' range whereas, Potassium fertility status of soil in the 'medium' range.

Parameter	Season	Nutrient Index	Fertility Rating
Nitrogen (kg/ha)	Monsoon	Low	1.0
	Winter	Low	1.0
	Pre-monsoon	Low	1.0
Phosphorus (kg/ha)	Monsoon	Medium	3.0
	Winter	Low	3.0
	Pre-monsoon	Low	3.0
Potassium (kg/ha)	Monsoon	Medium	2.6
	Winter	Medium	2.6
	Pre-monsoon	Medium	2.6

3.2.7.4 Conclusion

- In general, all the physical and chemical soil quality indicators reflect the good quality of the soil.
- The soil fertility based upon Nutrient Index in terms of NPK shows that Nitrogen is in the 'Low' range Phosphorus fertility rating 'Medium' range during monsoon but in pre-monsoon and winter season is in the 'Low' range whereas, Potassium fertility status of soil in the 'medium' range.

3.2.8 Air Environment

The baseline status concerning ambient air quality of the study area and superimposition of potential releases of air pollutants during the project's construction and operation phase helps in impact assessment and preparation of mitigation and management measures. As the study area is mainly a rural area with no industrial establishment and medium traffic movement, the ambient air in the study area is free from any pollution sources. Ambient air quality data/ results observed during three seasons of monitoring in the study area are given in **Table 3.16**. The location of ambient air quality monitoring sites in the study area is given in **Figure 3.2**.

i. PM_{2.5} levels

PM_{2.5} levels were minimum at AQ4/Near NHPC Complex Village with 14.5 µg/m³ during the monsoon season, 16.7 µg/m³ during the winter season and 18.2 µg/m³ during pre-monsoon. Maximum levels of PM_{2.5} were recorded at AQ1/Army Entry Gate near Limber village where levels were 23.8 µg/m³, 30.2 µg/m³ and 32.9 µg/m³ during monsoon, winter, and pre-monsoon seasons, respectively (**Table 3.16**).

ii. PM₁₀ levels

The maximum PM₁₀ levels observed during ambient air quality monitoring were 66.6 µg/m³, 70.8 µg/m³ and 75.0 µg/m³ at monitoring site AQ1/Army Entry Gate near Limber village in monsoon, winter, and pre-monsoon seasons, respectively. Minimum levels were recorded at monitoring site AQ6/Gurudwara near TRT with 39.7 µg/m³ in the monsoon season, 47.8 µg/m³ in the winter season, and 50.7 µg/m³ in the pre-monsoon season (**Table 3.16**).

iii. SO₂ levels and NO₂ levels

The SO₂ and NO₂ levels observed during the study were much lower than the permissible limit of 80 µg/m³ at most of the locations (see **Table 3.16**). SO₂ was maximum at AQ3/Near Chandanwari village with 8.9 µg/m³ during the monsoon season, 9.7 µg/m³ at AQ5/Powerhouse site during the winter season and 9.9 µg/m³ at AQ5/ Powerhouse site during pre-monsoon season (**Table 3.16**).

Similarly, NO₂ was maximum at AQ1/ Army Entry Gate near Limber village with 13.4 µg/m³ during monsoon season, 14.0 µg/m³ during the winter season and 14.1 µg/m³ during pre-monsoon (**Table 3.16**).

Table 3.16: Ambient Air Quality in the study area (unit: µg/m³)

Monsoon Season					
Monitoring Location	Monitoring Schedule	Parameters (µg/m ³)			
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂
AQ1/Army Entry Gate (near Limber Village)	1-9-2021 to 2-9-2021	23.2	60.1	7.8	12.2
	4-9-2021 to 5-9-2021	22.2	62.5	7.9	12.1
	8-9-2021 to 9-9-2021	22.2	66.6	8.0	11.1
	11-9-2021 to 12-9-2021	21.2	62.5	8.2	13.4
	15-9-2021 to 16-9-2021	23.2	61.2	7.8	13.3
	18-9-2021 to 19-9-2021	22.2	63.6	7.9	12.3
	22-9-2021 to 23-9-2021	23.8	64.5	7.6	12.4
	25-9-2021 to 26-9-2021	23	61	8.1	13.0
	Min	21.2	60.1	7.6	11.1
	Max	23.8	66.6	8.2	13.4
	Average	22.6	62.8	7.9	12.5
AQ2/Near Barrage Site	2-9-2021 to 3-9-2021	20.0	49.5	7.8	8.9
	5-9-2021 to 6-9-2021	21.1	50.2	7.7	9.0
	9-9-2021 to 10-9-2021	20.2	51.2	7.8	9.1
	12-9-2021 to 13-9-2021	18.9	50.8	7.7	9.2
	16-9-2021 to 17-9-2021	22.2	50.0	7.6	8.9
	19-9-2021 to 20-9-2021	21.0	48.9	7.7	8.8
	23-9-2021 to 24-9-2021	21.4	49.0	7.3	8.3
	26-9-2021 to 27-9-2021	21.9	50.1	7.2	9.0
	Min	18.9	48.9	7.2	8.3
	Max	22.2	51.2	7.8	9.2

Monsoon Season					
Monitoring Location	Monitoring Schedule	Parameters ($\mu\text{g}/\text{m}^3$)			
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂
AQ3/Near Chandanwari Village	Average	20.8	50.0	7.6	8.9
	3-9-2021 to 4-9-2021	22.2	61.2	7.8	10.2
	6-9-2021 to 7-9-2021	21.1	60.2	8.8	11.1
	10-9-2021 to 11-9-2021	21.1	58.9	8.7	12.2
	13-9-2021 to 14-9-2021	22	57.6	7.8	12.5
	17-9-2021 to 18-9-2021	21.4	58.9	8.0	10.6
	20-9-2021 to 21-9-2021	22.2	61.6	8.8	11.5
	24-9-2021 to 25-9-2021	21.1	62.1	8.9	10.8
	27-9-2021 to 28-9-2021	22.2	60.8	8.5	10.9
	Min	21.1	57.6	7.8	10.2
	Max	22.2	62.1	8.9	12.5
AQ4/NHPC Complex (Gingal Village)	Average	21.7	60.2	8.4	11.2
	1-9-2021 to 2-9-2021	16.7	48.9	7.5	7.6
	4-9-2021 to 5-9-2021	17.6	46.7	7.1	7.8
	8-9-2021 to 9-9-2021	15.6	50.4	6.8	7.0
	11-9-2021 to 12-9-2021	16.7	55.5	6.6	7.5
	15-9-2021 to 16-9-2021	15.5	47.8	6.5	7.5
	18-9-2021 to 19-9-2021	14.5	45.6	6.2	7.0
	22-9-2021 to 23-9-2021	15.6	48.7	6.2	7.6
	25-9-2021 to 26-9-2021	17.6	48.7	6.1	7.0
	Min	14.5	45.6	6.1	7
	Max	17.6	55.5	7.5	7.8
AQ5/Powerhouse Site	Average	16.2	49.0	6.6	7.4
	2-9-2021 to 3-9-2021	20.2	55.5	8.8	9.9
	5-9-2021 to 6-9-2021	21.1	54.5	8.7	9.9
	9-9-2021 to 10-9-2021	20.2	55.5	8.7	9.7
	12-9-2021 to 13-9-2021	20.2	51.5	8.0	9.5
	16-9-2021 to 17-9-2021	19.4	56.2	8.0	9.2
	19-9-2021 to 20-9-2021	18.5	52.5	8.0	9.0
	23-9-2021 to 24-9-2021	18.9	53.5	8.7	8.9
	26-9-2021 to 27-9-2021	18	51.5	8.1	9.2
	Min	18	51.5	8	8.9
	Max	21.1	56.2	8.8	9.9
AQ6/Gurudwara near TRT Site	Average	19.6	53.8	8.4	9.4
	3-9-2021 to 4-9-2021	15.2	45.4	6.7	7.1
	6-9-2021 to 7-9-2021	14.5	42.4	6.6	7.2
	10-9-2021 to 11-9-2021	16.4	45.4	6.7	7.2
	13-9-2021 to 14-9-2021	15	43.4	6.0	7.6
	17-9-2021 to 18-9-2021	15.4	44.4	6.7	7.7
	20-9-2021 to 21-9-2021	15.6	42.3	6.9	7.3
	24-9-2021 to 25-9-2021	15.5	40.2	6.6	7.1
	27-9-2021 to 28-9-2021	15.8	39.7	6.5	7.0
	Min	14.5	39.7	6	7
	Max	16.4	45.4	6.9	7.7
Permissible Limit 24 h NAAQS 2009	Average	15.4	42.9	6.6	7.3
		60.0	100.0	80.0	80.0

Winter Season					
Monitoring Location	Monitoring Schedule	Parameters ($\mu\text{g}/\text{m}^3$)			
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂
AQ1/Army Entry Gate (near Limber Village)	3-1-2022 to 4-1-2022	26.7	66.6	7.9	12.8
	6-1-2022 to 7-1-2022	28.9	69.8	8.0	13.4
	10-1-2022 to 11-1-2022	30.2	70.8	7.9	13.0
	13-1-2022 to 14-1-2022	28.7	68.6	8.0	12.9
	17-1-2022 to 18-1-2022	27.6	66.6	8.2	13.0

Winter Season					
Monitoring Location	Monitoring Schedule	Parameters ($\mu\text{g}/\text{m}^3$)			
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂
	20-1-2022 to 21-1-2022	26.5	67.6	8.3	14.0
	24-1-2022 to 25-1-2022	27.8	66.7	8.0	13.8
	27-1-2022 to 28-1-2022	27.8	67.6	7.8	13.0
	Min	26.5	66.6	7.8	12.8
	Max	30.2	70.8	8.3	14
	Average	28.0	68.0	8.0	13.2
AQ2/Near Barrage Site	4-1-2022 to 5-1-2022	24.2	50.5	8.0	9.0
	7-1-2022 to 8-1-2022	23.4	53.5	7.8	9.2
	11-1-2022 to 12-1-2022	24.4	53.5	8.0	9.8
	14-1-2022 to 15-1-2022	23.4	55.5	8.8	9.0
	18-1-2022 to 19-1-2022	23.4	52.5	8.7	8.9
	21-1-2022 to 22-1-2022	26.5	50.5	7.9	8.9
	25-1-2022 to 26-1-2022	24.5	49.9	8.0	9.0
	28-1-2022 to 29-1-2022	24.2	51.2	8.3	8.9
	Min	23.4	49.9	7.8	8.9
	Max	26.5	55.5	8.8	9.8
	Average	24.3	52.1	8.2	9.1
AQ3/Near Chandanwari Village	5-1-2022 to 6-1-2022	25.3	63	8.0	11.1
	8-1-2022 to 9-1-2022	23.3	61	8.2	12.1
	12-1-2022 to 13-1-2022	23.4	59.6	8.9	12.2
	15-1-2022 to 16-1-2022	25.4	60	8.9	12.6
	19-1-2022 to 20-1-2022	23.2	61.2	9.0	11.2
	22-1-2022 to 23-1-2022	24.45	62.5	8.7	12.5
	26-1-2022 to 27-1-2022	23	60	8.0	11.1
	29-1-2022 to 30-1-2022	24.5	62.3	9.0	12.0
	Min	23	59.6	8	11.1
	Max	25.4	63	9	12.6
	Average	24.1	61.2	8.6	11.9
AQ4/NHPC Complex (Gingal Village)	3-1-2022 to 4-1-2022	19.4	50.5	7.8	8.0
	6-1-2022 to 7-1-2022	20.2	52	7.8	7.8
	10-1-2022 to 11-1-2022	19.5	50.5	7.5	8.0
	13-1-2022 to 14-1-2022	18.5	57.8	7.8	8.2
	17-1-2022 to 18-1-2022	17.8	56.5	7.6	8.0
	20-1-2022 to 21-1-2022	18.6	50.6	7.6	8.2
	24-1-2022 to 25-1-2022	16.7	53.5	6.6	7.9
	27-1-2022 to 28-1-2022	18	56.5	6.3	8.0
	Min	16.7	50.5	6.3	7.8
	Max	20.2	57.8	7.8	8.2
	Average	18.6	53.9	7.4	8.0
AQ5/Power House Site	4-1-2022 to 5-1-2022	23.2	56.7	9.0	10.2
	7-1-2022 to 8-1-2022	22.2	56.6	9.7	10.2
	11-1-2022 to 12-1-2022	21	55.5	9.2	11.1
	14-1-2022 to 15-1-2022	21.2	58.9	9.0	10.5
	18-1-2022 to 19-1-2022	20.5	60.6	9.6	11.1
	21-1-2022 to 22-1-2022	23.2	57.6	9.3	12.1
	25-1-2022 to 26-1-2022	24	56.5	9.2	10.5
	28-1-2022 to 29-1-2022	22.5	55.4	9.1	10.5
	Min	20.5	55.4	9	10.2
	Max	24	60.6	9.7	12.1
	Average	22.2	57.2	9.3	10.8
AQ6/Gurudwara near TRT Site	5-1-2022 to 6-1-2022	18.9	47.8	6.8	7.2
	8-1-2022 to 9-1-2022	19.5	50.5	7.0	7.4
	12-1-2022 to 13-1-2022	19.5	51.1	7.5	7.3
	15-1-2022 to 16-1-2022	20.1	49.5	7.0	7.6
	19-1-2022 to 20-1-2022	20.1	50.5	7.5	7.3
	22-1-2022 to 23-1-2022	18.9	51.1	6.0	7.5
	26-1-2022 to 27-1-2022	19.7	50.2	6.9	7.8

Winter Season					
Monitoring Location	Monitoring Schedule	Parameters ($\mu\text{g}/\text{m}^3$)			
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂
	29-1-2022 to 30-1-2022	18.9	52.3	7.6	7.6
	Min	18.9	47.8	6	7.2
	Max	20.1	52.3	7.6	7.8
	Average	19.5	50.4	7.0	7.5
Permissible Limit 24 h NAAQS 2009		60.0	100.0	80.0	80.0

Pre-monsoon Season					
Monitoring Location	Monitoring Schedule	Parameters ($\mu\text{g}/\text{m}^3$)			
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂
AQ1/Army Entry Gate (near Limber Village)	2-5-2022 to 3-5-2022	29.1	70.6	8.1	12.9
	5-5-2022 to 6-5-2022	31.5	74.0	8.2	13.5
	9-5-2022 to 10-5-2022	32.9	75.0	8.1	13.1
	12-5-2022 to 13-5-2022	31.3	72.7	8.2	13.0
	16-5-2022 to 17-5-2022	30.1	70.6	8.4	13.1
	19-5-2022 to 20-5-2022	28.9	71.7	8.5	14.1
	23-5-2022 to 24-5-2022	30.3	70.7	8.2	13.9
	26-5-2022 to 27-5-2022	30.3	71.7	8.0	13.1
	Min	28.9	70.6	8.0	12.9
	Max	32.9	75.0	8.5	14.1
	Average	30.5	72.1	8.2	13.4
AQ2/Near Barrage Site	3-5-2022 to 4-5-2022	26.4	53.5	8.2	9.1
	6-5-2022 to 7-5-2022	25.5	56.7	8.0	9.3
	10-5-2022 to 11-5-2022	26.6	56.7	8.2	9.9
	13-5-2022 to 14-5-2022	25.5	58.8	9.0	9.1
	17-5-2022 to 18-5-2022	25.5	55.7	8.9	9.0
	20-5-2022 to 21-5-2022	28.9	53.5	8.1	9.0
	24-5-2022 to 25-5-2022	26.7	52.9	8.2	9.1
	27-5-2022 to 28-5-2022	26.4	54.3	8.5	9.0
	Min	25.5	52.9	8.0	9.0
	Max	28.9	58.8	9.0	9.9
	Average	26.4	55.3	8.4	9.2
AQ3/Near Chandanwari Village	4-5-2022 to 5-5-2022	27.6	66.8	8.2	11.2
	7-5-2022 to 8-5-2022	25.4	64.7	8.4	12.2
	11-5-2022 to 12-5-2022	25.5	63.2	9.1	12.3
	14-5-2022 to 15-5-2022	27.7	63.6	9.1	12.7
	18-5-2022 to 19-5-2022	25.3	64.9	9.2	11.3
	21-5-2022 to 22-5-2022	26.7	66.3	8.9	12.6
	25-5-2022 to 26-5-2022	25.1	63.6	8.2	11.2
	28-5-2022 to 29-5-2022	26.7	66.0	9.2	12.1
	Min	25.1	63.2	8.2	11.2
	Max	27.7	66.8	9.2	12.7
	Average	26.2	64.9	8.8	12.0
AQ4/NHPC Complex (Gingal Village)	2-5-2022 to 3-5-2022	21.1	53.5	8.0	8.1
	5-5-2022 to 6-5-2022	22.0	55.1	8.0	7.9
	9-5-2022 to 10-5-2022	21.3	53.5	7.7	8.1
	12-5-2022 to 13-5-2022	20.2	61.3	8.0	8.3
	16-5-2022 to 17-5-2022	19.4	59.9	7.8	8.1
	19-5-2022 to 20-5-2022	20.3	53.6	7.8	8.3
	23-5-2022 to 24-5-2022	18.2	56.7	6.7	8.0
	26-5-2022 to 27-5-2022	19.6	59.9	6.4	8.1
	Min	18.2	53.5	6.4	7.9
	Max	22.0	61.3	8.0	8.3
	Average	20.3	56.7	7.5	8.1
AQ5/Power House Site	3-5-2022 to 4-5-2022	25.3	60.1	9.2	10.3
	6-5-2022 to 7-5-2022	24.2	60.0	9.9	10.3
	10-5-2022 to 11-5-2022	22.9	58.8	9.4	11.2

Pre-monsoon Season					
Monitoring Location	Monitoring Schedule	Parameters ($\mu\text{g}/\text{m}^3$)			
		PM _{2.5}	PM ₁₀	SO ₂	NO ₂
	13-5-2022 to 14-5-2022	23.1	62.4	9.2	10.6
	17-5-2022 to 18-5-2022	22.3	64.2	9.8	11.2
	20-5-2022 to 21-5-2022	25.3	61.1	9.5	12.2
	24-5-2022 to 25-5-2022	26.2	59.9	9.4	10.6
	27-5-2022 to 28-5-2022	24.5	58.7	9.3	10.6
	Min	22.3	58.7	9.2	10.3
	Max	26.2	64.2	9.9	12.2
	Average	24.2	60.7	9.4	10.9
AQ6/Gurudwara near TRT Site	4-5-2022 to 5-5-2022	20.6	50.7	6.9	7.3
	7-5-2022 to 8-5-2022	21.3	53.5	7.1	7.5
	11-5-2022 to 12-5-2022	21.3	54.2	7.7	7.4
	14-5-2022 to 15-5-2022	21.9	52.5	7.1	7.7
	18-5-2022 to 19-5-2022	21.9	53.5	7.7	7.4
	21-5-2022 to 22-5-2022	20.6	54.2	6.1	7.6
	25-5-2022 to 26-5-2022	21.5	53.2	7.0	7.9
	28-5-2022 to 29-5-2022	20.6	55.4	7.8	7.7
	Min	20.6	50.7	6.1	7.3
	Max	21.9	55.4	7.8	7.9
	Average	21.2	53.4	7.2	7.5
Permissible Limit 24 h NAAQS 2009		60.0	100.0	80.0	80.0

The results of monitoring show that PM_{2.5}, PM₁₀, SO₂, and NO₂ levels at all the sites are well within the Residential & Rural area permissible limits prescribed by National Ambient Air Quality Standard 2009 notified by CPCB. Air quality was also assessed using 24h averages of PM_{2.5}, PM₁₀, SO₂, and NO₂ levels in the AQI calculator of CPCB and calculated AQI values given in **Table 3.17**. All the locations fall under the 'Satisfactory' category in the different seasons in the study area except at AQ2/near Barrage Site, AQ4/Near NHPC complex and AQ6/Gurudwara near TRT during monsoon season fall under 'Good' category in the study area (**Table 3.17**).

Table 3.17: Air Quality Index for Different Monitoring sites

Season/ Site	AQI					
	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6
Monsoon	63	50	60	49	54	43
Winter	68	52	61	54	57	50
Pre-monsoon	72	55	65	57	61	53
Air Quality = Good (0-50), Satisfactory (50-100), Moderate (100-200), Poor (200-300), Very Poor (300-400) and Severe (>400). AQ1 -AQ6: Air Quality Monitoring Site						

3.2.9 Noise & Traffic Monitoring

3.2.9.1 Sound Level

The results of sound levels monitoring i.e., equivalent Noise levels [Leq dB(A)] in the study area at given in **Table 3.18 (refer Figure 3.2)**. Levels were compared with the Ambient Air Quality Standard in respect of Noise, given in Schedule as part of The Noise Pollution (Regulation and Control) Rules, 2000 (amended to date). From the recorded values, day-time equivalent levels were calculated. From the data on sound pressure levels equivalent levels (Leq) for daytime, night-time, as well as day-night average, were calculated.

Table 3.18: Equivalent Noise levels (Leq dB(A) in the study area

Site Code	Monitoring location	Monsoon			Winter			Pre-monsoon			CPCB Limits	
		Leq Day dB(A)	Leq Night dB(A)	Leq Day and Night dB(A)	Leq Day dB(A)	Leq Night dB(A)	Leq Day and Night dB(A)	Leq Day dB(A)	Leq Night dB(A)	Leq Day and Night dB(A)	Day Time dB(A)	Night Time dB(A)
NT1	Gantamulla Payeen	61.2	47.2	60.1	60.0	46.3	58.9	63.1	48.7	61.9	55	45
NT2	Near Boniyar Town	63	48.6	61.8	61.1	47.1	60.0	65.0	50.1	63.7	55	45
NT3	NHPC Colony Road	50	39.1	49.7	53.3	41.2	52.6	56.7	43.8	55.8	55	45
NT4	Near Powerhouse Site	55	42.5	54.2	48.5	37.9	48.3	51.5	40.2	51.1	65	55
NT5	Near Gurudwara (Param Pilla Road)	46.6	36.4	46.5	45.2	35.3	45.2	48.0	37.5	47.8	55	45
NT6	Machhi Karand Village (NH1A)	53	41.4	52.5	51.4	40.1	51.0	54.6	42.7	54.0	55	45

As seen from **Table 3.18** equivalent sound levels during daytime as well as night-time were within prescribed standards of CPCB. The traffic data reveals that the Average Daily Traffic was highest at Boniyar town the only town in the study area and the minimum was recorded near Gurudwara (Param Pilla Road) in the study area.

3.2.9.2 Traffic Volume

The data on Average Daily Traffic collected during field surveys were compiled and is given in **Table 3.19**. The traffic data reveals that the Average Daily Traffic was highest at Boniyar town during all the seasons in the study area.

Table 3.19: Average Daily Traffic in the study area

Site Code	Monitoring Location	PCU factor	Monsoon			Winter			Pre-monsoon		
			HMV	LMV	TW	HMV	LMV	TW	HMV	LMV	TW
			3	1.5	0.5	3	1.5	0.5	3	1.5	0.5
NT1	Gantamulla Payeen (Near Army Entry Gate)	No. of vehicles/day	120	220	46	105	155	55	124	225	60
		No. of PCUs/day	360	330	23	315	232.5	27.5	372	337.5	30
NT2	Near Boniyar Town	No. of vehicles/day	90	250	67	126	178	76	92	255	70
		No. of PCUs/day	270	375	33.5	378	267	38	276	382.5	35
NT3	Near NHPC Complex	No. of vehicles/day	64	150	39	45	125	32	67	152	40
		No. of PCUs/day	192	225	19.5	135	187.5	16	201	228	20
NT4	Near Powerhouse Site	No. of vehicles/day	70	147	52	78	140	58	75	155	62
		No. of PCUs/day	210	220.5	26	234	210	29	225	232.5	31
NT5	Near Gurudwara (Param Pilla Road)	No. of vehicles/day	5	30	45	7	24	38	6	38	40
		No. of PCUs/day	15	45	22.5	21	36	19	18	57	20
NT6	Near Machhi Karand Village (NH1A)	No. of vehicles/day	82	210	79	72	138	47	83	220	80
		No. of PCUs/day	246	315	39.5	216	207	23.5	249	330	40

HMV= Heavy Motor Vehicle; LMV= Light Motor Vehicle; TW= Two Wheelers; PCUs: Passenger Car Units

Conclusion

Based upon the ambient air quality monitoring done in the study area, it is concluded that air quality, in general, is good and within the permissible limits of CPCB standards. Noise levels are also well within permissible limits as per CPCB standards.

Ambient Air Quality Monitoring Locations

	
AQ1: Army Entry Gate (Near Limber Village)	AQ2: Barrage Site (Uri-I Power Station)
	
AQ3: Near Chandanwari Village	AQ4: NHPC Complex (Gingal Village)
	
AQ5: Powerhouse Site	AQ6: Gurudwara near TRT Site

Noise and Traffic Monitoring in the Study Area

	
NT1: Gantamulla Payeen	NT2: Near Boniyar Town
	
NT3: Near NHPC Complex	NT4: Near Powerhouse Site
	
NT5: Near Gurudwara (Param Pilla Road)	NT6: Machhi Karand Village

3.2.10 Water Environment

3.2.10.1 Surface Water Quality

Analytical results of water quality at all 5 sampling locations during three seasons are given in **Table 3.20** and their location in the map is given in **Figure 3.3**. The pH varied from 6.59 to 8.06 during the monitoring. Dissolved oxygen ranged from 7.72 to 10.2 mg/l at all sampling locations. All the heavy metals were below detectable limits. Biological oxygen demand levels ranged from <2.0 mg/l at all sampling locations. Chemical oxygen demand levels ranged from <6.0 mg/l in samples collected in the study area.

Table 3.20: Physico-Chemical Characteristics of Surface water at different seasons

S. No.	Parameters	Season	Sampling Sites				
			SW1	SW2	SW3	SW4	SW5
1	Temperature (°C)	Monsoon	21.9	22.5	20	21.9	21.4
		Winter	5.1	6.2	4.3	5.3	7.04
		Pre-monsoon	24.5	25.4	25.6	25.6	26.7
2	pH	Monsoon	7.79	7.46	7.69	6.59	7.2
		Winter	7.71	6.95	7.74	8.06	7.2
		Pre-monsoon	7.7	7.3	7.5	7.7	7.1
3	Dissolved Oxygen (mg/l)	Monsoon	9.4	9.8	10.2	9.3	8.9
		Winter	8.5	8.32	8.77	7.72	9.11
		Pre-monsoon	9.2	9.8	9.2	8.8	8.9
4	Electrical Conductivity, (µs/cm)	Monsoon	210	240	150	220	250
		Winter	190	220	140	210	230
		Pre-monsoon	198	230	138	205	234
5	Total Dissolved Solids, mg/L	Monsoon	137	156	98	143	163
		Winter	124	143	91	137	150
		Pre-monsoon	128.7	149.5	89.7	133.25	152.1
6	Turbidity (NTU)	Monsoon	100	90	65	120	150
		Winter	4	3	4	5	4
		Pre-monsoon	45	64	5	55	70
7	Total Suspended Solids (mg/l)	Monsoon	124.5	109.5	97	134.5	167.2
		Winter	6.7	7	7.9	8.7	8.7
		Pre-monsoon	88.9	98.2	27.7	92.5	97.5
8	Chloride (as Cl), mg/L	Monsoon	10.2	7.8	12.2	7.8	8.4
		Winter	12.4	9	13.5	9.8	10.2
		Pre-monsoon	11.1	8.8	14.3	8.9	9.9
9	Total Alkalinity (as CaCO ₃), mg/L	Monsoon	75.6	76.3	44	72	89.7
		Winter	80	76.8	45	68	85
		Pre-monsoon	78.9	75.6	42	72	86.7
10	Total Hardness (as CaCO ₃), mg/L	Monsoon	92.13	88.05	63.44	88.53	96.33
		Winter	94.56	86.6	62.12	82.98	92.31
		Pre-monsoon	91.32	87.62	60.78	86.8	93.94
11	Calcium (as Ca), mg/L	Monsoon	29.8	30.3	19.8	30	32.3
		Winter	27	28.9	19.6	28.6	30.2
		Pre-monsoon	28	29.8	18.9	29.8	32
12	Magnesium (as Mg), mg/L	Monsoon	4.3	3	3.4	3.3	3.8
		Winter	6.6	3.5	3.2	2.8	4.1
		Pre-monsoon	5.2	3.2	3.3	3	3.4
13	Sulphate (as SO ₄), mg/L	Monsoon	2.9	2.6	2.2	6.9	3.2
		Winter	2.6	2.4	2	5.5	3
		Pre-monsoon	2.7	2.5	2.1	5.5	3.2
14	Nitrate (as NO ₃), mg/L	Monsoon	1.2	<0.1	<0.1	1.6	1.8
		Winter	1.1	<0.1	<0.1	1.2	1.2
		Pre-monsoon	1.12	<0.1	<0.1	1.4	1.5
15	Nitrite (NO ₂) (mg/l)	Monsoon	<0.1	<0.1	<0.1	<0.1	<0.1
		Winter	<0.1	<0.1	<0.1	<0.1	<0.1
		Pre-monsoon	<0.1	<0.1	<0.1	<0.1	<0.1

S. No.	Parameters	Season	Sampling Sites				
			SW1	SW2	SW3	SW4	SW5
16	Phosphates (P) (PO ₄) mg/L	Monsoon	0.34	<0.1	<0.1	0.88	0.54
		Winter	0.34	0.05	0.22	0.12	0.5
		Pre-monsoon	0.32	<0.1	0.24	0.8	0.55
17	Sodium, (Na) mg/L	Monsoon	3.4	2.4	1.6	2.8	5.8
		Winter	3	2.2	1.4	2.4	4.5
		Pre-monsoon	3.2	2.3	1.5	2.5	5.2
18	Potassium (K), mg/L	Monsoon	1.1	1.2	0.88	1.3	2
		Winter	0.8	1	0.8	1.1	1.8
		Pre-monsoon	1	1.2	0.82	1.2	1.9
19	Sodium Adsorption Ratio	Monsoon	0.2	0.1	0.1	0.1	0.3
		Winter	0.1	0.1	0.1	0.1	0.2
		Pre-monsoon	0.15	0.11	0.08	0.12	0.23
20	Silica (Si) (mg/l)	Monsoon	<1.0	<1.0	<1.0	<1.0	<1.0
		Winter	<1.0	<1.0	<1.0	<1.0	<1.0
		Pre-monsoon	<1.0	<1.0	<1.0	<1.0	<1.0
21	Iron (Fe), mg/l	Monsoon	0.12	0.04	0.05	0.02	0.05
		Winter	0.1	0.02	0.04	0.04	0.05
		Pre-monsoon	0.05	0.03	0.04	0.05	0.04
22	Phenolic Compound, mg/L	Monsoon	<0.01	<0.01	<0.01	<0.01	<0.01
		Winter	<0.01	<0.01	<0.01	<0.01	<0.01
		Pre-monsoon	<0.01	<0.01	<0.01	<0.01	<0.01
23	Oil and Grease, mg/L	Monsoon	<1.0	<1.0	<1.0	<1.0	<1.0
		Winter	<1.0	<1.0	<1.0	<1.0	<1.0
		Pre-monsoon	<1.0	<1.0	<1.0	<1.0	<1.0
24	Cadmium (Cd), mg/l	Monsoon	<0.001	<0.001	<0.001	<0.001	<0.001
		Winter	<0.001	<0.001	<0.001	<0.001	<0.001
		Pre-monsoon	<0.001	<0.001	<0.001	<0.001	<0.001
25	Arsenic (As), mg/l	Monsoon	<0.005	<0.005	<0.005	<0.005	<0.005
		Winter	<0.005	<0.005	<0.005	<0.005	<0.005
		Pre-monsoon	<0.005	<0.005	<0.005	<0.005	<0.005
26	Mercury (Hg), mg/l	Monsoon	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
		Winter	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
		Pre-monsoon	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
27	Copper (Cu), mg/l	Monsoon	<0.05	<0.05	<0.05	<0.05	<0.05
		Winter	<0.05	<0.05	<0.05	<0.05	<0.05
		Pre-monsoon	<0.05	<0.05	<0.05	<0.05	<0.05
28	Zinc (Zn), mg/l	Monsoon	<0.01	<0.01	<0.01	<0.01	<0.01
		Winter	<0.01	<0.01	<0.01	<0.01	<0.01
		Pre-monsoon	<0.01	<0.01	<0.01	<0.01	<0.01
29	Total Chromium (Cr), mg/l	Monsoon	<0.01	<0.01	<0.01	<0.01	<0.01
		Winter	<0.01	<0.01	<0.01	<0.01	<0.01
		Pre-monsoon	<0.01	<0.01	<0.01	<0.01	<0.01
30	Chromium 6 (Cr ⁺⁶), mg/l	Monsoon	<0.05	<0.05	<0.05	<0.05	<0.05
		Winter	<0.05	<0.05	<0.05	<0.05	<0.05
		Pre-monsoon	<0.05	<0.05	<0.05	<0.05	<0.05
31	Manganese (Mn),	Monsoon	<0.05	<0.05	<0.05	<0.05	<0.05

S. No.	Parameters mg/l	Season	Sampling Sites				
			SW1	SW2	SW3	SW4	SW5
		Winter	<0.05	<0.05	<0.05	<0.05	<0.05
		Pre-monsoon	<0.05	<0.05	<0.05	<0.05	<0.05
32	Lead (Pb), mg/l	Monsoon	<0.005	<0.005	<0.005	<0.005	<0.005
		Winter	<0.005	<0.005	<0.005	<0.005	<0.005
		Pre-monsoon	<0.005	<0.005	<0.005	<0.005	<0.005
33	Biological Oxygen Demand (mg/l)	Monsoon	<2	<2	<2	<2	<2
		Winter	<2	<2	<2	<2	<2
		Pre-monsoon	<2	<2	<2	<2	<2
34	Chemical Oxygen Demand (mg/l)	Monsoon	<6	<6	<6	<6	<6
		Winter	<6	<6	<6	<6	<6
		Pre-monsoon	<6	<6	<6	<6	<6
35	Total Coliform (MPN/100 ml)	Monsoon	<2	<2	<2	<2	<2
		Winter	<2	<2	<2	<2	<2
		Pre-monsoon	<2	<2	<2	<2	<2

The Permissible limit for Total Hardness (as CaCO_3) concentration as per Drinking Water Standards IS 10500: 2012 is 200 (mg/l). Based upon the Total Hardness concentration in water samples collected from different locations, the water is under the 'Soft and Moderately Hard Water' water category as per the standards given in the table below.

Total Hardness (as CaCO_3) (mg/l) Scale	Indication
0-60	Soft water
61-120	Moderately Hard Water
121-180	Hard water
>180	Very Hard Water

Surface water quality of Jhelum and its tributaries samples collected during monsoon, winter and pre-monsoon seasons was compared with the Water Quality Criteria of Central Pollution Control Board (http://www.cpcb.nic.in/Water_Quality_Criteria.php) fall under Class 'A' with Drinking-Water Source without conventional treatment but after disinfection, this is due to DO concentration is more than 6 mg/l, BOD is less than 2 mg/l, pH range between 6.5 and 8.5 and the Total coliform count is less than 50 MPN/100ml (Table 3.21).

Table 3.21: Water Quality Criteria for designated Best Use by CPCB, New Delhi

Designated-Best-Use	Class of water	Criteria
Drinking-Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less
		pH between 6.5 and 8.5
		Dissolved Oxygen 6mg/l or more
		Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less, pH between 6.5 and 8.5, Dissolved Oxygen 5mg/l or more
		Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less, pH between 6 and 9, Dissolved Oxygen 4mg/l or more
		Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wildlife and Fisheries	D	pH between 6.5 to 8.5, Dissolved Oxygen 4mg/l or more
		Free Ammonia (as N) 1.2 mg/l or less

Designated-Best-Use	Class of water	Criteria
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 and 8.5
		Electrical Conductivity at 25°C micromhos/cm Max.2250
		Sodium Absorption Ratio Max. 26
		Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

i. Drinking-Water Quality Index

A commonly-used water quality index (WQI) developed by the National Sanitation Foundation (NSF) in 1970 by Brown Oram (<https://water-research.net/index.php/water-treatment/water-monitoring/monitoring-the-quality-of-surfacewaters>) and Washington State Department of Ecology, Environmental Assessment Programme was used for assessing the surface water quality. The NSF WQI was developed to provide a standardized method for comparing the water quality of various bodies of water. The water quality index is a 100-point scale that summarizes results from a total of 9 different parameters listed below in the table.

pH	Delta Temperature Change (°C)	Total Phosphates (mg/L)
Dissolved Oxygen (DO) Saturation (%)	Total Coliforms (MPN/100ml)	Nitrates (mg/L)
Turbidity (NTU)	Biochemical Oxygen Demand (BOD) (mg/L)	Total Suspended Solids (TSS) (mg/L)

The analysis of water quality, therefore, is based upon 9 parameters as defined for WQI above, and based upon the score at each sampling site water quality has been designated as Excellent, Good, Medium, etc. as per the range defined in the table below.

Water Quality Index	
Range	Quality
90-100	Excellent
70-90	Good
50-70	Medium
25-50	Bad
0-25	Very bad

The water quality index based upon the above parameters is given in the **Table 3.22**.

Table 3.22: Surface water quality index Jhelum River and Its Tributaries

WQI	SW1	SW2	SW3	SW4	SW5
Monsoon	73.61	82.85	83.55	69.17	70.98
Winter	77.18	85.13	85.8	76.58	78.3
Pre-monsoon	76.04	83.13	83.72	73.84	73.19

According to WQI values obtained for different seasons surface water quality, in general, is in the 'Good' category in all the sampling locations in the study area.

Therefore, based upon CPCB guidelines as well the WQI calculated above the water of Jhelum River and its tributaries is safe for drinking without conventional treatment but after disinfection.

3.2.10.2 Ground Water Quality

Analytical results of Groundwater quality of a spring water located near Mahura (Mohra) Village in the study area are given in **Table 3.23**. The pH of Groundwater samples collected seasonally varied from 7.21 to 7.6. Electrical Conductivity varied from low of 76 $\mu\text{S}/\text{cm}$ to highest of 80 $\mu\text{S}/\text{cm}$. Total dissolved solids concentration in ground water sample varied from 40 mg/l to 49 mg/l. All the heavy metals were found to be below detectable limits.

Analytical results of Groundwater samples were compared with drinking water standards IS-10500:2012 to assess the status of Groundwater taken from Spring water as this water is used for drinking purposes in villages. All the samples were found within permissible limits as per drinking water standards prescribed by CPCB following IS-10500:2012.

Table 3.23: Physico-Chemical Characteristics of Ground water in different seasons

S. No.	Parameters	Monsoon	Winter	Pre-monsoon	CPCB Permissible Limits (IS 10500:2012)
1	Temperature (°C)	15.9	13.4	17.6	-
2	pH	7.23	7.21	7.6	6.5-8.5
3	Electrical Conductivity ($\mu\text{S}/\text{cm}$)	80	76	78	-
4	Total Dissolved Solids (mg/l)	40	49	42	2000
5	Turbidity (NTU)	<2	<2	<2	5
6	Total Suspended Solids (mg/l)	2	2	2	-
7	Chloride (as Cl) (mg/l)	60	56	58	1000
8	Total Alkalinity (mg/l)	160	178	165	600
9	Total Hardness (as CaCO_3) (mg/l)	163.6	175.2	162	600
10	Calcium (as Ca) (mg/l)	31	34	32	200
11	Magnesium (as Mg) (mg/l)	21	22	20	100
12	Sulphate (SO_4) (mg/l)	8	9	8	400
13	Nitrate (NO_3) (mg/l)	0.21	0.26	0.24	45
14	Nitrite (NO_2) (mg/l)	<0.1	<0.1	<0.1	-
15	Phosphate (as PO_4) (mg/l)	1.9	2	1.2	-
16	Sodium (mg/l)	42	44	45	-
17	Potassium (mg/l)	1.82	1.45	1.25	-
18	Silica (mg/l)	<1.0	<1.0	<1.0	-
19	Fluoride (mg/l)	0.16	0.14	0.15	1.5
20	Iron (Fe) (mg/l)	0.29	0.24	0.22	0.3
21	Phenolic Compounds (mg/l)	<0.01	<0.01	<0.01	0.002
22	Oil & Grease (mg/l)	<1.0	<1.0	<1.0	-
23	Residual Sodium Carbonate	-0.11	0.02	0.02	-
24	Cadmium (Cd) (mg/l)	<0.001	<0.001	<0.001	0.003
25	Arsenic (As) (mg/l)	<0.005	<0.005	<0.005	0.05
26	Mercury (Hg) (mg/l)	<0.0001	<0.0001	<0.0001	0.001
27	Copper (Cu) (mg/l)	<0.05	<0.05	<0.05	1.5
28	Zinc (Zn) (mg/l)	3.3	3.2	3.4	15
29	Total Chromium (Cr) (mg/l)	<0.05	<0.05	<0.05	0.05
30	Chromium-6 (Cr-6) (mg/l)	<0.05	<0.05	<0.05	0.05
31	Lead (Pb) (mg/l)	<0.005	<0.005	<0.005	0.01
32	Manganese (Mn) (mg/l)	<0.05	<0.05	<0.05	0.3
33	Biological Oxygen Demand (mg/l)	<2.0	<2.0	<2.0	-
34	Chemical Oxygen Demand (mg/l)	<6.0	<6.0	<6.0	-
35	Total Coliform (MPN/100ml)	<2.0	<2.0	<2.0	-

i. Drinking-Water Quality Index (DWQI)

Drinking water quality index was computed to assess the suitability of groundwater quality for drinking purpose, which is a mathematical tool to provide a comprehensive model of groundwater quality into a single number (Ramakrishnaiah *et al.*, 2009; Varol and Davraz, 2015; Narsimha *et al.*, 2018; Ramyapriya and Elango, 2018). The following five steps were involved in the calculation of the drinking water quality index for examination of individual chemical parameters (pH, TDS, Ca, Mg, Na, K, Bicarbonate, Cl, Sulphate, and Nitrates). The steps are: i) assignment of weight to each chemical parameter, ii) computation of relative weight, iii) calculation of water quality rating scale, iv) computation of water quality sub-indices for each chemical parameter and v) estimation of drinking water quality index.

Based upon DWQI range calculated based formula using parameters, have been categorized the Groundwater quality into different groups as shown below in **Table 3.24**.

Table 3.24: Drinking-Water Quality Standards

DWQI range	Water Quality
<50	Excellent
50-100	Good
100-200	Poor
200-300	Very poor
>300	Water unsuitable for drinking purpose

The DWQI calculated for Groundwater sample collected from the spring used as drinking water sources by nearby villagers in the study area is given in the table below. According to DWQI tabulated in the table below, All the samples of groundwater fall in 'Excellent' water quality class in all the sampling locations.

Table 3.25: Drinking-Water Quality Index

GWQI	Monsoon	Winter	Pre-monsoon
	17.66	17.98	18.29

Even though Total Hardness (as CaCO₃) concentration in the Groundwater samples from study area as per Drinking Water Standards IS 10500: 2012 is within permissible limits i.e. <600 (mg/l), based upon the Total Hardness concentration in water samples collected from drinking water source in the study area, the Groundwater is under 'Hard Water' category as per the standards given in the **Table 3.26**.

Table 3.26: Total Hardness Range

Total Hardness (as CaCO ₃) (mg/l) Scale	Indication
0-60	Soft water
61-120	Moderately Hard Water
121-180	Hard water
>180	Very Hard Water

3.2.10.3 Conclusion

- As seen from Table 3.22, the surface water quality in the study area, in general, is good. This is primarily due to the absence of any industrial establishment and low population density in and around the project area.

- The water of Jhelum River and its tributaries is categorized under Class 'A' i.e., with Drinking-Water Source without conventional treatment but after disinfection according to Water Quality Criteria of Central Pollution Control Board.
- Based upon CPCB guidelines as well as the Surface Water Quality Index calculated to access the water quality of Jhelum River and its tributaries, the surface water sources in the study area are safe for drinking without conventional treatment but after disinfection.
- According to BIS standards for Drinking Water (2012) the groundwater samples collected from the study area fall within permissible limits prescribed by CPCB.
- According to Drinking Water Quality Index calculated in Table 3.25, the ground water sample fall in 'Excellent' water quality class.

WATER SAMPLING LOCATIONS

	
SW1: Jhelum River Upstream of Reservoir area	SW2: Jhelum River: Reservoir area near Barrage Site
	
SW3: Boniyar Nalla: Downstream of Barrage site	SW4: Jhelum River: Near Gingal Village
	
SW5: Jhelum River: Downstream of Tailrace Outfall	GW1: Near Mahura Village

B. Biological Environment

3.2.11 Forest Types

The project area falls in Jhelum Valley Forest Division of UT of Jammu and Kashmir Forest Department. A large part of the vegetation is comprised of conifer forests especially in the surrounding of proposed project components. Forests in the study area can be classified following the 'A Revised Survey of the Forest Types of India' by Champion and Seth (1968) and fall under **Group 12-Himalayan Moist Temperate Forest and Group 13-Dry Temperate Forest**. Further, forest in the area can be categorized under following four sub-groups:

12/C1/f: Low-level Blue Pine Forest

This type of forest is distributed within an altitude of 1700 to 2300 metres on relatively drier but easy slopes as well as fresh alluvium, the Karewa formations and degenerated sites. These forests are dominated by *Pinus wallichiana* and its colonisation in the recent and exposed sites is common feature. These forests are seral in nature and are distributed over the gentle to moderately steep slopes on either sides of the low lying perennial Nallas of the division. The associated plant species are *Juglans regia*, *Aesculus indica*, *Fraxinus excelsior*, *Parrotiopsis jacquemontiana*, *Viburnum grandiflorum*, *Cotoneaster bacillaris*, *Indigofera heterantha*, *Berberis lycium*, *Plantago* spp., *Rubus* spp., etc.

13/C2b: Dry Deodar Forest

This type of forest extends from 1600 to 2100 meters elevation, generally as pure crop. However, *Pinus wallichiana* is also mixed occasionally, particularly towards upper limits and on ill drained sites. Other most common associated plant species are *Juglans regia*, *Aesculus indica*, *Ulmus wallichiana*, *Fraxinus excelsior*, *Parrotiopsis jacquemontiana*, *Viburnum grandiflorum*, *Cotoneaster bacillaris*, *Indigofera heterantha*, *Berberis lycium*, *Taraxicum* spp., *Viola odorata*, *Fragaria nubicola*, etc.

12/Ce: Moist Temperate Deciduous Forest

This type of forest is distributed within an altitude of 1800-2750 meters in moist hollows and depressions often as strips along the hill streams and many of gentler slopes. These forests are comprised of the conifer species like *Pinus wallichiana*, *Abies pindrow* and the floor of valley carries broadleaved forest including *Ulmus villosa*, *Celtis australis*, *Juglans regia*, *Prunus padus*, *Fraxinus* with *Salix wallichiana* and *Populus ciliata* along the streams.

13/C3: West Himalayan Dry Temperate Deciduous Forest

This forest type is distributed within an altitudinal range of 1800 to 2700 meters and extends well into the dry zone behind the Himalayan axis, with rainfall under 1000 mm. This type is edaphic post climax to the coniferous forest on the slope. The common plant species are *Juglans regia*, *Prunus cornuta*, *Aesculus indica*, *Acer pictum*, *Fraxinus excelsior*, *Salix* spp., *Populus* spp., *Parrotiopsis jacquemontiana*, *Viburnum grandiflorum*, *Cotoneaster bacillaris*, *Skimmia* spp., *Indigofera heterantha*, *Sambucus* spp., *Rosa* spp., *Fragaria nubicola*, *Rumex nepalensis*, etc.

3.2.12 Floristics

The vegetation of the project area is quite diverse due to varied microclimatic and ecological factors. The vegetation is generally composed of coniferous forests mainly associated with broad-leaved forests or with their corresponding undergrowth at higher elevations. The following section on Terrestrial ecology is based on data collected during field surveys conducted in three seasons during 2021-22 at various localities within the study area.

Objectives

The main objectives of the floristic study is as follows:

- To prepare an inventory of plants (Angiosperms and Gymnosperms, Pteridophytes and Bryophytes) in the study area
- Assessment of trees, shrubs, and herbs diversity in the study area
- Determination of Importance Value Index, Shannon Wiener Diversity Index and Evenness Index for the trees, shrubs, and herbs in the study area.

3.2.12.1 Taxonomic Diversity

A total of 192 plant species, belonging to 67 families, were reported in the study area during three seasons study. A brief description of number of plant species recorded from various taxonomic groups is given in the following paragraphs. Details of plant species recorded during the field surveys along with no. of families, genera and species are given at **Table 3.27**.

Table 3.27: Number of species of different plant groups reported from the study area

S. No.	Habit	No. of Families	No. of Genera	No. of Species
1	Angiosperms			
	Trees	15	23	26
	Shrubs	21	34	39
	Herbs	31	84	90
	Grasses	2	10	13
	Climbers	6	6	6
2	Gymnosperms			
	Trees	2	5	5
	Shrubs	2	2	3
3	Pteridophytes	2	3	3
4	Bryophytes	2	2	2
5	Lichens	4	5	5

i. Angiosperms

As per data collected during 3 seasons (monsoon, winter and pre-monsoon) field surveys, an inventory of 174 species of plants belonging to angiosperms was compiled which includes plant species found in forested areas, scrub land, near agricultural fields and settlements, abandoned land, etc. This list includes 26 species of trees, 39 species of shrubs, 90 species of herbaceous plants, 13 species of grasses and 6 species of climbers. Dominant families in the area are Asteraceae (27 species) and Rosaceae (20 species), followed by Poaceae (10 species), Lamiaceae (10 species) and Fabaceae (8 species). List of angiosperms recorded from the area is given in **Table 3.28**.

Table 3.28: List of Angiosperms recorded from the study area

S. No.	Family / Botanical Name	Habit	S. No.	Family / Botanical Name	Habit
	Acanthaceae		47	<i>Arabidopsis thaliana</i>	Herb
1	<i>Justicia adhatoda</i>	Shrub	48	<i>Capsella bursa-pastoris</i>	Herb
2	<i>Strobilanthes urticifolia</i>	Herb	49	<i>Rorippa indica</i>	Herb
	Amaranthaceae			Cannabaceae	
3	<i>Achyranthes bidentata</i>	Herb	50	<i>Celtis australis</i>	Tree
4	<i>Axyris hybrida</i>	Herb	51	<i>Cannabis sativa</i>	Herb
5	<i>Chenopodium album</i>	Herb		Caprifoliaceae	
6	<i>Gomphrena celosioides</i>	Herb	52	<i>Lonicera angustifolia</i>	Shrub
	Apiaceae		53	<i>Sambucus wightiana</i>	Shrub
7	<i>Angelica glauca</i>	Herb	54	<i>Valeriana jatamansi</i>	Herb
8	<i>Carum carvi</i>	Herb		Caryophyllaceae	
9	<i>Chaerophyllum reflexum</i>	Herb	55	<i>Arenaria serpyllifolia</i>	Herb
10	<i>Heracleum lanatum</i>	Herb	56	<i>Stellaria monosperma</i>	Herb
	Araliaceae			Celastraceae	
11	<i>Hedera nepalensis</i>	Climber	57	<i>Euonymus lucidus</i>	Tree
	Apocynaceae			Convolvulaceae	
12	<i>Vincetoxicum hirundinaria</i>	Herb	58	<i>Cuscuta reflexa</i>	Herb
	Asteraceae			Cyperaceae	
13	<i>Ageratina adenophora</i>	Shrub	59	<i>Carex infusca</i>	Grass
14	<i>Artemisia nilagirica</i>	Shrub	60	<i>Carex obscura</i>	Grass
15	<i>Achillea millefolium</i>	Herb	61	<i>Eriophorum comosum</i>	Grass
16	<i>Ainsliaea aptera</i>	Herb		Dioscoreaceae	
17	<i>Anaphalis contorta</i>	Herb	62	<i>Dioscorea deltoidea</i>	Climber
18	<i>Anthemis cotula</i>	Herb		Elaeagnaceae	
19	<i>Artemisia filifolia</i>	Herb	63	<i>Elaeagnus umbellata</i>	Shrub
20	<i>Aster thomsonii</i>	Herb		Euphorbiaceae	
21	<i>Bidens pilosa</i>	Herb	64	<i>Ricinus communis</i>	Shrub
22	<i>Carduus edelbergii</i>	Herb	65	<i>Euphorbia pilosa</i>	Herb
23	<i>Centaurea iberica</i>	Herb		Fabaceae	
24	<i>Cichorium intybus</i>	Herb	66	<i>Bauhinia variegata</i>	Tree
25	<i>Cirsium wallichii</i>	Herb	67	<i>Robinia pseudoacacia</i>	Tree
26	<i>Erigeron aegyptiacus</i>	Herb	68	<i>Desmodium elegans</i>	Shrub
27	<i>Erigeron canadensis</i>	Herb	69	<i>Indigofera cassioides</i>	Shrub
28	<i>Cousinia thomsonii</i>	Herb	70	<i>Spartium junceum</i>	Shrub
29	<i>Dichrocephala integrifolia</i>	Herb	71	<i>Lespedeza cuneata</i>	Herb
30	<i>Erigeron bonariensis</i>	Herb	72	<i>Oxytropis humifusa</i>	Herb
31	<i>Erigeron multiradiatus</i>	Herb	73	<i>Trifolium pratense</i>	Herb
32	<i>Erigeron trilobus</i>	Herb		Geraniaceae	
33	<i>Galinsoga parviflora</i>	Herb	74	<i>Geranium lucidum</i>	Herb
34	<i>Inula racemosa</i>	Herb	75	<i>Geranium nepalense</i>	Herb
35	<i>Saussurea costus</i>	Herb	76	<i>Geranium wallichianum</i>	Herb
36	<i>Jacobaea analoga</i>	Herb		Grossulariaceae	
37	<i>Sonchus mauritanicus</i>	Herb	77	<i>Ribes glaciale</i>	Shrub
38	<i>Taraxacum officinale</i>	Herb		Hydrangeaceae	
39	<i>Youngia japonica</i>	Herb	78	<i>Deutzia staminea</i>	Shrub
	Balsaminaceae			Hypericaceae	
40	<i>Impatiens edgeworthii</i>	Herb	79	<i>Hypericum oblongifolium</i>	Shrub
41	<i>Impatiens glandulifera</i>	Herb		Iridaceae	
	Berberidaceae		80	<i>Iris kashmiriana</i>	Herb
42	<i>Berberis lycium</i>	Shrub		Juglandaceae	
	Betulaceae		81	<i>Juglans regia</i>	Tree
43	<i>Alnus nitida</i>	Tree		Lamiaceae	
44	<i>Corylus Jacquemontii</i>	Tree	82	<i>Pseudocaryopteris bicolor</i>	Shrub
	Boraginaceae		83	<i>Isodon rugosus</i>	Shrub
45	<i>Arnebia benthamii</i>	Herb	84	<i>Ajuga integrifolia</i>	Herb
46	<i>Cynoglossum zeylanicum</i>	Herb	85	<i>Clinopodium umbrosum</i>	Herb
	Brassicaceae		86	<i>Elsholtzia ciliata</i>	Herb

S. No.	Family / Botanical Name	Habit
87	<i>Lamium album</i>	Herb
88	<i>Nepeta laevigata</i>	Herb
89	<i>Origanum vulgare</i>	Herb
90	<i>Prunella vulgaris</i>	Herb
91	<i>Thymus linearis</i>	Herb
	Lythraceae	
92	<i>Punica granatum</i>	Shrub
	Malvaceae	
93	<i>Grewia optiva</i>	Tree
94	<i>Malva verticillata</i>	Herb
	Meliaceae	
95	<i>Toona ciliata</i>	Tree
96	<i>Toona sinensis</i>	Tree
	Moraceae	
97	<i>Ficus Palmata</i>	Tree
98	<i>Morus serrata</i>	Tree
	Nitrariaceae	
99	<i>Peganum harmala</i>	Herb
	Oleaceae	
100	<i>Fraxinus excelsior</i>	Tree
101	<i>Chrysojasminum humile</i>	Shrub
	Oxalidaceae	
102	<i>Oxalis corniculata</i>	Herb
	Papaveraceae	
103	<i>Argemone mexicana</i>	Herb
104	<i>Corydalis crassifolia</i>	Herb
	Plantaginaceae	
105	<i>Digitalis purpurea</i>	Herb
106	<i>Lindenbergia grandiflora</i>	Herb
107	<i>Plantago coronopus</i>	Herb
108	<i>Plantago major</i>	Herb
	Platanaceae	
109	<i>Platanus orientalis</i>	Tree
	Poaceae	
110	<i>Agrostis pilosula</i>	Grass
111	<i>Apluda mutica</i>	Grass
112	<i>Aristida adscensionis</i>	Grass
113	<i>Arundo donax</i>	Grass
114	<i>Chrysopogon fulvus</i>	Grass
115	<i>Eragrostis pilosa</i>	Grass
116	<i>Festuca kashmiriana</i>	Grass
117	<i>Poa annua</i>	Grass
118	<i>Poa himalayana</i>	Grass
119	<i>Poa stapfiana</i>	Grass
	Polygonaceae	
120	<i>Polygonum molle</i>	Herb
121	<i>Fagopyrum acutatum</i>	Herb
122	<i>Oxyria digyna</i>	Herb
123	<i>Persicaria nepalensis</i>	Herb
124	<i>Rumex hastatus</i>	Herb
125	<i>Rumex nepalensis</i>	Herb
	Primulaceae	
126	<i>Myrsine africana</i>	Shrub
127	<i>Primula denticulata</i>	Herb
	Ranunculaceae	
128	<i>Caltha palustris</i>	Herb
129	<i>Delphinium denudatum</i>	Herb
130	<i>Ranunculus arvensis</i>	Herb
131	<i>Thalictrum elegans</i>	Herb

S. No.	Family / Botanical Name	Habit
132	<i>Clematis montana</i>	Climber
	Rhamnaceae	
133	<i>Rhamnus virgata</i>	Shrub
	Rosaceae	
134	<i>Malus baccata</i>	Tree
135	<i>Prunus armeniaca</i>	Tree
136	<i>Prunus cornuta</i>	Tree
137	<i>Pyrus pashia</i>	Tree
138	<i>Sorbus cuspidata</i>	Tree
139	<i>Cotoneaster microphyllus</i>	Shrub
140	<i>Crataegus oxyacantha</i>	Shrub
141	<i>Prinsepia utilis</i>	Shrub
142	<i>Pyracantha crenulata</i>	Shrub
143	<i>Rosa macrophylla</i>	Shrub
144	<i>Rosa moschata</i>	Shrub
145	<i>Rosa webbiana</i>	Shrub
146	<i>Rubus foliosus</i>	Shrub
147	<i>Rubus macilentus</i>	Shrub
148	<i>Rubus niveus</i>	Shrub
149	<i>Sorbaria tomentosa</i>	Shrub
150	<i>Spiraea canescens</i>	Shrub
151	<i>Potentilla indica</i>	Herb
152	<i>Fragaria vesca</i>	Herb
153	<i>Rosa brunonii</i>	Climber
	Rubiaceae	
154	<i>Leptodermis lanceolata</i>	Shrub
155	<i>Rubia cordifolia</i>	Climber
	Rutaceae	
156	<i>Skimmia laureola</i>	Shrub
	Salicaceae	
157	<i>Populus ciliata</i>	Tree
158	<i>Salix alba</i>	Tree
159	<i>Salix tetrasperma</i>	Tree
	Sapindaceae	
160	<i>Acer caesium</i>	Tree
161	<i>Aesculus indica</i>	Tree
	Saxifragaceae	
162	<i>Bergenia ciliata</i>	Herb
163	<i>Saxifraga saginoides</i>	Herb
	Scrophulariaceae	
164	<i>Buddleja asiatica</i>	Shrub
165	<i>Verbascum thapsus</i>	Herb
	Simaroubaceae	
166	<i>Ailanthus excelsa</i>	Tree
	Ulmaceae	
167	<i>Ulmus wallichiana</i>	Tree
	Urticaceae	
168	<i>Boehmeria penduliflora</i>	Shrub
169	<i>Girardinia diversifolia</i>	Shrub
170	<i>Pouzolzia zeylanica</i>	Herb
171	<i>Urtica dioica</i>	Herb
	Viburnaceae	
172	<i>Viburnum cotinifolium</i>	Shrub
173	<i>Viburnum grandiflorum</i>	Shrub
	Vitaceae	
174	<i>Parthenocissus semicordata</i>	Climber

ii. Gymnosperms

Gymnosperms in the area are represented by 8 species belonging to 3 families and 7 genera. A list of gymnosperms recorded from the study area is given in **Table 3.29**.

Table 3.29: List of Gymnosperms recorded from the study area

S. No.	Family	Scientific Name
1	Cupressaceae	<i>Cupressus sempervirens</i>
2	Cupressaceae	<i>Juniperus communis</i>
3	Ephedraceae	<i>Ephedra vulgaris</i>
4	Ephedraceae	<i>Ephedra gerardiana</i>
5	Pinaceae	<i>Abies pindrow</i>
6	Pinaceae	<i>Cedrus deodara</i>
7	Pinaceae	<i>Picea smithiana</i>
8	Pinaceae	<i>Pinus wallichiana</i>

i. Lower Plants (Pteridophytes and Bryophytes)

In the study area presence of pteridophytes and bryophytes were observed along the streams and moist and wet places. The Pteridophyte group is represented by 3 species belong to 3 genera and 2 families. *Athyrium foliolosum*, *Pteris cretica* and *Pteridium aquilinum* are dominant pteridophyte species in the area. Bryophytes in the study area are represented by 2 species belonging to 2 families. *Funaria hygrometrica* and *Marchantia paleacea* are commonly found bryophytes in the study area. The list of Pteridophytes and Bryophytes recorded from the study area are list below in **Table 3.30**.

Table 3.30: List of lower plants recorded from the study area

S. No.	Family	Name of Species
Pteridophytes		
1	Athyriaceae	<i>Athyrium foliolosum</i>
2	Pteridaceae	<i>Pteris cretica</i>
3	Pteridaceae	<i>Pteris aquilinum</i>
Bryophytes		
1	Funariaceae	<i>Funaria hygrometrica</i>
2	Marchantiaceae	<i>Marchantia paleacea</i>

j. Lichens

During field survey five genera of Lichens were recorded from the study area. List of Lichens recorded are given below in **Table 3.31**.

Table 3.31: List of lichens recorded from the study area

S. No.	Family	Scientific Name
1	Physciaceae	<i>Anaptychia sp.</i>
2	Cladoniaceae	<i>Cladonia sp.</i>
3	Parmeliaceae	<i>Flavoparmelia sp.</i>
4	Parmeliaceae	<i>Usnea sp.</i>
5	Teloschistaceae	<i>Xanthoria sp.</i>

3.2.12.2 Rare, Endangered and Threatened (RET) Species

The conservation status (Rare, Endangered, and Threatened) of all 192 species of plants reported from the study area was assessed by consulting Red Data Book of Indian Plants and IUCN Red List of Threatened Species Version 2022-2.

As per the Red Data Book of Indian Plants published by Botanical Survey of India (https://bsienviis.nic.in/Database/RedlistedPlants_3940.aspx), *Acer caesium*, *Dioscorea deltoidea* and *Inula racemosa* are listed as Vulnerable (VU) species, while *Saussurea costus* is listed as Endangered (EN) species.

Out of 192 plant species reported from the study area, only 66 species were evaluated by IUCN ver. 2022-2 (**Table 3.32**). As per the IUCN Red List of Threatened Species 2022-2, *Saussurea costus* was listed under Critically Endangered (CR), *Angelica glauca* under Endangered (EN), *Ephedra gerardiana*, *Marchantia paleacea* and *Ulmus wallichiana* under Vulnerable (VU), *Sonchus mauritanicus* and *Fraxinus excelsior* were listed under Near Threatened (NT) category. The rest 59 plant species evaluated by IUCN are under Least Concern (LC) or Data Deficient (DD) category of IUCN Red List of Threatened Species ver. 2022-2. Rest 67 plant species are not evaluated by IUCN.

None of the species reported under Red Data Book of Indian Plants and IUCN ver. 2022-2 are recorded during field survey from project area as well as from study area.

Table 3.32: Conservation Status of Plant species as per IUCN ver. 2022-2

S. No.	Family/ Botanical Name	Conservation Status	S. No.	Family/ Botanical Name	Conservation Status
	Acanthaceae		18	<i>Elaeagnus umbellata</i>	LC
1	<i>Justicia adhatoda</i>	LC		Ephedraceae	
	Aceraceae		19	<i>Ephedra vulgaris</i>	LC
2	<i>Acer caesium</i>	LC	20	<i>Ephedra gerardiana</i>	VU
	Apiaceae			Fabaceae	
3	<i>Angelica glauca</i>	EN	21	<i>Bauhinia variegata</i>	LC
4	<i>Carum carvi</i>	LC	22	<i>Desmodium elegans</i>	LC
	Asteraceae		23	<i>Lespedeza cuneata</i>	LC
5	<i>Achillea millefolium</i>	LC	24	<i>Robinia pseudoacacia</i>	LC
6	<i>Cichorium intybus</i>	LC	25	<i>Trifolium pratense</i>	LC
7	<i>Saussurea costus</i>	CR		Funariaceae	
8	<i>Sonchus mauritanicus</i>	NT	26	<i>Funaria hygrometrica</i>	LC
9	<i>Taraxacum officinale</i>	LC		Geraniaceae	
	Berberidaceae		27	<i>Geranium wallichianum</i>	LC
10	<i>Berberis lycium</i>	LC		Hippocastanaceae	
	Betulaceae		28	<i>Aesculus indica</i>	LC
11	<i>Alnus nitida</i>	LC		Juglandaceae	
12	<i>Corylus jacquemontii</i>	DD	29	<i>Juglans regia</i>	LC
	Brassicaceae			Lamiaceae	
13	<i>Capsella bursa-pastoris</i>	LC	30	<i>Lamium album</i>	LC
	Cannabaceae		31	<i>Origanum vulgare</i>	LC
14	<i>Celtis australis</i>	LC	32	<i>Prunella vulgaris</i>	LC
	Convolvulaceae			Lythraceae	
15	<i>Cuscuta reflexa</i>	LC	33	<i>Punica granatum</i>	LC
	Cupressaceae			Malvaceae	
16	<i>Cupressus sempervirens</i>	LC	34	<i>Grewia optiva</i>	LC
17	<i>Juniperus communis</i>	LC		Marchantiaceae	
	Elaeagnaceae		35	<i>Marchantia paleacea</i>	VU

S. No.	Family/ Botanical Name	Conservation Status	S. No.	Family/ Botanical Name	Conservation Status
	Meliaceae			Ranunculaceae	
36	<i>Toona ciliata</i>	LC	51	<i>Caltha palustris</i>	LC
37	<i>Toona sinensis</i>	LC		Rhamnaceae	
	Moraceae		52	<i>Rhamnus virgata</i>	LC
38	<i>Ficus Palmata</i>	LC		Rosaceae	
	Oleaceae		53	<i>Malus baccata</i>	LC
39	<i>Fraxinus excelsior</i>	NT	54	<i>Prunus armeniaca</i>	DD
	Pinaceae		55	<i>Prunus padus</i>	LC
40	<i>Abies pindrow</i>	LC	56	<i>Pyracantha crenulata</i>	LC
41	<i>Cedrus deodara</i>	LC	57	<i>Pyrus pashia</i>	LC
42	<i>Picea smithiana</i>	LC	58	<i>Spiraea canescens</i>	LC
43	<i>Pinus wallichiana</i>	LC		Salicaceae	
	Plantaginaceae		59	<i>Populus ciliata</i>	LC
44	<i>Digitalis purpurea</i>	LC	60	<i>Salix alba</i>	LC
45	<i>Plantago major</i>	LC	61	<i>Salix tetrasperma</i>	LC
	Platanaceae			Saxifragaceae	
46	<i>Platanus orientalis</i>	DD	62	<i>Bergenia ciliata</i>	LC
	Poaceae			Scrophulariaceae	
47	<i>Arundo donax</i>	LC	63	<i>Verbascum thapsus</i>	LC
48	<i>Poa annua</i>	LC	64	<i>Buddleja asiatica</i>	LC
	Pteridaceae			Ulmaceae	
49	<i>Pteris cretica</i>	LC	65	<i>Ulmus wallichiana</i>	VU
50	<i>Pteridium aquilinum</i>	LC	66	<i>Urtica dioica</i>	LC

EN=Endangered; CR=Critically Endangered; VU=Vulnerable; NT=Near Threatened; DD=Data Deficient; LC=Least Concern

3.2.12.3 Community Structure in Study Area

In order to monitor long term changes in a community, it is first necessary to obtain baseline data on the structure of vegetation community. Community structure can be examined through the determination of various attributes of its component species and their association.

Community Structure

Vegetative sampling was carried out at six sites in the study area. Description of vegetation in various sampling sites in study area is discussed below:

i. Trees

Tree cover in the study area was mainly represented by conifers species observed in patches all over the study area. Out of 31 tree species of angiosperms and gymnosperms recorded during survey, 16 species were recorded during sampling at six identified sampling sites.

During the study *Cedrus deodara* was found to be dominant tree species in the area recorded from all the sampling sites. *Pinus wallichiana* and *Picea smithiana* are the other conifer species associated with *Cedrus deodara* in the study area. Among the broad leaf species, *Celtis australis*, *Fraxinus xanthoxyloides* and *Robinia pseudo-acacia* are dominant in area while, *Grewia optiva*, *Malus baccata*, *Prunus americana*, *Aesculus indica*, *Ailanthus excelsa*, *Juglans regia*, *Bauhinia variegata*, *Toona ciliata* and *Salix tetrasperma* are the species common in the area (**Table 3.33**).

ii. **Shrubs**

During study 39 species of shrubs were recorded from the study area. Out of 39 species, 19 species of shrubs were recorded from the six sampling sites. Based on estimated density, *Sorbaria tomentosa*, *Cotoneaster microphyllus*, *Desmodium elegans*, *Spartium junceum*, *Artemisia nilagirica* and *Myrsine africana* were the most dominant shrub species recorded during sampling at different sampling locations in the area.

Boehmeria platyphylla, *Gerardiana heterophylla*, *Indigofera cassioides*, *Viburnum grandiflorum*, *Caryopteris odorata*, and *Prinsepia utilis* were the other commonly found shrub species in the study area **Tables 3.34**.

iii. **Herbs**

During monsoon season sampling, herbaceous flora in the study area was dominated by grass species. Out of 90 herb species recorded during the survey, 35 species of herbs were recorded from sampling sites. The number of herbs in each site varies from 12 to 14 species. *Carex infusata* and *Apluda mutica* were the dominant grass species recorded during monsoon season survey. Among other herbaceous species *Anaphalis contorta*, *Achyranthes bidentata*, *Axyris hybrida*, *Chrysopogon fulvus*, *Fragaria vesca*, *Lindenbergia grandiflora*, *Ranunculus arvensis*, *Rumex hastatus* and *Thalictrum elegans* were common in the area (**Table 3.35**).

During winter season sampling for herbaceous flora a total of 28 species of herbs were recorded from all sampling sites (**Table 3.36**). Distribution of herbs at various sampling sites varies from 10 to 13 species at each site. Maximum number of herbs during sampling was recorded from sampling site V3 located on Left Bank of Jhelum River in the downstream area of Barrage site and at site V5 located near Powerhouse site.

Rumex hastatus and *Ephedra gerardiana* are most dominating herb species during winter season. Other herbs species found during winter season sampling in the sampling area were *Caltha palustris*, *Anaphalis contorta*, *Artemisia filifolia*, *Chenopodium album* and *Bidens pilosa*. Among grass species *Carex infusata*, *Eriophorum comosum*, *Apluda mutica* and *Chrysopogon fulvus* are common in the sampling area.

During pre-monsoon season sampling for herbaceous flora, a total of 36 species of herbs were recorded from all sampling sites (**Table 3.37**). Distribution of herbs at various sampling sites varies from 13 to 15 species at each site. The maximum number of herbs (15 species) in the sampling area was recorded from sampling site V5 located on the left bank of Jhelum River near Powerhouse site.

Rumex hastatus and *Ephedra gerardiana* were found to be the most dominating herb species in all study sites during pre-monsoon season. Other herbs species in the sampling area were *Lindenbergia grandiflora*, *Anaphalis contorta*, *Artemisia filifolia*, *Fragaria vesca*, *Geranium lucidum*, *Sorbaria tomentosa* and *Thalictrum elegans*.

Table 3.33: Community Structure –Trees

S. No.	Name of Species	V1				V2				V3				V4				V5				V6			
		F	D	Ab.	TBC	F	D	Ab.	TBC	F	D	Ab.	TBC	F	D	Ab.	TBC	F	D	Ab.	TBC	F	D	Ab.	TBC
1	<i>Aesculus indica</i>	30	30	1.00	0.88	--	--	--	--	--	--	--	--	--	--	--	--	50	60	1.20	0.74	--	--	--	--
2	<i>Ailanthus excelsa</i>	30	30	1.00	0.41	50	60	1.20	0.70	--	--	--	--	--	--	--	--	40	60	1.50	1.37	--	--	--	--
3	<i>Bauhinia variegata</i>	30	30	1.00	0.58	--	--	--	--	--	--	--	--	30	50	1.67	0.32	--	--	--	--	30	40	1.33	0.32
4	<i>Cedrus deodara</i>	80	150	1.88	2.88	90	160	1.78	1.26	60	160	3	1.21	60	110	1.83	1.14	60	130	2.17	1.10	50	60	1.20	0.99
5	<i>Celtis australis</i>	--	--	--	--	40	60	1.50	0.67	40	50	1.25	0.88	30	40	1.33	0.52	50	80	1.60	0.79	60	80	1.33	0.91
6	<i>Fraxinus excelsior</i>	40	70	1.75	0.97	--	--	--	--	50	80	2	0.46	--	--	--	--	--	--	--	--	20	30	1.50	0.33
7	<i>Grewia optiva</i>	--	--	--	--	--	--	--	--	10	10	1	0.22	--	--	--	--	--	--	--	--	--	--	--	--
8	<i>Juglans regia</i>	--	--	--	--	40	50	1.25	0.94	--	--	--	--	30	50	1.67	0.88	--	--	--	--	30	30	1.00	0.75
9	<i>Malus baccata</i>	--	--	--	--	--	--	--	--	--	--	--	--	20	20	1.00	0.73	20	20	1.00	0.31	--	--	--	--
10	<i>Picea smithiana</i>	20	20	1.00	0.79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11	<i>Pinus wallichiana</i>	60	80	1.33	1.09	60	60	1.00	1.14	30	60	2	1.03	40	60	1.50	0.86	40	80	2.00	0.73	--	--	--	--
12	<i>Populus ciliata</i>	--	--	--	--	40	50	1.25	0.54	30	50	2	0.70	--	--	--	--	--	--	--	--	--	--	--	--
13	<i>Prunus americana</i>	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	40	50	1.25	0.29	--	--	--	--
14	<i>Robinia pseudoacacia</i>	--	--	--	--	40	40	1.00	0.36	60	110	2	0.68	50	80	1.60	0.31	--	--	--	--	40	70	1.75	0.39
15	<i>Salix tetrasperma</i>	30	50	1.67	0.38	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	40	50	1.25	0.28
16	<i>Toona ciliata</i>	--	--	--	--	--	--	--	--	--	--	--	--	40	60	1.50	0.38	--	--	--	--	30	40	1.33	0.41

F=Frequency (%), D=Density (No. of Individuals/ha), Ab. =Abundance, TBC= Total Basal Area/ Cover (sq. m/ha)

Table 3.34: Community Structure –Shrubs

S. No.	Name of Species	V1			V2			V3			V4			V5			V6		
		Freq	Den.	Abu.	Freq	Den.	Abu.	Freq	Den.	Abu.	Freq	Den.	Abu.	Freq	Den.	Abu.	Freq	Den.	Abu.
1	<i>Artemisia nilagirica</i>	--	--	--	50	520	2.6	30	360	3.0	40	480	3.0	--	--	--	60	720	3.0
2	<i>Berberis lycium</i>	40	360	2.3	40	440	2.8	20	240	3.0	--	--	--	--	--	--	--	--	--
3	<i>Boehmeria platyphylla</i>	--	--	--	30	360	3.0	--	--	--	40	520	3.3	40	480	3.0	40	480	3.0
4	<i>Buddleja asiatica</i>	40	400	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5	<i>Caryopteris odorata</i>	--	--	--	--	--	--	40	360	2.3	30	400	3.3	--	--	--	40	480	3.0
6	<i>Cotoneaster microphyllus</i>	50	520	2.6	20	200	2.5	40	520	3.3	40	520	3.3	60	600	2.5	40	520	3.3
7	<i>Desmodium elegans</i>	--	--	--	50	600	3.0	20	240	3.0	40	400	2.5	40	480	3.0	60	760	3.2
8	<i>Ageratina adenophora</i>	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9	<i>Gerardiana heterophylla</i>	--	--	--	--	--	--	--	--	--	40	440	2.75	40	440	2.75	40	480	3.0
10	<i>Indigofera cassioides</i>	40	440	2.75	30	320	2.7	40	320	2	30	360	3	--	--	--	--	--	--
11	<i>Juniperus communis</i>	50	480	2.4	--	--	--	--	--	--	--	--	--	40	520	3.25	--	--	--

S. No.	Name of Species	V1			V2			V3			V4			V5			V6		
		Freq	Den.	Abu.	Freq	Den.	Abu.	Freq	Den.	Abu.	Freq	Den.	Abu.	Freq	Den.	Abu.	Freq	Den.	Abu.
12	<i>Justicia adhatoda</i>	40	440	2.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
13	<i>Myrsine africana</i>	40	440	2.75	70	720	2.6	40	360	2.25	40	480	3	--	--	--	--	--	--
14	<i>Prinsepia utilis</i>	--	--	--	--	--	--	--	--	--	--	--	--	50	640	3.2	40	480	3.0
15	<i>Ricinus communis</i>	--	--	--	--	--	--	--	--	--	--	--	--	50	640	3.2	--	--	--
16	<i>Rosa webbiana</i>	30	280	2.3	--	--	--	--	--	--	--	--	--	40	520	3.3	--	--	--
17	<i>Sorbaria tomentosa</i>	50	680	3.4	40	480	3.0	40	440	2.8	40	400	2.5	40	520	3.3	50	600	3.0
18	<i>Spartium junceum</i>	30	360	3	60	800	3.3	54.5	680	2.8	--	--	--	--	--	--	50	400	2
19	<i>Viburnum grandiflorum</i>	--	--	--	40	480	3.0	40	480	3.0	30	360	3.0	--	--	--	--	--	--

F=Frequency (%), D=Density (No. of Individuals/ha), Ab. =Abundance

Table 3.35: Community Structure –Herbs (Monsoon)

S.No.	Name of Species	V1		V2		V3		V4		V5		V6	
		Freq.	Den.	Freq.	Den.	Freq.	Den.	Freq.	Den.	Freq.	Den.	Freq.	Den.
1	<i>Achillea millefolium</i>	30	8000	--	--	--	--	--	--	--	--	--	--
2	<i>Achyranthes bidentata</i>	--	--	--	--	--	--	--	--	60	37000	--	--
3	<i>Anaphalis contorta</i>	50	32000	60	31000	--	--	--	--	50	24000	30	16000
4	<i>Apluda mutica</i>	40	43000	--	--	40	30000	40	28000	--	--	40	42000
5	<i>Artemisia filifolia</i>	30	26000	40	23000	40	30000	50	26000	--	--	--	--
6	<i>Axyris hybrida</i>	--	--	30	22000	--	--	50	38000	--	--	--	--
7	<i>Bidens pilosa</i>	--	--	--	--	--	--	60	28000	--	--	--	--
8	<i>Caltha palustris</i>	--	--	40	29000	--	--	--	--	--	--	50	26000
9	<i>Carex infusca</i>	--	--	--	--	50	30000	--	--	--	--	--	--
10	<i>Chenopodium album</i>	--	--	--	--	--	--	50	26000	60	30000	--	--
11	<i>Chrysopogon fulvus</i>	--	--	40	20000	--	--	--	--	30	26000	50	22000
12	<i>Corydalis crassifolia</i>	--	--	40	19000	--	--	--	--	--	--	--	--
13	<i>Dioscorea deltoidea</i>	--	--	50	16000	--	--	--	--	--	--	--	--
14	<i>Ephedra gerardiana</i>	40	17000	50	23000	--	--	--	--	40	27000	30	35000
15	<i>Erigeron bonariensis</i>	--	--	--	--	--	--	--	--	50	21000	--	--
16	<i>Eriophorum comosum</i>	--	--	--	--	50	27000	--	--	50	28000	--	--
17	<i>Fragaria vesca</i>	50	21000	60	25000	--	--	--	--	60	31000	60	30000
18	<i>Geranium wallichianum</i>	60	16000	--	--	50	22000	--	--	--	--	--	--
19	<i>Gomphrena celosioides</i>	--	--	--	--	--	--	50	21000	--	--	40	13000
20	<i>Hedera nepalensis</i>	--	--	--	--	--	--	--	--	50	15000	--	--
21	<i>Impatiens edgeworthii</i>	--	--	--	--	40	17000	--	--	--	--	50	15000
22	<i>Lindenbergia grandiflora</i>	40	13000	--	--	50	27000	50	25000	60	34000	--	--
23	<i>Oxalis corniculata</i>	--	--	--	--	50	19000	--	--	--	--	50	28000

S.No.	Name of Species	V1		V2		V3		V4		V5		V6	
		Freq.	Den.	Freq.	Den.	Freq.	Den.	Freq.	Den.	Freq.	Den.	Freq.	Den.
24	<i>Plantago lanceolata</i>	--	--	--	--	--	--	60	15000	--	--	--	--
25	<i>Plantago major</i>	--	--	--	--	--	--	--	--	40	37000	--	--
26	<i>Pteridium aquilinum</i>	40	23000	--	--	--	--	--	--	60	36000	50	31000
27	<i>Ranunculus arvensis</i>	--	--	40	25000	--	--	60	30000	--	--	--	--
28	<i>Rumex hastatus</i>	50	26000	--	--	60	33000	60	30000	60	32000	50	26000
29	<i>Saxifraga saginoides</i>	--	--	--	--	40	20000	--	--	--	--	50	24000
30	<i>Sonchus arvensis</i>	--	--	--	--	--	--	--	--	50	21000	--	--
31	<i>Strobilanthes attenuata</i>	50	24000	40	21000	--	--	--	--	--	--	--	--
32	<i>Thalictrum elegans</i>	--	--	70	28000	60	30000	40	22000	--	--	--	--
33	<i>Urtica dioica</i>	50	17000	--	--	60	22000	--	--	--	--	40	19000
34	<i>Verbascum thapsus</i>	--	--	50	10000	--	--	--	--	--	--	--	--
35	<i>Vincetoxicum hirundinaria</i>	--	--	--	--	50	13000	--	--	--	--	--	--

F=Frequency (%), D=Density (No. of Individuals/ha), Ab. =Abundance

Table 3.36: Community Structure – Herbs (Winter)

S. No.	Name of Species	V1		V2		V3		V4		V5		V6	
		Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.
1	<i>Ajuga bracteosa</i>	30	8000	--	--	40	14000	--	--	--	--	30	11000
2	<i>Anaphalis contorta</i>	50	21000	60	31000	--	--	--	--	30	15000	--	--
3	<i>Apluda mutica</i>	40	43000	--	--	50	27000	40	23000	--	--	40	29000
4	<i>Artemisia filifolia</i>	30	26000	40	23000	60	28000	40	22000	40	19000	--	--
5	<i>Axyris hybrida</i>	--	--	30	22000	--	--	--	--	--	--	--	--
6	<i>Bidens pilosa</i>	--	--	--	--	--	--	60	28000	--	--	--	--
7	<i>Caltha palustris</i>	--	--	40	29000	--	--	--	--	--	--	40	20000
8	<i>Carex infusata</i>	--	--	--	--	40	25000	--	--	--	--	--	--
9	<i>Chenopodium album</i>	--	--	--	--	--	--	50	26000	40	19000	--	--
10	<i>Chrysopogon fulvus</i>	40	31000	40	20000	--	--	--	--	40	22000	50	29000
11	<i>Corydalis crassifolia</i>	--	--	40	19000	--	--	--	--	--	--	--	--
12	<i>Dioscorea deltoidea</i>	--	--	50	16000	--	--	--	--	--	--	--	--
13	<i>Ephedra gerardiana</i>	40	17000	50	23000	--	--	--	--	60	26000	40	35000
14	<i>Eriophorum comosum</i>	--	--	--	--	40	22000	--	--	40	21000	--	--
15	<i>Fragaria vesca</i>	--	--	--	--	--	--	--	--	40	18000	50	18000
16	<i>Geranium wallichianum</i>	--	--	--	--	40	11000	--	--	--	--	--	--
17	<i>Gomphrena celosioides</i>	--	--	--	--	--	--	40	17000	--	--	30	12000
18	<i>Hedera nepalensis</i>	--	--	--	--	--	--	--	--	40	14000	--	--
19	<i>Lindenbergia grandiflora</i>	40	13000	--	--	40	16000	50	25000	--	--	--	--

S. No.	Name of Species	V1		V2		V3		V4		V5		V6	
		Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.
20	<i>Oxalis corniculata</i>	--	--	--	--	40	14000	--	--	--	--	50	21000
21	<i>Plantago lanceolata</i>	--	--	--	--	--	--	60	14000	40	18000	--	--
22	<i>Pteridium aquilinum</i>	40	23000	--	--	--	--	--	--	30	13000	40	18000
23	<i>Ranunculus arvensis</i>	--	--	40	25000	--	--	40	23000	--	--	--	--
24	<i>Rumex hastatus</i>	50	26000	--	--	70	35000	60	30000	50	24000	50	23000
25	<i>Sonchus arvensis</i>	--	--	--	--	--	--	--	--	30	13000	--	--
26	<i>Strobilanthes attenuata</i>	50	24000	--	--	--	--	--	--	--	--	--	--
27	<i>Thalictrum elegans</i>	--	--	70	28000	50	18000	50	25000	--	--	--	--
28	<i>Verbascum thapsus</i>	--	--	50	10000	40	12000	--	--	--	--	--	--

F=Frequency (%), D=Density (No. of Individuals/ha), Ab. =Abundance

Table 3.37: Community Structure – Herbs (Pre-monsoon)

S. No.	Name of Species	V1		V2		V3		V4		V5		V6	
		Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.
1	<i>Achillea millefolium</i>	60	1700	--	--	--	--	--	--	--	--	--	--
2	<i>Achyranthes bidentata</i>	--	--	--	--	--	--	--	--	60	3600	--	--
3	<i>Anaphalis contorta</i>	80	2500	70	3200	--	--	--	--	70	3200	40	2000
4	<i>Anthemis cotula</i>	--	--	50	1900	60	1900	--	--	50	2500	--	--
5	<i>Artemisia filifolia</i>	50	3000	50	1900	50	3200	60	2600	--	--	--	--
6	<i>Axyris hybrida</i>	--	--	60	3000	--	--	70	3300	--	--	--	--
7	<i>Bidens pilosa</i>	--	--	--	--	--	--	60	2900	--	--	--	--
8	<i>Caltha palustris</i>	--	--	50	2500	--	--	--	--	--	--	60	2800
9	<i>Cannabis sativa</i>	60	1500	--	--	50	1700	--	--	--	--	50	1600
10	<i>Centaurea iberica</i>	50	1200	--	--	--	--	60	2200	40	1500	50	1600
11	<i>Chenopodium album</i>	--	--	--	--	--	--	50	1800	50	3000	--	--
12	<i>Corydalis crassifolia</i>	--	--	50	2200	--	--	--	--	--	--	--	--
13	<i>Dioscorea deltoidea</i>	--	--	60	1300	--	--	--	--	--	--	--	--
14	<i>Ephedra gerardiana</i>	70	3100	50	2300	--	--	--	--	70	4000	60	4400
15	<i>Erigeron bonariensis</i>	--	--	--	--	--	--	--	--	70	2300	--	--
16	<i>Fragaria vesca</i>	50	2300	70	1900	--	--	--	--	60	2600	50	2800
17	<i>Geranium lucidum</i>	80	2600	60	2300	--	--	--	--	40	1800	50	2800
18	<i>Geranium wallichianum</i>	60	1700	--	--	70	2400	--	--	--	--	--	--
19	<i>Gomphrena celosioides</i>	--	--	--	--	--	--	50	2200	--	--	60	1800
20	<i>Hedera nepalensis</i>	--	--	--	--	--	--	--	--	50	1700	--	--
21	<i>Impatiens edgeworthii</i>	--	--	--	--	70	2600	--	--	--	--	50	2200

S. No.	Name of Species	V1		V2		V3		V4		V5		V6	
		Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.	Freq	Den.
22	<i>Lindenbergia grandiflora</i>	60	1900	--	--	60	3200	70	2800	60	3500	--	--
23	<i>Oxalis corniculata</i>	--	--	--	--	60	2500	--	--	--	--	50	2700
24	<i>Plantago lanceolata</i>	--	--	--	--	--	--	60	1500	--	--	--	--
25	<i>Plantago major</i>	--	--	--	--	--	--	--	--	50	3700	--	--
26	<i>Polygonum nepalensis</i>	--	--	--	--	--	--	60	3000	--	--	--	--
27	<i>Ranunculus arvensis</i>	--	--	60	2400	--	--	60	3000	--	--	--	--
28	<i>Rumex hastatus</i>	50	2600	--	--	50	2500	60	3600	50	2900	60	3500
29	<i>Saxifraga saginoides</i>	--	--	--	--	60	2400	--	--	--	--	40	1900
30	<i>Sonchus arvensis</i>	--	--	--	--	--	--	--	--	50	2500	--	--
31	<i>Sorbaria tomentosa</i>	60	1600	--	--	60	3000	50	1800	50	1900	30	1100
32	<i>Strobilanthes attenuata</i>	60	2800	50	2000	--	--	--	--	--	--	--	--
33	<i>Thalictrum elegans</i>	--	--	60	2300	60	3000	60	3100	--	--	--	--
34	<i>Urtica dioica</i>	60	2200	--	--	70	2800	--	--	--	--	--	--
35	<i>Verbascum thapsus</i>	--	--	40	1200	--	--	--	--	--	--	40	1900
36	<i>Vincetoxicum hirundinaria</i>	--	--	--	--	60	1800	--	--	--	--	--	--

F=Frequency (%), D=Density (No. of Individuals/ha), Ab. =Abundance

LANDUSE AND VEGETATION COVER IN THE STUDY AREA**UPSTREAM OF RESERVOIR NEAR GANTAMULLA VILLAGE****NEAR RESERVOIR AREA****ALONG BONIYAR NALLA**



CONFLUENCE OF JHELUM RIVER AND BONIYAR Nalla



JHELUM RIVER NEAR POWERHOUSE



NEAR TAIL RACE OUTLET



JHELMUM RIVER UPSTREAM OF GINGAL VILLAGE



VEGETATION SURVEY NEAR DOWNSTREAM OF RESERVOIR

3.2.12.4 *Density & Dominance*

i. Density

Density is one of the indicators to assess the dominance of a plant species occurring in an area. The density of trees varied from site to site depending upon elevation, land use pattern, and the extent of the area subjected to road construction in the area.

The total tree density, throughout the study area, ranged from a minimum of 460 plants/ha, recorded from sampling site V1 located at Gantamulla village, to the maximum of 520 plants/ha at sampling site V3 located at the downstream of barrage site (**Table 3.38**).

In case of shrubs, the density varied from 4000 plants/ha to 4920 plants/ha. The lowest density was estimated at the sampling site V3 located at the downstream of barrage site and the highest at sampling site V2 and V6 which are located at Barrage site and Downstream of Uri-I Power Station near Tail Race Outfall, respectively **Table 3.38**.

In case of herbaceous plants, in monsoon season, the highest plant density was recorded at the Site V6 (3,27,000 plants/ha) at Downstream of Uri-I Power Station near Tail Race Outfall. On the other hand, the lowest density was observed at the Site V1 (2,66,000 plants/ha) at Gantamulla

village.

In winter season, the highest density was recorded at the Site V2 (2,46,000 plants/ha) around barrage site. Whereas the lowest was observed at the Site V6 (2,16,000 plants/ha) locates near the Tail Race Outfall.

In Pre-monsoon season, the highest density was recorded at Site V5 (4,07,000 plants/ha) near Powerhouse site which was followed by at Site V4 (3,38,000 plants/ha). The lowest was recorded at the Site V2 (3,04,000 plants/ha) around Barrage Site.

When comparing all three season data, the highest herb density was found in the pre-monsoon season, followed by monsoon and the lowest winter season.

Table 3.38: Density (plants per ha) of Trees

Sites	Tree	Shrub	Herbs		
			Monsoon	Winter	Pre-monsoon
V1	460	4400	2,66,000	2,32,000	3,07,000
V2	480	4920	2,92,000	2,46,000	3,04,000
V3	520	4000	3,20,000	2,22,000	3,30,000
V4	470	4360	2,89,000	2,33,000	3,38,000
V5	480	4840	3,99,000	2,22,000	4,07,000
V6	400	4920	3,27,000	2,16,000	3,31,000

ii. Dominance

The area was dominated mostly by *Cedrus deodara*, the species was structurally most important tree species at all sampling sites with highest IVI value, which was followed by *Pinus wallichiana* (Table 3.39). Among angiosperms, *Celtis australis*, *Robinia pseudoacacia*, *Ailanthus excelsa* and *Juglans regia* were having the highest IVI values and were structurally the most important tree species recorded in the study area (see the Table 3.39).

Table 3.39: IVI (Importance Value Index) of tree species at different sampling locations

S. No.	Name of Species	V1	V2	V3	V4	V5	V6
1	<i>Aesculus indica</i>	26.89	--	--	--	43.10	--
2	<i>Ailanthus excelsa</i>	21.04	38.80	--	--	51.53	--
3	<i>Bauhinia variegata</i>	23.18	--	--	26.81	--	27.23
4	<i>Cedrus deodara</i>	93.71	80.76	75.59	65.53	67.77	54.28
5	<i>Celtis australis</i>	--	35.61	40.82	28.65	48.11	60.89
6	<i>Fraxinus excelsior</i>	39.88	--	42.18	--	--	21.77
7	<i>Grewia optiva</i>	--	--	9.81	--	--	--
8	<i>Juglans regia</i>	--	38.30	--	37.74	--	34.58
9	<i>Malus baccata</i>	--	--	--	25.16	16.70	--
10	<i>Picea smithiana</i>	20.46	--	--	--	--	--
11	<i>Pinus wallichiana</i>	49.84	49.55	42.08	42.82	43.69	--
12	<i>Populus ciliata</i>	--	31.12	33.83	--	--	--
13	<i>Prunus americana</i>	--	--	--	--	29.11	--
14	<i>Robinia pseudoacacia</i>	--	25.87	55.69	39.76	--	39.65
15	<i>Salix tetrasperma</i>	25.01	--	--	--	--	32.15
16	<i>Toona ciliata</i>	--	--	--	33.53	--	29.45

3.2.12.5 Distribution

A/F Ratio is a measure of the distribution of a species over an area i.e., whether it is homogeneously distributed or has a clumped distribution. A/F ratio <0.025 indicates regular distribution, between 0.025 and 0.05 indicates random distribution while >0.05 indicates clumped or contagious distribution.

During the study, *Cedrus deodara*, *Pinus wallichiana* and *Ailanthus excelsa* were only species which showed a regular distribution at Site V1 and V2 (**Table 3.40**). *Salix tetrasperma* was the only species having a clumped distribution at the Site V1. Other species showed a random distribution at the Site V1 and V2 as the value of A/F ratio was between 0.025 – 0.05.

At the Site V3, *Grewia optiva*, *Pinus wallichiana* and *Populus ciliate* showed a contagious distribution. The remaining species were having a random distribution. Whereas, at the Site V4, *Juglans regia* was the only species which showed a clumped distribution. Other species were having a random distribution.

At the Site V5, all the species showed a random distribution except *Aesculus indica*, which was having a regular distribution as the value of A/F ratio was <0.025 .

In case of the Site V6, *Fraxinus excelsior* was having a clumped distribution and *Cedrus deodara* & *Celtis australis* showed a regular distribution. All the other species showed a random distribution.

Table 3.40: A/F ratio of tree species

S. No.	Name of Species	V1	V2	V3	V4	V5	V6
1	<i>Aesculus indica</i>	0.033	--	--	--	0.024	--
2	<i>Ailanthus excelsa</i>	0.033	0.024	--	--	0.038	--
3	<i>Bauhinia variegata</i>	0.033	--	--	0.056	--	0.044
4	<i>Cedrus deodara</i>	0.023	0.020	0.044	0.031	0.036	0.024
5	<i>Celtis australis</i>	--	0.038	0.031	0.044	0.032	0.022
6	<i>Fraxinus excelsior</i>	0.044	--	0.032	--	--	0.075
7	<i>Grewia optiva</i>	--	--	0.100	--	--	--
8	<i>Juglans regia</i>	--	0.031	--	0.056	--	0.033
9	<i>Malus baccata</i>	--	--	--	0.050	0.050	--
10	<i>Picea smithiana</i>	0.050	--	--	--	--	--
11	<i>Pinus wallichiana</i>	0.022	0.017	0.067	0.038	0.050	--
12	<i>Populus ciliata</i>	--	0.031	0.056	--	--	--
13	<i>Prunus americana</i>	--	--	--	--	0.031	--
14	<i>Robinia pseudoacacia</i>	--	0.025	0.031	0.032	--	0.044
15	<i>Salix tetrasperma</i>	0.056	--	--	--	--	0.031
16	<i>Toona ciliata</i>	--	--	--	0.038	--	0.044

3.2.12.6 Species Diversity Index (H') & Evenness Index (E)

I. Diversity

To understand species diversity, the Shannon-Wiener Diversity Index (H') and Evenness Indices were calculated for trees, shrubs, and herbs (see **Table 3.41**).

Among the tree species, diversity Index was lowest at sampling site V3 located in the downstream of barrage site in the right bank of Jhelum River (1.75) and highest at sampling site V6 located in the downstream of TRT outfall along the Jhelum River (2.02). Among shrubs, the

highest species diversity was recorded at site V4 located near Gingal Village (2.29) and lowest at site V6 located in the downstream of project area along Jhelum River (2.18). (**Table 3.41**).

Diversity of herb species during pre-monsoon season was recorded relatively higher as compared to the monsoon and winter season (**Table 3.41**). During pre-monsoon season highest diversity for herb was recorded for sampling site V5 (2.67) located near Powerhouse site and lowest at site V4 located on the left bank of Jhelum River near Gingal village (2.54).

Table 3.41: Species Diversity Index (H')

Sampling Sites	Tree	Shrub	Herb		
			Monsoon	Winter	Pre-monsoon
V1	1.87	2.28	2.49	2.22	2.60
V2	1.82	2.24	2.53	2.36	2.61
V3	1.75	2.25	2.53	2.33	2.55
V4	1.99	2.29	2.46	2.28	2.54
V5	1.84	2.19	2.61	2.46	2.67
V6	2.02	2.18	2.51	2.25	2.58

II. Evenness Index

Evenness Index (E) was calculated by using Evenness Index Formula and is indicative of distribution pattern of vegetation in any area. The Evenness Index of the tree species ranged between 0.90 and 0.97 (**Table 3.42**). Site V6 (0.97) showed a relatively higher evenness value as compared to the other sites. The lowest (0.90) was calculated at the Site V1 and V3 which means these sites were represented by a single tree species (**Table 3.42**).

In case of shrubs, the Evenness value ranged from 0.97 to 0.99. The evenness values in all sites showed that the shrub species were evenly distributed in all the study sites.

In case of herbs, the Evenness values in monsoon and pre-monsoon seasons showed that the herb species were evenly distributed in all sampling sites as the values were mostly close to 1. During winter season, the Evenness values ranged from 0.91 to 0.99. The values lies close to 1 in most of the sites except site V3 (0.91) and V4 (0.92) where the values were relatively lower as compared to the other sites (**Table 3.42**).

Table 3.42: Evenness Index (E) of Plant Species

Sites	Tree	Shrub	Herbs		
			Monsoon	Winter	Pre-monsoon
V1	0.90	0.99	0.97	0.97	0.99
V2	0.94	0.97	0.99	0.98	0.99
V3	0.90	0.98	0.99	0.91	0.99
V4	0.96	0.99	0.99	0.92	0.99
V5	0.95	0.99	0.99	0.99	0.99
V6	0.97	0.99	0.98	0.98	0.98

3.2.12.7 Economically Important and Medicinal Plant Species

i. Medicinal Plants

Local people in the area use many plants for different medicinal purposes. They use various plants for treating diseases like stomach disorders, diarrhoea, dysentery, cold, cough, fever, asthma, rheumatism, skin diseases, cuts, boil and injuries.

Ethnobotanical uses of plants for medicinal purposes especially by community in this area have been studied by the researchers like Lone and Jain (2022), Jan et al (2021), Wagay (2014) and Keng and Bano (2001). Although modern medical facilities are available in the area, still villagers in the area prefer using different plants species owing to their traditional belief. The rural and tribal men are well-versed with the symptoms of various types of diseases and with their herbal remedies because they have carried on practice traditionally by verbal instruction. A list of commonly used medicinal plants in the area is list below in **Table 3.43**.

Table 3.43: Medicinal Plant Species in the study area

S. No.	Botanical Name	Local Name	Parts used	Ailments
1	<i>Abies pindrow</i>	Budul	Leaves, Bark, Resin	Rashes, Rheumatism, Wounds, Swellings
2	<i>Achillea millefolium</i>	Phelgaus /Berguer	Leaves, Flowers	Inflamed gums, Toothache, snake bite, fever, headache and urinary disorders.
3	<i>Aesculus indica</i>	Handoon	Bark, Fruit	Tonic and febrifuge. Rheumatic pains. Cathartic.
4	<i>Ajuga bracteosa</i>	Janiadam	Leaves	Abdominal pain, Worms, Diarrhoea
5	<i>Anthemis cotula</i>	Fack gasa	Whole plant	Muscular pain
6	<i>Berberis lycium</i>	Kawdach	Fruits, Roots, & Bark	Wounds as they are coagulant, astringent. Cholera. Relieve indigestion, constipation and irregular bowl movement.
7	<i>Cannabis sativa</i>	Bang	Leaves	Regulate the menstrual cycle in women, checks the night urination in children. Narcotic
8	<i>Capsella bursa-pastoris</i>	Kral mond	Leaves	Diarrhoea
9	<i>Cedrus deodara</i>	Deodar	Stem	Fever
10	<i>Celtis australis</i>	Brimij	Leaves	Anti-inflammatory
11	<i>Centaurea iberica</i>	Kreach	Flower	Skin rashes, Wound healing
12	<i>Chenopodium album</i>	Liss	Leaves	Stimulate bowel movement, Intestinal worms, Diarrhoea
13	<i>Cuscuta reflexa</i>	Kokliport	Whole plant	Abortion. jaundice, stomache, and urinary disorders.
14	<i>Inula racemosa</i>	Poshkar	Root	Hypertension
15	<i>Juglans regia</i>	Doon	Bark, Leaves	Cleaning teeth, intestinal worms.
16	<i>Pinus wallichiana</i>	Kayar	Resin, Stem	Cracked heals, Wounds, Skin rashes, Boils
17	<i>Plantago major</i>	Bead-gul	Leaves	Rheumatic pain, Fractured bones, Dysentery
18	<i>Prunella vulgaris</i>	Kulwauth	Flowering Tops	Headache, fever, and body muscular pain.
19	<i>Punica granatum</i>	Daen	Fruit	General body tonic, Diarrhoea, Jaundice
20	<i>Ranunculus arvensis</i>	Dimm-gassh	Whole plant	Fungal infections, Diarrhoea
21	<i>Robinia pseudoacacia</i>	Kikar	Leaves	Chilblains, Swelling of joints, Fever
22	<i>Rubus niveus</i>	Chaanch	Leaves, Fruit	Menorrhagia, Fever, Tonsillitis
23	<i>Rumex nepalensis</i>	Abuj	Roots	Cough and constipation, Skin diseases.
24	<i>Salix alba</i>	Veer	Leaves and Branches	Rheumatism and dissolving blood clots in veins and arteries in heart patients
25	<i>Sambucus wightiana</i>	Gundula	Fruit, Root	Expel poisonous substances from stomach, Poliomyelitis, Diuretic
26	<i>Taraxacum officinale</i>	Hand	Leaves	Bone fractures
27	<i>Thymus linearis</i>	Jangli javind	Whole plant	Cough and fever.
28	<i>Trifolium pratense</i>	Tri patr / Batakunur	Flowers & leaves	Restore the irregular menses and to promote conception. Bronchitis, burns and sedation
29	<i>Urtica dioica</i>	Soi	Whole plant	Rheumatoid pains and fever, minor wounds.

ii. Wild Edible Plants

List of wild edible plants used by villagers in the study area was prepared in consultation with local population and published literatures like Showkat and Akhtar (2018) and the same is given at **Table 3.44**.

Table 3.44: Wild Edible Plants of the Study Area

S. No.	Botanical name/ Family	Vernacular name	Part used	Uses
1	<i>Berberis lycium</i>	Kawdach	Leaves	Raw leaves are eaten
2	<i>Capsella bursa pastoris</i>	Kralmund	Whole	Used as vegetable
3	<i>Centaurea iberica</i>	Kreaxeh	Leaves	Leaves are used as vegetable
4	<i>Chenopodium album</i>	kunne	Leaves	Leaves are cooked as vegetable
5	<i>Cichorium intybus</i>	Posh handh	Whole plant	Used as vegetable especially by women during pregnancy.
6	<i>Morus serrata</i>	Tul	Fruits	Fruits are eaten
7	<i>Plantago major</i>	bud gul	Whole	Used as vegetable in Juvenile stage.
8	<i>Punica granatum</i>	Daen	Fruits	Fruits are eaten
9	<i>Ranunculus arvensis</i>	Cherim	Whole plant	The green part of the plant is used as vegetable.
10	<i>Rubus foliosus</i>	chhanchh	Fruits	Fruits are eaten
11	<i>Rubus niveus</i>	chhanchh	Fruits	Fruits are eaten
12	<i>Taraxacum officinale</i>	Handh	Leaves	Young leaves are cooked and used as vegetable.
13	<i>Urtica dioica</i>	Soii	Leaves	Leaves are used as vegetable

iii. Timber Yielding Tree Species

A total number of 13 timber yielding tree species were found in the study area, illustrated in **Table 3.45**.

Table 3.45: Timber Yielding Trees of the Study Area

S. No.	Family	Species Name
1	Hippocastanaceae	<i>Aesculus indica</i>
2	Simaroubaceae	<i>Ailanthus excelsa</i>
3	Betulaceae	<i>Alnus nitida</i>
4	Fabaceae	<i>Bauhinia variegata</i>
5	Pinaceae	<i>Cedrus deodara</i>
6	Malvaceae	<i>Grewia optiva</i>
7	Juglandaceae	<i>Juglans regia</i>
8	Pinaceae	<i>Picea smithiana</i>
9	Pinaceae	<i>Pinus roxburghii</i>
10	Pinaceae	<i>Pinus wallichiana</i>
11	Platanaceae	<i>Platanus orientalis</i>
12	Rosaceae	<i>Pyrus pashia</i>
13	Meliaceae	<i>Toona ciliata</i>

3.2.12.8 Main Agricultural Crops Grown in the Area

According to Agro-Ecological Sub Region (ICAR) classification (2017), the study area falls under Western Himalayas, Warm Subhumid (To Humid with Inclusion of Perhumid) Eco-Region (14.2) and according to Agro Climatic Zone (NARP, 1998), it falls in the mid to high altitude temperate zone (JK-3). Primarily the economy of the district depends on horticultural crops, the major horticulture crops in the area are Apple, Pear, Cherry, Apricot, Walnut and Almond. Agricultural crops grown in the district are Paddy, Maize, Green-pea, Beans, pulses, and other fodder species.

3.2.13 Faunal Diversity

A list of faunal elements comprising mammals, birds, and butterflies found in the study area was

compiled from sightings during the field visits and supplemented by data collected from secondary sources as well as information provided by local people during field surveys. Among secondary sources, Forest Working Plan of the Jhelum Valley Forest Division, J&K Forest Department was consulted. In addition, data was compiled from published literatures like Prater (1998) for mammals, Daniel (2002) for reptiles, Ali & Ripley (1983), Grimmett *et al.* (1998, 2011), Inskipp *et al.* (1999) and Kazmierczak (2000) for birds and Kehimkar (2008) for butterflies. The classification and nomenclature of bird species are based upon <https://avibase.bsc-eoc.org/> accessed in December 2022. The classification and nomenclature of butterfly species are based upon <https://www.ifoundbutterflies.org/> (Butterflies of India).

3.2.13.1 Mammals

Presence of Mammals based upon Field Surveys

During field surveys only Rhesus macaque (*Macaca mulatta*) and Small Indian Mongoose (*Herpestes auropunctatus*) are the species sighted in the study area. Besides these, no other wild animal was sighted during field investigation. A list of mammals commonly reported in the area is listed in **Table 3.46**.

Data on mammals based upon secondary data

The data on mammals reported from the study area was compiled from the Forest Working Plan (implanting years 2020-21 to 2030-31) of the Jhelum Valley Forest Division after consultation with forest officials and villagers. Forest officials mentioned the presence of Common Leopard (*Panthera pardus*), Common Langur (*Semnopithecus entellus*), Himalayan Goral (*Naemorhedus goral*) and Asiatic black bear (*Ursus thibetanus*) in the study area lies under Jhelum Valley Forest Division and same was confirmed by villagers in the study area. However, no direct or indirect evidence could be recorded during the field survey about their presence in and around the project area. According to the list prepared as described above, 22 species of mammals are reportedly found in the area and the same is given in **Table 3.46**.

Table 3.46: List of Mammalian species reportedly found in the study area

S. No.	Family/Scientific name	Common name	Conservation status	
			IUCN 2022-2	WPA 2022
	ORDER: CETARTIODACTYLA			
	Family - Cervidae			
1	<i>Muntiacus muntjak</i>	Barking Deer	LC	II
2	<i>Naemorhedus goral</i>	Himalayan Goral	NT	I
	Family - Moschidae			
3	<i>Moschus leucogaster</i>	Himalayan Musk Deer	EN	I
	Family - Suidae			
4	<i>Sus scrofa</i>	Wild Boar	LC	II
	ORDER: CARNIVORA			
	Family - Felidae			
5	<i>Panthera pardus</i>	Common Leopard	VU	I
6	<i>Prionailurus bengalensis</i>	Leopard Cat	LC	I
7	<i>Felis chaus</i>	Jungle Cat	LC	I
	Family - Herpestidae			
8	<i>Herpestes edwardsii</i>	Grey mongoose	LC	I
9	<i>Herpestes auropunctatus</i>	Small Indian mongoose	LC	I
	Family - Canidae			
10	<i>Canis aureus</i>	Golden Jackal	LC	I

S. No.	Family/Scientific name	Common name	Conservation status	
			IUCN 2022-2	WPA 2022
11	<i>Vulpes vulpes</i>	Red Fox	LC	I
12	<i>Vulpes bengalensis</i>	Bengal Fox	LC	I
13	<i>Cuon alpinus</i>	Wild Dog	EN	I
	Family - Ursidae			
14	<i>Ursus thibetanus</i>	Asiatic Black Bear	VU	I
	Family - Mustelidae			
15	<i>Mustela sibirica</i>	Himalayan Weasel	LC	I
16	<i>Lutra lutra</i>	Common Otter	NT	I
	ORDER: PRIMATES			
	Family - Cercopithecidae			
17	<i>Macaca mulatta</i>	Rhesus Macaque	LC	--
18	<i>Semnopithecus entellus</i>	Common Langur	LC	II
	ORDER: RODENTIA			
	Family - Hystricidae			
19	<i>Hystrix indica</i>	Indian Crested Porcupine	LC	I
	Family - Muridae			
20	<i>Mus booduga</i>	Little Indian Field Mouse	LC	--
	Family - Sciuridae			
21	<i>Funambulus pennantii</i>	Himalayan five-striped Palm Squirrel	LC	--
22	<i>Petaurista petaurista</i>	Red Giant Flying Squirrel	LC	I

IUCN- International Union for Conservation of Nature; VU – Vulnerable; NT- Near Threatened; LC - Least Concern; WPA – Wildlife Protection Amendment Act, 2022

3.2.13.2 Avifauna

As time constraint and accessibility plays an important role in conducting the survey, birds were sampled on the same transect and trails marked for mammals. Sampling was carried out on a fixed width trails of 2 km wherever the terrain permitted during the study.

During the field survey, a total number of 25 bird species were sighted. A large portion of avifauna species comprised of resident birds in the project study area. Himalayan Bulbul, Red-vented Bulbul, Russet Sparrow, Black Drongo, Black Kite, Water Redstart, Slaty-headed Parakeet and Long-tailed Shrike were the most frequently sighted bird species in the study area. Based on the sighted birds during the field survey, an inventory of avifauna was prepared which is enlisted in **Table 3.47**.

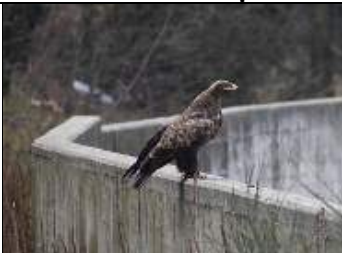
Table 3.47: List of avifauna recorded from the study area with their conservation status

S. No.	Family	Common Name	Scientific Name	Conservation Status		Residential Status
				IUCN 2022-2	WPA 2022	
	ORDER: BUCEROTIFORMES					
1	Upupidae	Common Hoopoe	<i>Upupa epops</i>	LC	II	SV
	ORDER: ACCIPITRIFORMES					
2	Accipitridae	Black Kite	<i>Milvus migrans</i>	LC	II	RR
3	Accipitridae	Crested-serpent eagle	<i>Spilornis cheela</i>	LC	I	RR
	ORDER: COLUMBIFORMES					
4	Columbidae	Spotted Dove	<i>Spilopelia chinensis</i>	LC	II	RR
5	Columbidae	Rock Dove	<i>Columba livia</i>	LC	--	RR
	ORDER: PASSERIFORMES					
6	Motacillidae	White Wagtail	<i>Motacilla alba</i>	LC	II	WV
7	Motacillidae	Grey wagtail	<i>Motacilla cinerea</i>	LC	II	SV

S. No.	Family	Common Name	Scientific Name	Conservation Status		Residential Status
				IUCN 2022-2	WPA 2022	
8	Leiotrichidae	Jungle Babbler	<i>Argya striata</i>	LC	II	RR
9	Passeridae	Russet Sparrow	<i>Passer cinnamomeus</i>	LC	II	RR
10	Passeridae	House Sparrow	<i>Passer domesticus</i>	LC	II	SV
11	Laniidae	Long-tailed Shrike	<i>Lanius schach</i>	LC	II	SV
12	Muscicapidae	White Capped water Redstart	<i>Phoenicurus leucocephalus</i>	LC	II	SV
13	Muscicapidae	Plumbeous water Redstart	<i>Phoenicurus fuliginosus</i>	LC	II	RR
14	Dicruridae	Black Drongo	<i>Dicrurus macrocercus</i>	LC	II	RR
15	Pycnonotidae	Red-vented bulbul	<i>Pycnonotus cafer</i>	LC	II	RR
16	Pycnonotidae	Himalayan Bulbul	<i>Pycnonotus leucogenys</i>	LC	II	RR
17	Sturnidae	Common Myna	<i>Acridotheres tristis</i>	LC	II	RR
18	Corvidae	Yellow-billed Blue Magpie	<i>Urocissa flavirostris</i>	LC	II	RR
19	Monarchidae	Indian Paradise-flycatcher	<i>Terpsiphone paradisi</i>	LC	II	SV
20	Muscicapidae	Grey Bushchat	<i>Saxicola ferreus</i>	LC	II	RR
21	Muscicapidae	Blue Whistling-thrush	<i>Myophonus caeruleus</i>	LC	II	RR
22	Corvidae	Eurasian Jackdaw	<i>Corvus monedula</i>	LC	II	RR
23	Corvidae	Large-billed crow	<i>Corvus macrorhynchos</i>	LC	II	RR
24	Corvidae	House Crow	<i>Corvus splendens</i>	LC	--	RR
ORDER: PSITTACIFORMES						
25	Psittacidae	Slaty-headed Parakeet	<i>Himalayapsitta himalayana</i>	LC	II	RR

IUCN- International Union for Conservation of Nature; LC - Least Concern; VU: Vulnerable; WPA – Wildlife Protection Amendment Act, 2022.; R: Resident; SV: Summer Visitor; PV: Passage Visitor

FAUNAL SPECIES SIGHTED DURING FIELD SURVEY

		
Small Indian Mongoose	Rhesus Macaque	Common Hoopoe
		
Slaty-headed Parakeet	Black kite	Crested serpent Eagle

		
Spotted Dove	Rock Dove	White wagtail
		
Grey wagtail	Jungle Babbler	Russet sparrow
		
House Sparrow	Long tailed shrike	White capped Water Redstart
		
Plumbeous Water Redstart	Black Drongo	Red Vented Bulbul
		
Himalayan Bulbul	Common Myna	Yellow-Billed blue Magpie
		
Indian Paradise-flycatcher	Grey Bushchat	Blue whistling thrush
		
Eurasian Jackdaw	Large-billed crow	House Crow

3.2.13.3 Herpetofauna

The herpetofauna were sampled on the same transect marked for mammals. The sampling also carried along riverbanks and the sampling was repeated during evening time following the time constrained Visual Encounter Rates (VES) method. During the survey, Garden lizard (*Calotes versicolor*), Kashmir Rock Agamid (*Laudakia tuberculata*), and Skinks (*Asymblepharus ladacensis*) were commonly sighted species in the area. Common Rat Snake (*Ptyas mucosa*) and Himalayan Pit Viper (*Gloydius himalayanus*) are also reported in the Working Plan of Jhelum Valley Forest Division.

Table 3.48: List of Herpetofauna recorded from the study area with their conservation status

S. No.	Family	Common name	Scientific name	Conservation Status	
				IUCN 2022-2	WPA 2022
1	Agamidae	<i>Laudakia tuberculata</i>	Kashmir Rock Agamid	LC	-
2	Agamidae	<i>Calotes versicolor</i>	Garden lizard	LC	-
3	Scincidae	<i>Asymblepharus ladacensis</i>	Skinks	LC	-
4	Colubridae	<i>Ptyas mucosa</i>	Common Rat Snake	LC	II
5	Viperidae	Himalayan Pit Viper	<i>Gloydius himalayanus</i>	LC	II

IUCN- International Union for Conservation of Nature; LC - Least Concern; WPA – Wildlife Protection Amendment Act, 2022

3.2.13.4 Butterflies

Based on monsoon, winter and pre-monsoon season field survey, an inventory of butterflies was prepared which is enlisted in **Table 3.49**. The six butterfly species found during survey belong to families Pieridae (3 species), Nymphalidae (2 species) and Lycaenidae (1 species).

Table 3.49: List of Butterflies recorded from Study Area

S. No.	Family	Common name	Scientific name	Conservation Status	
				IUCN 2022-2	WPA 2022
1	Lycaenidae	<i>Lycaena phlaeas</i>	Small Copper	--	--
2	Nymphalidae	<i>Aglais caschmirensis</i>	Indian Tortoiseshell	--	--
3	Nymphalidae	<i>Vanessa cardui</i>	Painted Lady	LC	--
4	Pieridae	<i>Pieris canidia indica</i>	Indian Cabbage White	--	--
5	Pieridae	<i>Colias fieldii</i>	Clouded Yellow	--	--
6	Pieridae	<i>Euchloe daphalis</i>	Pearl white	--	--

IUCN- International Union for Conservation of Nature; LC - Least Concern; WPA – Wildlife Protection Amendment Act, 2022

3.2.13.5 Conservation Status of Fauna

Himalayan Musk Deer (*Moschus leucogaster*) is the species listed under the Endangered (EN) category of the IUCN Red List of Threatened Species Version 2022-2. Common Leopard (*Panthera pardus*) and Asiatic Black Bear (*Ursus thibetanus*) are listed under Vulnerable (VU) category. Himalayan Goral (*Naemorhedus goral*) and Common Otter (*Lutra lutra*) are the species listed under the Near Threatened (NT) category of IUCN (**Table 3.46**). The remaining species are listed under Least Concerned (LC) category.

As per Wildlife Protection Amendment Act, 2022, Common Leopard (*Panthera pardus*), Himalayan Musk Deer (*Moschus leucogaster*), Himalayan Goral (*Naemorhedus goral*), Jungle Cat (*Felis chaus*), Leopard Cat (*Prionailurus bengalensis*), Grey mongoose (*Herpestes edwardsii*), Small Indian mongoose (*Herpestes auropunctatus*), Golden Jackal (*Canis aureus*), Red Fox (*Vulpes vulpes*), Bengal Fox (*Vulpes bengalensis*), Cuon alpinus (Wild Dog), Asiatic Black Bear (*Ursus*

thibetanus), Himalayan Weasel (*Mustela sibirica*), Common Otter (*Lutra lutra*), Red Giant Flying Squirrel (*Petaurista petaurista*) and Indian Crested Porcupine (*Hystrix indica*) are the mammalian species listed as Schedule I species (**Table 3.46**). All other species are either listed under Schedule II or not included in any schedule of IWP Amendment Act, 2022.

All the avifaunal species sighted from the study area fall under Least Concern (LC) category as per IUCN 2022-2. As per Wildlife Protection Amendment Act, 2022, Crested-serpent eagle (*Spilornis cheela*) is under schedule-I. Rest of the avifaunal species recorded from the area are listed as Schedule II except House crow and Rock dove which are not listed under any schedule of Wildlife Protection Amendment Act, 2022.

3.2.13.6 Aquatic Ecology

a. Phytobenthos

Total 33 species belong to class Bacillariophyceae of phytobenthos were recorded from Jhelum River and its tributaries during field sampling conducted in three seasons in the study area (**Table 3.50**). The maximum number of species of phytobenthos were recorded during the monsoon season, a total of 33 species recorded during sampling. The most common species recorded during monsoon season are *Achnanthes*, *Gomphonema*, *Cymbella* and *Navicula* were the most abundant and frequent genera. *Achnanthes linearis*, *Achnanthes minutissima*, *Achnanthes saccula*, *Planothidium lanceolata*, *Synedra ulna* and *Didymosphenia geminata* were some of the common benthic species found at most of the sites (**Table 3.50**).

In all total, 25 and 21 species of phytobenthos were identified during winter and pre-monsoon season sampling in the samples collected from proposed hydroelectric project study area (**Table 3.50**). Maximum species during winter and pre-monsoon season sampling was recorded from site located in the downstream of tailrace outlet of Uri-I Power Station, followed by sampling site located on Boniyar nala. Minimum numbers of species were recorded from site SW1 and SW2 located Jhelum River in the upstream of Uri Stage-I barrage site (**Table 3.50**).

Most common species during Pre-monsoon sampling are *Didymosphenia geminate*, *Cymbella hungarica*, *Gomphonema constrictum*, *Nitzschia palea*, *Pinnularia viridis*, *Achnanthes affinis* and *Cymbella ventricose*.

Table 3.50: Phytobenthos recorded from the study area

S. No.	Class/Taxa	SW1	SW2	SW3	SW4	SW5
	Bacillariophyceae					
1	<i>Achnanthes affinis</i>	M	M	M	M	M
		W	W	W	W	W
		-	-	PM	PM	PM
2	<i>Achnanthes austriaca</i>	-	-	M	M	M
		-	-	W	W	W
		-	-	PM	-	PM
3	<i>Achnanthes biasoletiana</i>	-	-	M	-	M
		-	-	-	-	-
		-	-	-	-	-
4	<i>Achnanthes exilis</i>	-	M	-	-	M
		-	-	W	-	W
		PM	-	-	PM	PM
5	<i>Achnanthes fragilaroides</i>	-	M	M	-	M
		-	-	-	-	-
		-	-	-	-	-

S. No.	Class/Taxa	SW1	SW2	SW3	SW4	SW5
6	<i>Achnanthes frigida</i>	M	-	M	M	-
		-	W	-	-	W
		-	PM	-	-	-
7	<i>Achnanthes kryophila</i>	-	-	M	M	-
		-	W	W	-	W
		-	PM	PM	-	PM
8	<i>Achnanthes linearis</i>	-	M	M	M	M
		W	-	W	W	-
		PM	-	PM	-	-
9	<i>Achnanthes minutissima</i>	M	M	M	M	M
		-	-	W	W	-
		-	-	-	-	-
10	<i>Achnanthes saccula</i>	M	M	M	M	M
		-	-	-	-	-
		-	-	-	-	-
11	<i>Cymbella hungarica</i>	-	-	M	M	M
		-	W	W	W	W
		-	PM	-	PM	PM
12	<i>Cymbella ventricosa</i>	-	-	M	-	M
		W	W	W	W	W
		PM	PM	-	PM	PM
13	<i>Didymosphenia geminata</i>	M	M	M	-	M
		W	W	W	W	W
		PM	-	PM	PM	-
14	<i>Fragilaria capucina</i>	M	M	M	-	-
		-	-	W	W	W
		-	-	PM	-	PM
15	<i>Fragilaria vaucherae</i>	M	-	M	-	M
		-	-	-	-	-
		-	-	-	-	-
16	<i>Gomphonema bohemicum</i>	-	-	M	-	-
		-	-	W	-	W
		-	-	PM	-	PM
17	<i>Gomphonema constrictum</i>	-	-	-	M	-
		W	W	W	-	W
		-	-	-	-	-
18	<i>Gomphonema lanceolatum</i>	-	M	M	M	-
		W	W	-	-	W
		PM	PM	-	-	PM
19	<i>Gomphonema olivaceum</i>	-	-	M	M	-
		W		W	-	W
		PM		PM	-	PM
20	<i>Gomphonema parvulum</i>	-	-	-	M	M
		-	-	-	-	-
		-	-	-	-	-
21	<i>Gomphonema sp.</i>	-	-	-	-	M
		-	-	W	-	-
		-	-	-	-	-
22	<i>Hannaea arcus var. linearis</i>	-	-	-	M	M
		-	W	-	W	W
		-	PM	-	PM	PM
23	<i>Navicula cryptocephala</i>	-	-	M	-	-
		W	-	W	-	W
		PM	-	PM	-	PM
24	<i>Navicula minuta</i>	-	-	-	M	M
		-	-	-	-	-
		-	-	-	-	-
25	<i>Navicula rhyncocephala</i>	-	M	-	M	M

S. No.	Class/Taxa	SW1	SW2	SW3	SW4	SW5
		W	W	-	W	-
		PM	PM	-	PM	-
26	<i>Nitzschia amphibia</i>	M	-	M	M	M
		-	-	-	-	-
		-	-	-	-	-
27	<i>Nitzschia palea</i>	-	M	-	M	M
		-	W	W	W	W
		-	PM	PM	PM	-
28	<i>Pinnularia viridis</i>	M	-	M	-	-
		W	W	W	-	W
		-	-	-	-	-
29	<i>Planothidium lanceolata</i>	M	M	M	M	M
		W	-	-	W	W
		PM	-	-	PM	PM
30	<i>Reimeria sinuata</i>	M	M	-	M	M
		W	-	-	-	W
		PM	-	-	-	-
31	<i>Surirella ovata</i>	-	-	M	M	M
		-	-	-	-	-
		-	-	-	-	-
32	<i>Surirella sp.</i>	-	-	-	M	M
		W	-	-	W	W
		PM	-	-	PM	PM
33	<i>Synedra ulna</i>	M	-	-	-	-
		-	W	-	W	W
		-	PM	-	PM	-

Sampling Site Code: SW1: Jhelum River Upstream of Reservoir area; SW2: Jhelum River: Reservoir area near Barrage Site; SW3: Boniyar Nalla: Downstream of Barrage site; SW4: Jhelum River: Near Gingal Village; SW5: Jhelum River: Downstream of Tailrace Outfall; M: Monsoon W: Winter; PM: Pre-Monsoon

b. Phytoplankton (Periphyton)

Total 17 species of Bacillariophyceae class of phytoplankton were identified in the samples collected from the proposed project study area (Table 3.51). The maximum number of species was recorded during monsoon season sampling (17 species), and the minimum was during post-monsoon (5 species). Bacillariophyceae is the most dominant Class and the common species observed during sampling *Achnanthes*, *Gomphonema*, *Cymbella* and *Navicula* were the most abundant and frequent genera. *Achnanthes linearis*, *Achnanthes minutissima*, *Achnanthes saccula*, *Planothidium lanceolata*, *Synedra ulna* and *Didymosphenia geminata* were some of the common species found in all the sampling locations (Table 3.51).

Table 3.51: Phytoplankton recorded in the study area

S. No	Class/Taxa	SW1	SW2	SW3	SW4	SW5
	Bacillariophyceae					
1	<i>Achnanthes affinis</i>	M	-	-	-	M
		W	-	-	-	W
		PM	-	-	-	PM
2	<i>Achnanthes biasolettiana</i>	-	M	-	-	-
		-	W	-	-	-
		-	PM	-	PM	-
3	<i>Achnanthes exigua</i>	M	-	-	-	M
		-	-	-	-	-
		-	-	-	-	-
4	<i>Achnanthes linearis</i>	M	M	M	-	M
		-	-	-	-	-
		-	-	-	-	-
5	<i>Achnanthes minutissima</i>	M	M	M	M	M

S. No	Class/Taxa	SW1	SW2	SW3	SW4	SW5
	Bacillariophyceae					
		W	W	W	W	W
		PM	PM	PM	PM	-
6	<i>Achnanthes saccula</i>	M	M	M	M	M
		W	W	W	W	W
		-	PM	PM	PM	-
7	<i>Didymosphenia geminata</i>	M	-	-	M	M
		W	-	-	W	W
		PM	-	-	-	PM
8	<i>Fragilaria capucina</i>	-	-	-	-	M
		-	-	W	-	W
		-	PM	PM	-	-
9	<i>Gomphonema intricatum</i>	-	-	-	-	M
		-	-	-	-	-
		-	-	-	-	-
10	<i>Gomphonema sp.</i>	M	-	-	-	-
		W	-	-	W	-
		-	-	-	PM	-
11	<i>Gomphonema sphaerophorum</i>	-	-	-	-	M
		-	W	-	-	W
		-	-	PM	-	PM
12	<i>Hannaea arcus var. linearis</i>	-	-	-	-	M
		-	-	-	W	-
		-	-	-	PM	-
13	<i>Navicula radiosa</i>	M	-	-	-	M
		W	-	W	W	-
		PM	-	PM	-	-
14	<i>Nitzschia amphibia</i>	M	-	-	-	M
		-	-	-	W	W
		-	-	-	PM	PM
15	<i>Planothidium lanceolata</i>	M	M	-	-	M
		W	W	-	-	W
		PM	PM	-	-	PM
16	<i>Reimeria sinuata</i>	M	-	-	-	-
		-	-	-	-	-
		-	-	-	-	-
17	<i>Synedra ulna</i>	M	-	-	-	M
		W	-	-	-	W
		PM	-	-	-	PM

c. Zooplankton

Zooplanktons are represented by protozoans, rotifers and crustaceans (cladocerans and copepods) and formed very small part of planktonic community. Total of 11 species of zooplanktons were identified during monsoon season, 8 species during winter season and pre-monsoon season. Among protozoans was represented by *Actinophrys* sp., *Arcella* sp. and *Ceratium* spp. in the study area. The Rotifers are represented by species of *Keratella* sp., *Brachionus* sp. and *Asplanchna* sp. The Cladoceran community was represented by *Bosmina affinis* and *Daphnia* species, whereas Copepods were represented by *Cyclopes* sp. and *Diaptomus* sp. (water fleas). *Actinophrys* sp., *Arcella* sp., *Brachionus* sp., *Asplanchna* sp. and *Cyclops* sp. were observed at most of the sampling sites in the study area (Tables 3.52 to 3.54).

Table 3.52: Zooplankton found in the study area during the monsoon season

S. No.	Name of species	SW1	SW2	SW3	SW4	SW5
	Protozoans					
1	<i>Actinophrys</i> sp.	-	+	+	+	+

S. No.	Name of species	SW1	SW2	SW3	SW4	SW5
2	<i>Arcella</i> sp.	+	-	-	-	-
3	<i>Ceratium</i> spp.	-	+	-	-	-
	Rotifers					
4	<i>Brachionus</i> sp.	-	+	-	+	-
5	<i>Keratella</i> sp.	+	-	-	-	-
6	<i>Epiphanes</i>	-	-	-	+	-
7	<i>Asplanchna</i> sp.	-	-	+	-	+
	Cladoceran					
8	<i>Bosmina affinis</i>	+	-	-	-	+
9	<i>Daphnia</i> sp.	-	+	-	-	-
	Copepods					
10	<i>Cyclops</i> sp.	-	+	+	-	-
11	<i>Diaptomus</i> sp.	-	-	-	-	+
Total number of species		3	5	3	3	4

Table 3.53: Zooplankton found in the study area during winter season

S. No.	Name of species	SW1	SW2	SW3	SW4	SW5
	Protozoans					
1	<i>Actinophrys</i> sp.	+	-	+	-	+
2	<i>Ceratium</i> spp.	-	+	-	-	+
	Rotifers					
3	<i>Keratella</i> sp.	-	+	+	-	-
4	<i>Epiphanes</i>	-	-	-	-	+
	Cladoceran					
5	<i>Bosmina affinis</i>	-	+	-	+	-
6	<i>Daphnia</i> sp.	+	-	+	-	+
	Copepods					
7	<i>Cyclops</i> sp.	-	-	+	-	+
8	<i>Diaptomus</i> sp.	-	-	-	+	-
Total number of species		2	3	4	2	5

Table 3.54: Zooplankton found in the study area during pre-monsoon season

S. No.	Name of species	SW1	SW2	SW3	SW4	SW5
	Protozoans					
1	<i>Actinophrys</i> sp.	+	-	+	-	+
2	<i>Ceratium</i> spp.	-	+	-	-	+
	Rotifers					
3	<i>Keratella</i> sp.	-	+	+	-	-
4	<i>Epiphanes</i>	-	-	-	-	+
	Cladoceran					
5	<i>Bosmina affinis</i>	-	+	-	+	-
6	<i>Daphnia</i> sp.	+	-	+	-	+
	Copepods					
7	<i>Cyclops</i> sp.	-	-	+	-	+
8	<i>Diaptomus</i> sp.	-	-	-	+	-
Total number of species		2	3	4	2	5

d. Macro-invertebrates (Macro zoobenthos)

The macroinvertebrate community contributes immensely to the functioning of the stream or river ecosystem. It serves as a major source of food for fishes. The abundance of invertebrate fauna mainly depends on the physical and chemical properties of the substratum.

The macro-invertebrate fauna of the study area comprised of five orders viz. Ephemeroptera, Plecoptera, Trichoptera, Diptera, Coleoptera and Odonata during the survey. During the sampling of macro invertebrates *Ephemerella*, *Baetis*, *Cinygmula*, *Hydroptila*, *Antocha* and

Simulium were the genera found most common in Jhelum River and its tributary. The percentage composition of macro-invertebrate fauna during different seasons is given in **Tables 3.55 to 3.57**.

Table 3.55: Percent composition of macro-invertebrates during monsoon season

S. No.	Family	Genera	SW1	SW2	SW3	SW4	W5
ORDER: EPHEMEROPTERA							
1	Heptageniidae	<i>Cinygmula</i>	39.39	45.95	33.35	45	32.43
2	Heptageniidae	<i>Stenonema</i>	-	-	4.76	-	25.14
3	Heptageniidae	<i>Epeorus</i>	27.27	16.22	14.25	15	-
4	Baetidae	<i>Baetis</i>	12.12	18.92	33.35	-	-
5	Ephemerellidae	<i>Ephemerella</i>	9.09	2.7	-	15	11.14
ORDER: PLECOPTERA							
6	Perlidae	<i>Acroneuria</i>	-	5.41	4.76	10	21.43
ORDER: TRICHOPTERA							
7	Hydropsychidae	<i>Hydropsyche</i>	3.03	2.7	-	-	-
ORDER: DIPTERA							
8	Tipulidae	<i>Antocha saxicola</i>	-	8.1	6.23	15	-
9	Simuliidae	<i>Simulium pictipes</i>	6.06	-	3.3	-	-
ORDER: ODONATA							
10	Gomphidae	<i>Ophiogomphus</i>	3.04	-	-	-	9.86

SW1-SW5= Sampling locations

Table 3.56: Percent composition of macro-invertebrates at during winter season

S. No.	Order/ Family	Genera	SW1	SW2	SW3	SW4	SW5
ORDER: EPHEMEROPTERA							
1	Baetidae	<i>Baetis</i>	8.12	18.92	3.33	12.4	-
2	Ephemerellidae	<i>Ephemerella</i>	13.39	28.15	14.33	28.2	16.63
3	Heptageniidae	<i>Cinygmula</i>	25.9	18.08	4.7	-	19.54
4	Heptageniidae	<i>Stenonema</i>	-	-	13.86	-	17.25
ORDER: PLECOPTERA							
5	Perlidae	<i>Acroneuria</i>	4.38	-	-	-	6.38
ORDER: TRICHOPTERA							
6	Hydroptilidae	<i>Hydroptila</i>	9.12	-	13.5	-	15.55
7	Hydropsychidae	<i>Hydropsyche</i>	14.81	12.05	12.4	-	-
ORDER: DIPTERA							
8	Tipulidae	<i>Antocha saxicola</i>	-	22.8	22.23	33.22	-
9	Simuliidae	<i>Simulium pictipes</i>	18.16	-	13.2	-	24.65
ORDER: ODONATA							
10	Gomphidae	<i>Ophiogomphus</i>	-	-	2.45	13.55	-
ORDER: COLEOPTERA							
11	Halipidae	<i>Halipus</i>	6.12	-	-	12.63	-

SW1-SW5= Sampling locations

Table 3.57: Percent composition of macro-invertebrates during pre-monsoon season

S. No.	Family	Genera	SW1	SW2	SW3	SW4	SW5
ORDER: EPHEMEROPTERA							
1	Baetidae	<i>Baetis</i>	12.12	18.92	33.33		
2	Heptageniidae	<i>Cinygmula</i>	39.39	45.95	33.33	44.35	31.43
3	Heptageniidae	<i>Stenonema</i>			4.76		37.14
4	Heptageniidae	<i>Epeorus</i>	27.27	16.22	14.29	15.65	
5	Ephemerellidae	<i>Ephemerella</i>	9.09	2.7		16.45	17.14
ORDER: PLECOPTERA							
6	Perlidae	<i>Acroneuria</i>		5.41	4.77	11.2	11.43
ORDER: TRICHOPTERA							
7	Hydropsychidae	<i>Hydropsyche</i>	3.03	2.68			

S. No.	Family	Genera	SW1	SW2	SW3	SW4	SW5
ORDER: DIPTERA							
8	Tipulidae	<i>Antocha saxicola</i>		8.12	4.71	12.35	
9	Simuliidae	<i>Simulium pictipes</i>	6.06		4.81		
ORDER: ODONATA							
10	Gomphidae	<i>Ophiogomphus</i>	3.04				2.86

SW1-SW5= Sampling locations

e. Fish Fauna

During field survey, experimental fishing was carried out with the help of local fisherman in Jhelum River and Boniyar nalla (**Figure 3.19a**). Snow trout (*Schizothorax plagiostomus*) (**Figure 3.19b**) was caught by the local fisherman during sampling. However, locals also confirmed the presence of Brown trout in the Jhelum River and Boniyar nalla in the intermediate zone between barrage and tailrace outlet of Uri-I Power Station near Gingal Bridge. The photos of brown trout were taken from the hatchery located near Boniyar Nalla within the study area (**Figure 3.19c**).

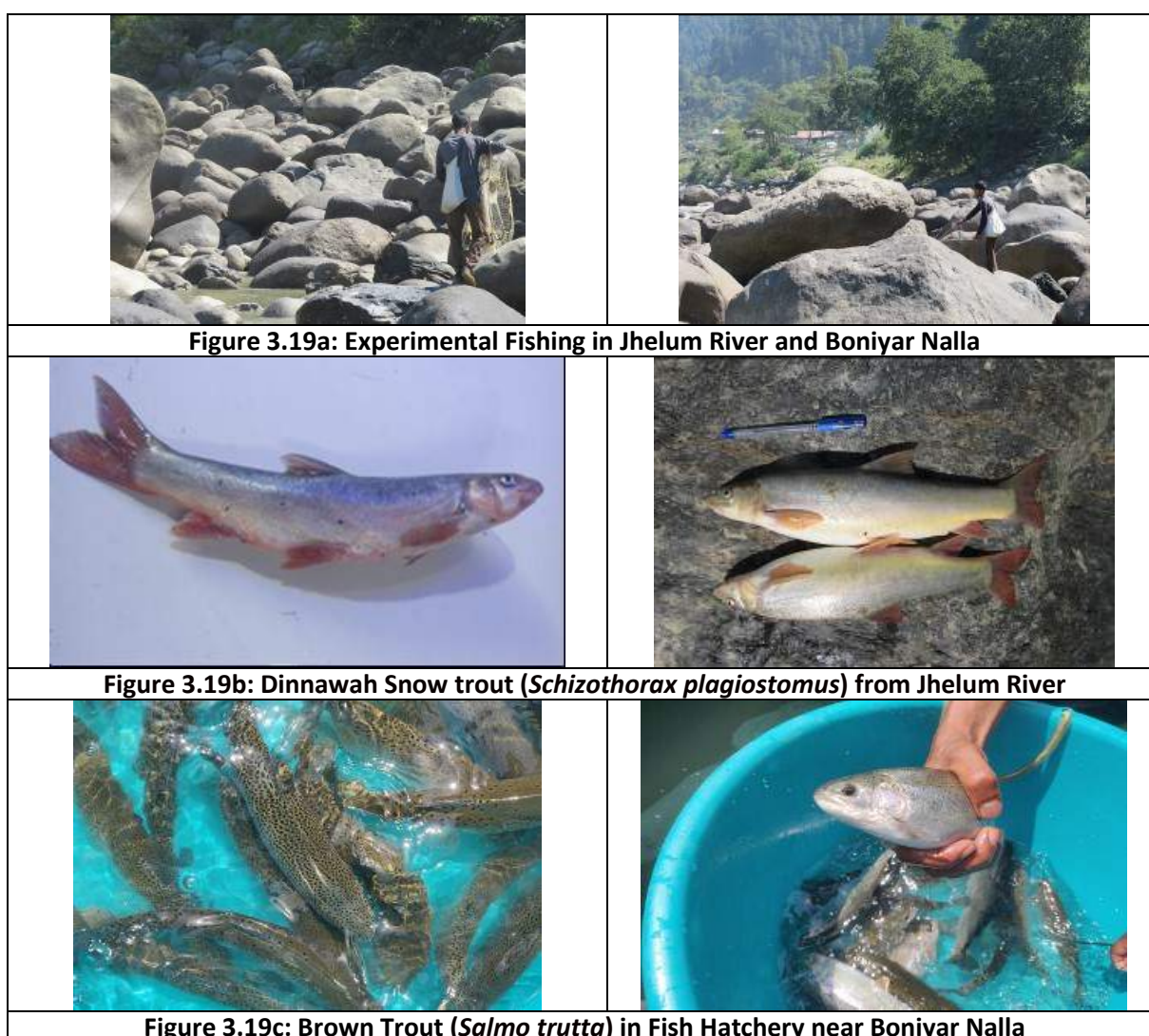


Figure 3.19: Fish Species found in Study Area

In addition to the primary survey secondary literature were also consulted for fish composition in Jhelum River in the study area of Uri-I Stage-II HEP.

Several studies have been conducted in the past on the fish and fisheries of the Valley. Yousuf et al. [2006] reported 18 species of fish belonging to Cypriniformes, Siluriformes, Cyprinodoniformes

and Salmoniformes from river Jhelum and its tributaries. Also, Sultan & Ravi Kant (2019) and Singh & Singh (2019) studied fish composition of Jhelum River including project study area. A list of 21 fish species reported from the area is given in **Table 3.58**.

Table 3.58: Fish Species reported from the study area

S. No.	Family	Name of Species
ORDER: CYPRINIFORMES		
1	Botiidae	<i>Botia birdi</i>
2	Cyprinidae	<i>Bangana diplostoma</i>
3	Cyprinidae	<i>Carassius carassius</i>
4	Cyprinidae	<i>Crossocheilus diplochilus</i>
5	Cyprinidae	<i>Cyprinus carpio communis</i>
6	Cyprinidae	<i>Cyprinus carpio specularis</i>
7	Cyprinidae	<i>Oncorhynchus mykiss</i>
8	Cyprinidae	<i>Puntius conchoniis</i>
9	Cyprinidae	<i>Salmo trutta fario</i>
10	Cyprinidae	<i>Schizothorax curvifrons</i>
11	Cyprinidae	<i>Schizothorax esocinus</i>
12	Cyprinidae	<i>Schizothorax labiatus</i>
13	Cyprinidae	<i>Schizothorax niger</i>
14	Cyprinidae	<i>Schizothorax plagiostomus</i>
15	Nemacheilidae	<i>Schistura punjabensis</i>
16	Nemacheilidae	<i>Triplophysa kashmirensis</i>
17	Nemacheilidae	<i>Triplophysa marmorata</i>
ORDER: CYPRINODONTIFORMES		
18	Poeciliidae	<i>Gambusia holbrooki</i>
ORDER: SILURIFORMES		
19	Sisoridae	<i>Glyptosternon reticulatum</i>
20	Sisoridae	<i>Glyptothorax kashmirensis</i>
21	Sisoridae	<i>Glyptothorax pectinopterus</i>

Fisheries Migration and Swamping Ground

Fish fauna in the Jhelum River and its streams is determined by the water temperature, the flow velocity and type of substrate. The species found here are either endowed with strong locomotion like Snow trout. No spawning ground were recognised between Diversion site of Lower Jhelum HEP and Uri-I barrage site. In the downstream of Uri-I Power Station barrage site, Boniyar Nala a left bank tributary of Jhelum River provides suitable habitat for migratory fishes and identified as spawning ground for *Schizothorax* species.

Aquatic EIA of Uri-I HE Project on river Jhelum, Kashmir

A study titled Aquatic EIA of Uri-I HE Project on river Jhelum, Kashmir carried by Lennart Nyman in the year 1995 for the Swedish International Development Cooperation Agency, Sida, the International consultancy group of the National Board of Fisheries. The study recorded a total of twelve species of fishes in the region affected by Uri HE Project. The study also reported that at least five species of snow trout (genus *Schizothorax*) are found in the lakes and rivers of Kashmir valley. Habitat of one species is lentic i.e. lives in lakes and the other four are migratory in nature i.e. performs spawning migrations and spawns in the tributaries of River Jhelum.

They perform 'spawning migrations up and downstream of the river Jhelum and its tributaries and their migration estimated to be disturbed by the diversion of water from the river and by the building of a barrage, despite the presence of a fish ladder.

The Buniyar nallah was identified as one of the important tributaries to have a significant affect on fish fauna as it has its confluence with River Jhelum only a few hundred metres downstream from the Uri Barrage and also it is unique in terms of both as an unpolluted clear water nallah and as a spawning ground for at least two species of snow trout and a number of other resident fish species.

The study have recorded two important factors that will adversely impact the fish fauna and eventually on the entire ecosystem of the River Jhelum. One of the factors state that the diversion of the entire discharge through the power station during six to seven months of the year shall virtually prevent fish migration or passively moving the fish population further downstream. The second factor states that the diversion of the same discharge from the original river along a stretch of 11 kms shall reduce the river to a trickle for half the year with reduction in its biological production proportionate to the area covered by running water.

To counter these two adverse effects, it was strongly advised that a minimum discharge should be maintained in such a way that the fish ladder would have a permanent water flow. In addition to the proposals mentioned above, to build a fishway past the barrier created by the diversion of Buniyar nallah.

Measures adopted by Uri-I HE Project

1. Ecological Sustainability – Uri barrage fish pass

The principal ecological sustainability issue of the Uri-I HE Project was related to fish migration, principally *Schizothorax* species (snow trout). Pool type fish pass with orifices and notched overflows connecting the pools has been incorporated in the barrage structure. It is located almost at the centre of the barrage. When viewed from the top of the barrage, the fish pass is sandwiched between six spillway gates on its right bank side and three spillway gates & the power intake on the left bank.

Since commissioning of the project in 1997, manual observation and fish tagging surveys (1997, 1998, 1999) conducted by University of Srinagar have confirmed that fish enter and pass through the Uri fish pass for upstream spawning migration in the months of April, May and June.

2. Fish Pass at Boniyar Nallah:

Boniyar Nala, a left bank tributary of Jhelum River join Jhelum in the downstream of Uri-I Power Station barrage site provide suitable habitat for migratory fishes and identified as spawning ground for *Schizothorax* species. A fish pass has also been provided in Boniyar Nallah for fish movement.

3. Environmental Flow (E-Flow)

There is already a provision of 2.5 cumecs downstream discharge through fish pass of barrage of Uri Power Station. Further, in view of recent NGT order vide OA no- 425/2019 dated 09.08.2017 on e-flow releases, e-flow of 15% of average lean season (four months, i.e. Oct. – Jan.) flow of Jhelum river at Uri Barrage as per average 10 daily flow series from 1976-77 to 2019-20 has been calculated as 14.2 cumecs. As such, out of total e-flow of 14.2 cumec, 2.5 cumecs is being maintained in the fish ladder whereas the additional downstream discharge of 11.70 cumecs is being released form the barrage of Uri-I Power station. However, as the reservoir of both the

Stages of Uri-I Stage-I & Uri-I Stage-II is same, no additional environmental release is considered in power potential studies.

As such, the operating Uri-I Power Station is maintaining e-flows to address the reduced water flows in downstream river stretches.

3.2.13.7 Conclusion

- i) As per landuse landcover map of the study area Evergreen/Semi-Evergreen Forest and Scrub Forest together constitutes predominant land use (66.95%) in the study area. Scrub land and Barren Rocky covers around 24.21% of the study area.
- ii) According to 'A Revised Survey of the Forest Types of India' by Champion and Seth (1968). Forests in the study area are comprised of Group 12-Himalayan Moist Temperate Forest and Group 13-Dry Temperate Forest.
- iii) The most common tree species in the project area are *Cedrus deodara*, *Pinus wallichiana*, *Picea smithiana*, *Celtis australis*, *Fraxinus xanthoxyloides* and *Robinia pseudo-acacia* are dominant in area.
- iv) The project area harbours 192 plant species belonging to different plant groups like Angiosperms, Gymnosperms, Pteridophytes, Bryophytes and Lichens.
- v) Angiosperms are represented by 174 species: gymnosperms by 8 species. 3 species of pteridophytes, 2 species bryophytes and 5 species of Lichens were recorded during the survey.
- vi) A list of mammals has been prepared after consultation with forest department officials and villagers. A total of 22 species of mammals were reported from the project area.
- vii) Common Leopard (*Panthera pardus*), Himalayan Musk Deer (*Moschus leucogaster*), and Mainland Leopard Cat (*Prionailurus bengalensis*) are the mammalian species listed as Schedule I species reported from the study area.
- viii) 25 species of birds were sighted during the study period. All the bird species are listed under Schedule-IV and Schedule-V of Wildlife Protection Act, 1972.
- ix) Among 5 species of herpetofauna reported from the study area, three were sighted during survey. 6 species of butterflies were recorded during the field survey.
- x) Kazinag National Park, Lachipora Wildlife Sanctuary and Limber Wildlife Sanctuary are the nearest protected areas from Uri-I Stage-II HE Project. All the project components are outside the notified ESZ of the protected areas.
- xi) Among fish fauna, Snow trout species were found in the Jhelum River and its tributaries in the study area. The brown trout was observed in the hatchery present in the study area near Boniyar Nalla.

3.2.14 Protected Area

Kazinag National Park, Lachipora Wildlife Sanctuary and Limber Wildlife Sanctuary are the nearest protected areas from Uri-I Stage-II HE Project. The location of all protected areas with respect to project components are shown in **Figure 3.20**. All project components are also outside the boundary of the National Park and Wildlife Sanctuaries. An Eco-Sensitive Zone (ESZ) has also been demarcated in the map showing that all the project components are well outside the notified ESZ. No protected area has been designated as the wildlife corridor in the area.

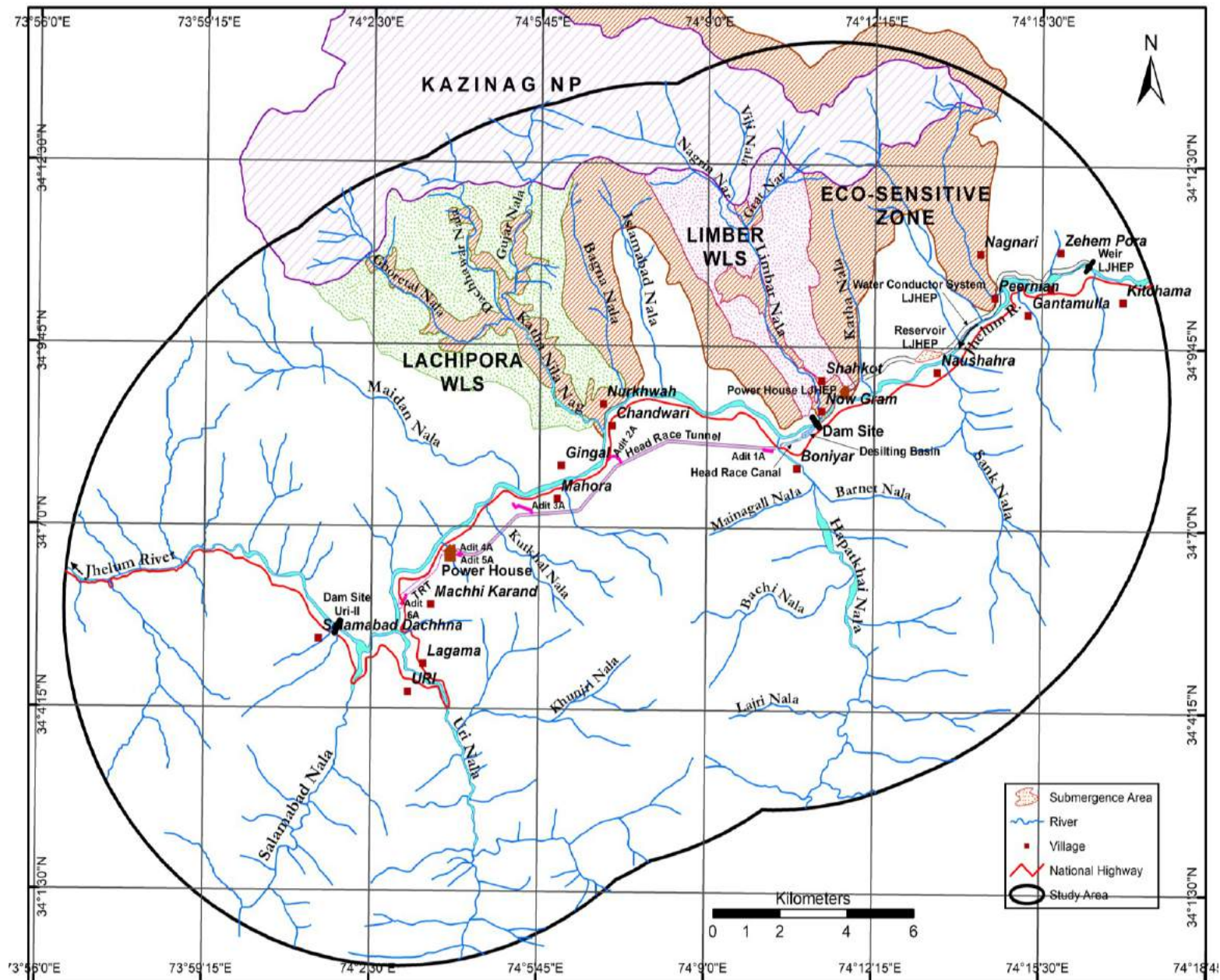


Figure 3.20: Map Showing distance of project components from protected area

3.2.15 Socio-economic Environment

For sustainable development it is important to understand social and economic conditions of the community in the region, impacts of development on the community, measures to mitigate negative impacts and enhance the positive impacts. Development work depends on an effective partnership between project developer and the local community. For new development initiatives, socio economic assessment plays an important role to ensure community participation and their acceptance of the development activity and also helps in planning the activities for local area development. This section outlines baseline socio-economic scenario of the study area villages.

The proposed project falls in the Uri & Boniyar tehsil of Baramulla district of Union Territory of Jammu & Kashmir. According to the 2011 census, Baramulla district has a population of 10,08,039. Of the total population, 534,733 (53.05%) were male and 473,306 (46.95%) were female, the sex ratio being 885 females for every 1,000 males. The district has a population density of 305 inhabitants per square kilometre. Baramulla district has a literacy rate of 66.93% with male literacy 77.35% and female literacy 55.01%. Baramulla town is the largest town in the district and the fourth most populous town in the UT of J&K (erstwhile state).

Baramulla is the largest producer of Horticulture products in the state. There are vast apple orchards in the district. World-class apples are grown here. Baramulla has a Rabbit Farm at Palhallan, Pattan, one of the only two rabbit farms in Northern India. Another one is in Himachal Pradesh. Baramulla has a Silkworm breeding unit at Mir Gund, Pattan. The district has four state owned powerhouses, viz., Lower Jhelum Hydel Project at Gantamulla (105 MW), Mohra Powerhouse at Asthan Nallah (3.75 MW), NHPC owned Uri-I Power Station (480 MW) and Uri-II Power Station (240 MW), is built on river Jhelum.

3.2.15.1 Socio-Economic Profile of the Study Area Villages

To study socio-economic profile of study area, village level survey was carried out in the villages adjacent to project site. In addition to field survey, secondary data has been collected from Village Amenities Directory (2018-19), District Baramulla and Census of India (2011). The entire study area falls under Baramulla district in Uri, Boniyar & Baramulla tehsils.

In the study area there are 93 settlements including 91 villages and two towns namely Lagama and Bandy. Out of 91 villages, 41 villages are in the Uri tehsil, 47 villages in Boniyar tehsil and 3 villages are in Baramulla tehsil. The Lagama and Bandy towns fall under Uri tehsil. List of villages lies in the study area is given in **Table 3.59**. Details related with demography of study area and other amenities have been discussed below:

Town Details: There are two towns falling in the study area namely Lagama and Bandy. In the Lagama town there are 1500 population comprising of 250 households and in Bandy town there is a population of 3150 comprising of 450 households. Most of the people in the towns depend on job/business and agriculture activities as their main source of living. Therefore, most of the people in the area depend on these activities for their livelihood either directly or indirectly.

Table 3.59: List of Villages in the Study Area

S. No.	Village Code	Village/ Town Name	S. No.	Village Code	Village/ Town Name
A	District Baramulla		48	002556	Biji Hama
i.	Tehsil URI		49	002557	Sheerwani Pora
1	002504	Darah Gutliyan	50	002558	Bagnah Noor Khah
2	002505	Dhani Saidan	51	002559	Salamabad Dachhna
3	002506	Zamboor Pattan	52	002560	Limber
4	002507	Chollan Kalsan	53	002561	Pahli Pora
5	002508	Paran Pilan	54	002562	Bimyar
6	002509	Dachi	55	002563	Ijara
7	002510	Basgran	56	002564	Nagnari
8	002511	Sultan Daki	57	002565	Manj Gram
9	002512	Bandi	58	002566	Peernian
10	002513	Chapper	59	002567	Zehem Pora
11	002514	Shadara	60	002568	Girda Nawah
12	002515	Kandi Barjala	61	002569	Hundi Noweshera
13	002516	Hardu Kamal Koote	62	002570	Wari Khah
14	002527	Isham	63	002571	Pringal
15	002528	Dulanja	64	002572	Chahal
16	002529	Dardkote	65	002573	Aithshm Pora
17	002530	Ramgal	66	002574	Azad Pora
18	002531	Nawa Rundan	67	002575	Now Gram
19	002532	Salam Abad	68	002576	Ram Poor
20	002533	Now Pora	69	002577	Kenchan
21	002534	Jablah	70	002578	Niloosa
22	002535	Gohallan	71	002582	Uranbua
23	002536	Badan	72	002583	Boniyar
24	002537	Sukhdar	73	002584	Javind
25	002538	Uri	74	002585	Shala Dajan
26	002539	Balgran	75	002586	Bernate
27	002540	Churanda	76	002587	Batangi
28	002541	Tulwari	77	002588	Hilad Peernian
29	002542	Salli Koot	78	002589	Ladi
30	002543	Thajal	79	002590	Bila Salamabad
31	002544	Bal Koote	80	002591	Pran Kutran
32	002545	Hathlanga	81	002592	Bichi
33	002546	Said Pura	82	002593	Banali
34	002547	Sahoora	83	002594	Tirkanjan
35	002548	Nambla	84	002595	Dara Kujan
36	002549	Ghar Kote	85	002596	Dudaran
37	002550	Dwaran	86	002597	Maidanan
38	002551	Gingal	87	002598	Salasan
39	002579	Bandi Brahmanan	88	002600	Jabdi
40	002580	Manchi Krand	89	002601	Gagar Hal
41	002581	Mahura (Mohra)	90	002603	Forest Block
42	-	Lagama Town	iii. Tehsil Baramulla		
43	-	Bandy Town	91	002431	Kitcha Hama
ii. Tehsil Boniyar			92	002432	Gantamulla Pain
44	002552	Mayan	93	002433	Gantamulla Bala
45	002553	Kathal Hil Patribal			
46	002554	Muqam Piran			
47	002555	Brari Pora			

Source: Census of India 2011

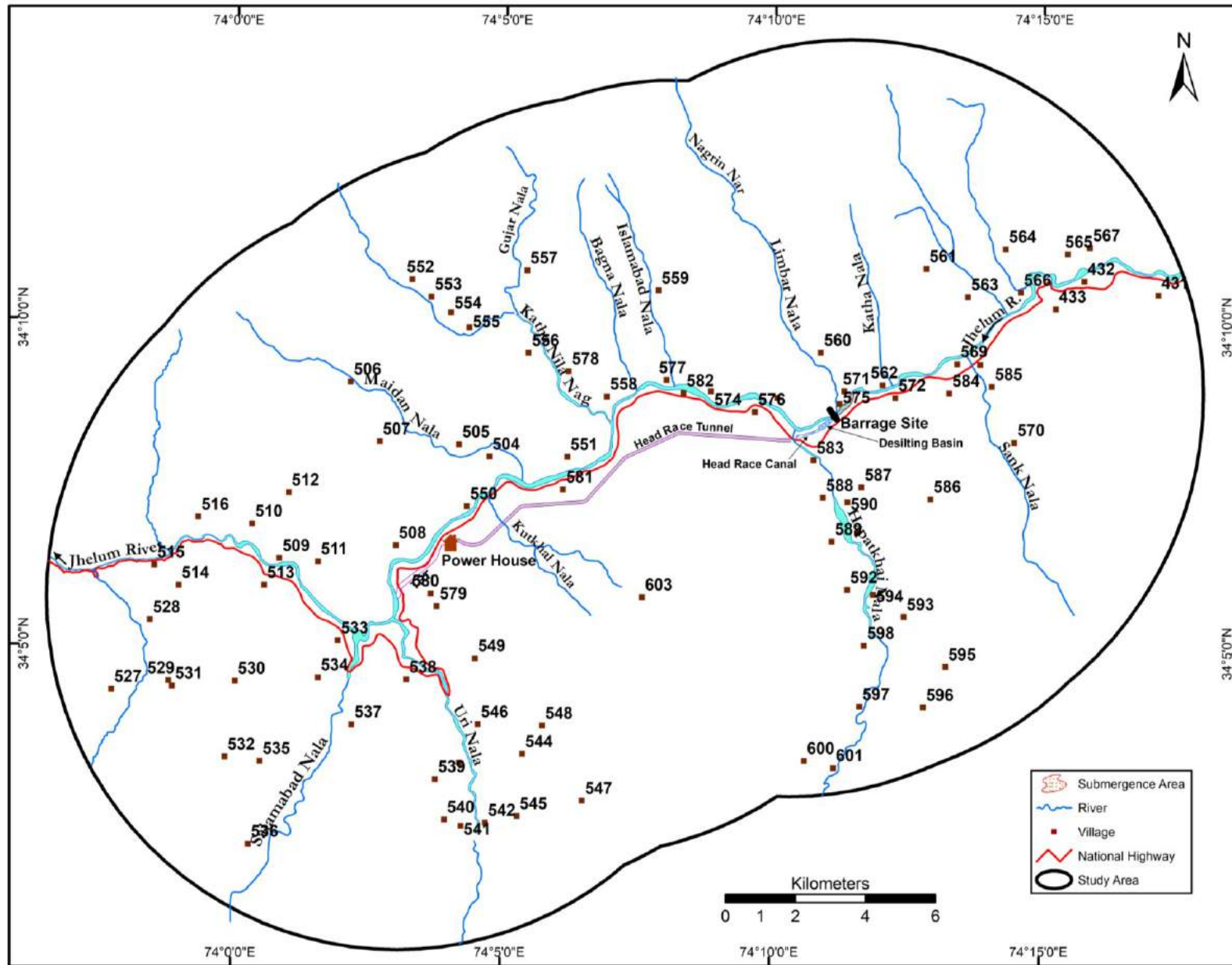


Figure 3.21: Map showing location of villages in the study area (Refer Table 3.58 for village code)

a) Demographic Profile of the Study Area

The Socio-economic profile of the study area covers aspects like demography, occupational pattern, literacy rate, amenities and other important socio-economic indicators of the villages. The entire study area falls under Baramulla district. A total of 91 inhabited villages falls in the study area. The population of the study area is 139213 with 75260 (54.06%) males and 63953 (45.93%) females. The number of children under 6 years old was found to be 27660 (19.86%). The number of households was 23256 with an average occupancy of 5 to 6 persons per household. The sex ratio was found at 849 females per 1000 males (**Table 3.60**).

Table 3.60: Demographic Profile of the Surveyed Villages

Parameter	Study Area Profile	
	Number	% to Respective Total
Household	23562	
Total Population	139213	
Male	75260	54.06
Female	63953	45.94
Sex Ratio	849	
Population below 6	27660	19.86
Male	14626	52.87
Female	13034	47.12
Child Sex Ratio	891	
Scheduled Castes (SC)	100	0.07
Male	93	93.00
Female	7	07.00
Scheduled Tribes	20582	14.78
Male	10900	52.95
Female	9682	47.04
Literacy		
Total Literate	66817	47.99
Male	45267	67.74
Female	21550	32.25
Literacy Rate (Population above age of 6 year)	59.89	
Male Literacy Rate	74.65	
Female Literacy Rate	42.32	
Gender Gap in Literacy Rate	32.23	

b) Social Category

The total Scheduled Castes (SC) population in the study area is 100 which is 0.07% of the total population with 93 males & 7 females. The total Scheduled Tribes (ST) population is 20582 which is 14.78% of the total population with 10900 males & 9682 females (**Table 3.60**).

c) Literacy

In the project study area, there are 66817 literates which constitute 47.99% of the total population of the study area. Out of total literates of the study area 67.74% are male literates and 32.25% are female literates. The literacy rate in the study area 59.89% (population above age of 6 year), among male, it is 74.65% while among females is 42.32, creating gender gap of 32.23% (refer **Table 3.60**).

d) Occupation Pattern

As per classification by Census of India there are different types of workers that may be classified as- those persons who had worked for at least six months or 183 days, are treated to be main workers, on the other hands if person categorized as worker has participated in any economic or productive activity for less than six months or 183 days during the last one year, is treated as a marginal worker. Non-workers are those who have not worked any time at all in the year preceding the enumeration.

The workers coming under main and marginal workers category are those involved in activities such as cultivation, agriculture, livestock, fishing, plantation, manufacturing, servicing, and repair in household industry, construction, trade and commerce, transportation, and other services.

- According to 2011 census, out of total population (139213) of study area 27.01% (37613) are categorized as workers.
- Out of total working population, main and marginal workers were represented by 48.57% (18269) and 51.42% (19344) respectively.

Worker's employment pattern: - Main and marginal workers are classified into four categories as cultivators, agricultural workers, household industry workers, and other workers. As per 2011 census out of a total of 37613 workers in the study area, 34.65% of the working population are engaged in agriculture and allied services, out of which 7.69% are cultivator and 26.96% are agriculture labour. Only a small percentage of the population engaged in household industry workers (2.69%) and 62.64% of the working population are engaged in other services category viz. Trade, commerce, business, Transport, Government and private jobs. Details of main and marginal working population in the study area is given in **Table 3.61**.

Table 3.61: Workforce in the Study Area

Particulars	Number	Respective %
Total Population	139213	
Total Workers	37613	27.01
Total Male Workers	34438	91.55
Total Female Workers	3175	8.44
Main Workers	18269	48.57
Male	16998	93.04
Female	1271	6.95
Marginal Worker	19344	51.42
Male	17440	90.15
Female	1904	9.84
Working Population Category		
Cultivators	2894	7.69
Male	2600	89.84
Female	294	10.15
Agricultural Labours	10144	26.96
Male	9822	96.82
Female	322	3.17

Particulars	Number	Respective %
Household Industrial Workers	1014	2.69
Male	735	72.48
Female	279	27.51
Other Workers	23561	62.64
Male	21281	90.32
Female	2280	9.67

Source: census of India, 2011

3.2.15.2 Socio-Economic Profile of the Surveyed village

A socio-economic survey of villages located in the surrounding of project area was carried out through sample survey by way of interacting with villagers, Panchayat members, and Sarpanch, etc. Discussions were carried out to understand the present socio-economic status of the villages, socio-economic issues in the area needing attention, their opinion/perception about the proposed project and expectations from the project, etc.

During the survey, a total of 8 villages and 2 towns were covered. All the surveyed villages/Towns fall under the Uri and Boniyar tehsils in Baramulla district. The list of surveyed villages/municipalities is given in the below **Table 3.62** with their respective tehsil.

Table 3.62: List of Surveyed Villages/Municipalities

S. No.	Village/Town Name		Village/Town Name
District: Baramulla			
i	Tehsil: Uri	ii.	Tehsil Boniyar
1	Mahura (Mohra)	6	Bernate
2	Manchi Krاند	7	Boniyar
3	Gingal	8	Uranbua
4	Bandy Town	9	Nowshera A
5	Lagama Town	10	Nowshera B

a) Demographic Profile

The total population of the surveyed village/Town area is 22242 where the number of households were 3465. In the surveyed village the total scheduled caste population were 102 and scheduled tribe were 1320. The scheduled caste and scheduled tribe population are living in small portion in the study were also in the surveyed villages/Towns. The surveyed village/town wise population and social category is given **Table 3.63**.

Table 3.63: Demographic Profile of Surveyed Villages/Towns

S. No	Village/Town Name	Total Household	Total Population	Total SC	Total ST
1	Mahura	373	2201	0	40
2	Manchi Krاند	263	1424	0	178
3	Gingal	465	3819	0	0
4	Bernate	358	2136	0	1102
5	Boniyar	257	1497	0	0
6	Bandy Town	450	3150	40	0
7	Lagama Town	250	1500	62	0
8	Uranbua	147	1029	0	0
9	Nowshera A	466	2796	0	0
10	Nowshera B	436	2690	0	0
Total		3465	22242	102	1320

Source: RSET Field Survey (2022)

b) Education Facilities

As per field survey, primary schools are available in all the surveyed villages while secondary schools are available in 7 villages/ towns namely Mahura (Mohra), Manchi Krand, Gingal, Bernate, Lagama, Nowshera A and Nowshera B. Students from the remaining village travel about 5-6 km to attend secondary school. There is a one private secondary school available at Nawshera-B village. For the higher education and Technical Training students of the village usually travel around 25 km where the college and training Institutes are available at Uri and Boniyar Town. In the study area there are 3 colleges up to graduation level at Boniyar and Nowshera. **Table 3.64** shows the nearest available education facilities in the surveyed village.

Table 3.64: Education Facilities of Surveyed Villages/Towns

S. No.	Village/Town Name	Primary School	Secondary School	Senior Secondary School	Colleges
1	Mahura (Mohra)	Yes	Yes	No (15 Km)	No (15 km)
2	Manchi Krand	Yes	Yes	No (8 Km)	No (8 km)
3	Gingal	Yes	Yes	No (10 Km)	No (10 km)
4	Bernate	Yes	No (5 Km)	No (8 Km)	No (27 km)
5	Boniyar	Yes	Yes	Yes	Yes
6	Bandy Town	Yes	No (3 Km)	No (10 Km)	No (10 km)
7	Lagama Town	Yes	Yes	Yes	No (10 km)
8	Uranbua	Yes	No (6 Km)	Yes	No (22 km)
9	Nowshera A	Yes	Yes	No (7 Km)	Yes
10	Nowshera B	Yes	Yes	No (7 Km)	Yes

Source: RSET Field Survey 2022

c) Medical Facilities

As per social survey there is a one Pvt. Hospital at Boniyar. There are 2 primary health sub centres and 5 primary health centres available in the surveyed area. There is no community health center in the survey villages. In addition to these, NHPC Uri-I Power Station Hospital at Gingal also provide basic medical facilities to the villagers.

The District Hospital and Medical College at district headquarter Baramulla is the only government hospital serve as referral center for complicated cases in the district. Details of medical facility in the surveyed villages is given below in **Table 3.65**.

Table 3.65: Nearest Medical Facilities available for surveyed Villages/Towns

S. No	Village/Town Name	Primary Health Sub Center (PHSC)	Primary Health Center (PHC)	Community Health Center (CHC)	District Hospital	Veterinary Hospital
1	Mahura (Mohra)	2 km	Yes	3 Km	53 km	10 km
2	Manchi Krand	2 km	3 Km	10 Km	48 km	4 km
3	Gingal	2 km	3 Km	10 Km	33 km	Yes
4	Bernate	--	Yes	23 Km	34 km	Yes
5	Boniyar	--	Yes	16 Km	29 km	Yes
6	Bandy Town	--	Yes	10 Km	64 km	2 km
7	Lagama Town	Yes	4 Km	10 Km	42 km	Yes
8	Uranbua	Yes	1 Km	16 Km	29 km	1 km
9	Nowshera A	--	Yes	--	56 km	Yes
10	Nowshera B					

Source: RSET Field Survey

d) Occupation Profile

Agriculture, Horticulture and allied services are the main occupation in the surveyed villages. Rice and Maize are the main crops cultivated by the villagers. Horticulture plays an important role in the economy of the area and also in the district. Baramulla district is the largest producer of Horticulture products in the Union Territory of J&K. Apple, Apricot, Cheery, pears, Walnut and Almond are the main horticulture products.

Apart from agriculture and allied services, people in the surveyed area are also involved in the job (Govt. /Pvt.). A small portion of the population of these villages go to work and mobile workforce (age group 20-40 years) go outside in search of an opportunities. The hydroelectric power project in the area also provides job and business opportunities to the local people in the area. Villagers worked on regular or contractual basis in hydro projects for technical and non-technical work.

e) Livestock

Along with agriculture and horticulture, livestock rearing is an important occupation in the area. A large part of the rural population along with migratory population depend on livestock rearing. Most of the families of the surveyed area keep domestic animals like cattle, buffalo, sheep, goats etc.

f) Drinking Water and Sanitation Facilities

Spring water and piped public water supply are the main sources of drinking water facilities in all the surveyed villages. As per the information collected during the field survey most of houses in the surveyed villages have in-door toilet facilities.

g) Irrigation Facilities

The majority of the surveyed villages have irrigated land. A network of canals and springs are the main source of irrigation. However, irrigation canal network required maintenance as most of the canals in the area needs to be channelized. The lift Irrigation scheme at Nowshera was found to be non-functional for a very long time.

h) Infrastructure Facilities

During public consultation at the time of field survey, it was observed that electricity and approach road facilities were available in all the surveyed villages. Most of the villages in the area are well connected by metalled road.

Uri and Boniyar are the main business centers in the area. Other than Uri and Boniyar, villagers depend on Lagama, Bandy and Nowshera (A) for market facilities. The fair price shops are located at Bernate and Boniyar. Out of 10 villages, Postal facility is available in seven villages/town (**refer Table 3.66**). Similarly, the Co-operative Banking & commercial banking facilities are easily accessible for the villagers. Mobile/ telephone connectivity is available in all the surveyed villages. Village wise infrastructure facilities summarized below **Table 3.66**.

Table 3.66: Infrastructure Facilities in the Surveyed Villages/Town

S. No.	Village/Town name	Post Office	Bank	Road Network	Fair Price Shop	Irrigation Facilities	Cooperative Society	Electricity	Community Hall	Tele-communication
1	Mahura (Mohra)	Yes	No	Yes	No	Yes	No	Yes	No	Yes
2	Manchi Krand	No	No	Yes	No	No	No	Yes	No	Yes
3	Gingal	Yes	Yes	Yes	No	No	No	Yes	No	Yes
4	Bernate	No	No	Yes	Yes	No	No	Yes	No	Yes
5	Boniya	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes
6	Bandy	No	Yes	Yes	No	Yes	No	Yes	No	Yes
7	Lagama	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
8	Uranbua	Yes	Yes	Yes	No	No	No	Yes	No	Yes
9	Nowshera A	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes
10	Nowshera B	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes

i) Energy and Fuel Source

Most of the households in the surveyed villages have LPG connections for cooking but due to easy accessibility and low cost of fuel wood villagers also use fuelwood as energy source for domestic cooking and heating purpose. Cow dung and kerosene oil are also used by villagers.

j) Transport & Communication

Baramulla is the nearest railway station to the surveyed villages. The approach roads in the area are good in condition, all the village roads are well connected to National Highway 1A connecting the project area to district headquarter. Transportation facilities are good in the area. Government and private buses and taxis are the main public transport facilities in the area. Postal and telecommunication facilities are also good in the area.

k) Culture and Religion

Islam is the main religion in the surveyed villages. A small portion of Hindu also live in the surveyed area. Kashmiri/ Pahari is the main spoken language in the surveyed area.

3.2.15.3 Historical, Religious and Archaeological Importance Places

Reservoir of Uri-I Power Station is common for both Stage-I and Stage-II schemes. Existing reservoir is in operation since 1997 and no site of national importance was notified by Archaeological survey of India in the reservoir area. Further, Archaeological Survey of India, Srinagar circle vide letter no. DAMA/957-59/AMA-203/NHPC dated 06.10.2021 issued NOC. Among the religious places there are Mosque, Temples and Gurudwara are located in the area. Among the temples, an ancient Data Mandir near Powerhouse area and Pandu temple at Lagama are the famous temples in the project area (**Appendix-II**).

3.2.15.4 Mineral Resources

Minerals of economic significance were observed within the submergence area of the reservoir. Directorate of Geology & Mining, Govt. of J&K UT vide letter JDK/DGM/SGR/F-79/4306-08 dated 28.07.2021 issued NOC for Uri-I Stage-II Project (**Appendix-III**).

3.2.15.5 Public Perception

A wide range of interactions and consultations were held with the different people during the socio-economic survey in the project area. The majority of the people expressed positive opinions about the likely developmental impacts of the project on the social and economic sectors. The proposed project is expected to improve accessibility through the development of roads and would also provide employment opportunities for local youth. The local population also perceives the likely contribution of the project in improving the educational, health and economic infrastructure and tourism potential of the area through corporate social responsibility activities.

3.2.15.6 Conclusion

On the basis of interpretation made above, primary survey (interaction with village Sarpanch, FGD and discussion with influential person in the study area and secondary sources, the major outcomes have been specified in the following observation.

- The Educational facility in the area is good up to secondary school level but for senior secondary school and college's students travel around 20 km from the villages.
- The primary medical facilities are good in the surveyed villages located around the proposed project, however strengthening and improvement of basic medical care facilities in the remote villages required attention.
- The livelihood of most of the people of the study area depends on agriculture, horticulture and allied services and government and private jobs. Diversion of spring and river water through small network of canal is source of irrigation in the area. Spring water and Piped water supply are the main source of drinking water in the study area.
- The post office and banking facilities are easily approachable from 70% of the surveyed villages. Every household has mobile and power supply available in the villages. The village approach road and village roads are good. Market facilities are situated at Lagama, Bandy and Boniyar. Fair price shops are available at Bernate and Boniyar.
- The most important road that passes through the area is National Highway 1A (Baramulla to Uri). Transportation facilities are good in the area, all the village roads are well connected to highway through metaled roads. Telecommunication and mobile facilities are available in the area.

3.3 BASE MAPS OF ALL ENVIRONMENTAL COMPONENTS

Study area of the project covers the project area or the direct impact area within 10 km radius of the main project components like, Existing Barrage Site, HRT, Powerhouse, and TRT etc. Base maps based on study area for all environmental components are prepared and given in respective sections above.

Social Survey Photographs



Consultation with Municipal Committee President, Lagama



Consultation with Machhi Karand Village



Consultation with villagers at Mahura Village



Consultation with B.D.C Chairman Panchayat Boniyar



Consultation with villagers at Gingal Village



Consultation with Deputy Sarpanch, Nowshera-B Panchayat



Consultation with Sarpanch, Bernate Village



Co-Operative Marketing Society, Boniyar

	
ITI, Lagama Village	Health and Wellness Centre, PHC Mahura Village
	
Ancient Pandu Temple, Lagama	Gurudwara and Mosque near Param Pilla Road
	
Ancient Datta Mandir, near Uri I Powerhouse	Pahari Cultural Festival, Uri
	
NHPC Hospital, NHPC Complex, Gingal	Kendriya Vidyalaya NHPC Complex, Gingal

**Chapter
4****ANTICIPATED ENVIRONMENTAL IMPACTS
AND MITIGATION MEASURES****4.1 DETAILS OF INVESTIGATED ENVIRONMENTAL IMPACTS**

Assessment of environmental impacts of any development activity is the key component of the EIA process. Environmental impacts are assessed based on the understanding of the project features/activities, environmental baseline setting in the area, and interaction of project activities with environment. The proposed Uri-I Stage-II HEP is a location-specific project and impact assessment is carried out by establishing site-specific environmental settings through baseline data collection and defining project components from detailed project information. Baseline environmental status in the project area is established through field studies in different seasons and by referring to various secondary data sources as discussed in the previous chapter. Project-related information is sourced from the Detailed Project Report (DPR) of the project to carry out the impact assessment for the project construction and operation phase.

Anticipated environmental impacts during the construction phase emanates from the activities such as drilling and blasting, excavation, concreting, dumping of muck generated from various project activities, transportation of material, material handling and storage, waste generation from labour colonies, operation of construction machinery/equipment, etc. Additionally, large-scale labour migration to the area, during the construction period, may create additional stress on the receiving environment. EIA helps in identification and quantification of such impacts so that appropriate and adequate mitigation/ management measures can be planned and implemented for mitigating and minimizing such impacts.

All the likely impacts have been considered for various aspects of the environment, including physico-chemical, ecological, and socio-economic aspects. Invariably two types of impacts occur due to construction and operation of projects viz. permanent which generally lead to loss of plant species, change of land-use, displacement of population, etc., which can only be compensated and managed; and temporary impacts which can be minimized and mitigated by implementing mitigation measures. Wherever possible, the impacts have been quantified and otherwise, qualitative assessment has been undertaken.

This chapter deals with the anticipated positive as well as negative impacts during the construction as well as operation phase of the proposed project.

Main activities during the construction as well as operation phase are as follows.

Major Activities during Construction Phase

- Construction of Head Race Tunnel (HRT), Surge Shaft, Pressure Shaft, an underground Powerhouse complex and Tail Race Tunnel (TRT).
- Transportation of construction material, disposal of muck and construction wastes.
- Operation and maintenance of construction equipments.
- Civil and mechanical fabrication works for construction of various project components.
- Operation of DG sets,
- Disposal of pollutants from workshops, etc.
- Disposal of effluents and solid wastes from labour camps and colonies, etc.

Operation Phase Activities

- Diversion of water from existing barrage for hydropower generation
- Equipment maintenance and restoration
- Sewage and solid waste generation from project colonies

4.1.1 Impacts on Air Quality

As per the results of Ambient Air Quality monitoring during baseline data collection, the PM_{2.5}, PM₁₀, SO₂, and NO₂ levels at all the sites are well within the Residential & Rural area permissible limits prescribed by National Ambient Air Quality Standard 2009 notified by CPCB. Similarly during period of data collection the Air Quality Index (AQI) at different sampling locations within the study area falls under 'Satisfactory' (AQI between 50-100), and 'Good' category (AQI between 0-50) as per National Ambient Air Quality Standard 2009 notified by Central Pollution Control Board.

4.1.1.1 Construction Phase Impacts

During construction phase of project, the sources and activities that might affect air quality in the project area are vehicular traffic, dust arising from unpaved village roads, and combustion of fuelwood for domestic uses. The air environment around the project site is free from any significant pollution sources. Therefore, ambient air quality is quite good in and around the project area.

Increased vehicular movement for transportation of men and construction material along with use of construction equipment will impact air quality at the construction site through emissions from the engines and equipments, fugitive emissions due to material handling, etc. Additionally, construction activities including operation of crushers, concrete batch plants, construction work, and movement of vehicles along the unpaved road will generate dust & gaseous emissions and may impact air quality. In absence of proper fuel, construction workers at the project site may tend to use wood as fuel for cooking and heating processes.

Pollution due to fuel combustion in various equipment

The operation of various construction equipment requires combustion of fuel. Normally, diesel is used in such equipments. The major pollutants which gets emitted because of the combustion of diesel is SO₂. The particulate matter emissions are minimal due to the low ash content in diesel. Depending upon the fuel quality and quantity and rating of DG sets and other equipments, it is important to provide adequate stack height for emission to be dispersed into the atmosphere to have a minimum increase in Ground Level Concentrations (GLCs).

Emissions from various crushers and other construction plants

The operation of crushers and other machineries during the construction phase generates dust and fugitive emissions, which may impact surrounding area, depending on wind direction. Such fugitive emissions comprising mainly of particulate matter will be generated. Preventive and protective measures are required to be implemented by contractors at the site to control such emissions and further reduce their impacts on surrounding area.

Fugitive Emissions from material handling and transportation

During the construction phase, there will be increased vehicular movement. A lot of construction material like sand and fine aggregate is stored at various sites, during the project construction phase. Normally, due to the blowing of winds, especially when the environment is dry, some of the stored material can get entrained into the atmosphere. Although it is very difficult to eliminate such an impact, it is possible to reduce its intensity by implementing mitigation measures discussed in the ensuing text.

4.1.1.2 Operation Phase Impacts

Hydro power schemes do not generate air pollution during the operation phase as there is no source of air pollution. Therefore, during the operation phase, no major impacts are envisaged on the air environment.

4.1.2 Impact on Noise Environment

Sources of noise will increase owing to vehicular traffic during project construction on approach roads and at construction sites. Due to construction activity in the area, noise levels will increase, and this impact will be temporary and will remain limited to the work area mainly where construction activity will take place. Other sources of noise and vibration will be from the use of explosives for limited and controlled blasting purposes during construction activities.

4.1.2.1 Construction Phase Impacts

a) Noise due to Construction Equipment

The expected noise levels due to the operation of the different construction equipment are given in **Table 4.1**.

Table 4.1: Equivalent Noise Levels due to Operation of Construction Equipment

Equipment	Noise level dB(A)	Equipment	Noise level dB(A)
Earth Moving		Material Handling	
Compactors	80-82	Concrete mixers	75-85
Front loaders	72-82	Movable cranes	82-84
Backhoes	70-92		
Tractors	76-90		
Scrappers, graders	82-90		
Truck	84-90		
Others			
Vibrators	69-81	Saws	74-81

Source: Construction Equipment Noise Levels and Ranges - Handbook - Construction Noise - Noise - Environment – FHWA (2017).

Noise level of about 80 dB(A) at 1m from the source will reduce significantly with distance and can be calculated with the following formula at any location:

$$N_2 = N_1 - 20 \log_{10}(r_2/r_1) - A_f \quad \text{dBA}$$

Where, N_2 = Sound level at any location at a distance r_2 from the source

N_1 = Sound level at any location at a distance r_1 from the source

The decrease in sound level of 80 dB(A) (at 1m from the source) at 100m from the source is 40 dB(A) even in the absence of an external attenuation factor. Decrease in sound levels

(measured at 1 m from the source) at various distances are given in **Table 4.2**. In the absence of details of attenuation factors, they have assumed zero, whereas, in actual practice attenuation factors such as vegetation, barricades, etc. will reduce the sound level significantly. Noise levels get reduced by 6 dB(A) with every doubling of distance.

Table 4.2: Decrease in Sound Levels with Distance from Source*

Distance from Source (m)	Corresponding Sound levels dB(A)
100	40.0
200	34.0
500	26.0
1000	20.0
1500	16.5
2000	14.0
2500	12.0
3000	10.5

* Source sound is 80 dB(A) at 1m

The walls of houses attenuate at least 30 dB(A) of noise. In addition, there is attenuation due to air absorption, atmospheric homogeneities, vegetal cover, etc. Thus, no increase in noise levels is anticipated beyond 100m from the source during the project construction phase. However, it can be a cause of concern for workers working in proximity to machines generating noise. Therefore, to address the safety of workers, provision of earplugs and earmuffs with Personal Protective Equipment has been kept under Labour Management Plan.

b) Noise due to increased vehicular movement

During the construction phase, there will be a significant increase in the vehicular movement for the transportation of construction material. Presently in the project area, the only sound is the noise emanating from the turbulent flow of the Jhelum River and there is very little vehicular movement in the area. During the construction phase, the increase in vehicular movement is expected to be at least 5-6 trucks/hour during the peak construction period. The impact on noise level due to increased vehicular movement cannot be quantified as it will depend upon various factors such as vehicle condition, vehicle speed, road condition, idling time, traffic condition, etc.

c) Noise Generated due to Blasting

The noise generated by blasting is instantaneous. Noise generated due to blasting is site-specific and depends on the type, quantity of explosives, dimension of the drill hole, degree of compaction of explosives in the holes, and rock. Noise levels generated due to blasting at various distances are given in **Table 4.3**.

Table 4.3: Noise generated due to blasting

No. of holes	Total charge (kg)	Maximum charge/delay (kg)	Distance (m)	Noise level dB(A)
15	1500	100	250	76-85
17	1700	100	250	76-86
18	1800	100	250	77-86
19	1900	100	250	77-87
20	2000	100	250	78-88

Source: Noise Measurement Manual 2020

It can be observed from **Table 4.3** that noise levels due to blasting operations are expected to be of the order of 76-88 dB(A) at about 250m. External attenuation factor will reduce it further. As the blasting is likely to last for 4 to 5 seconds depending on the charge, noise levels over this time would be instantaneous and short in duration. Considering attenuation due to various sources, even the instantaneous increase in noise level is not expected to be significant especially during daytime. Hence, higher noise levels generated due to blasting are not expected to cause any significant adverse impact.

e) Impacts due to Ground Vibrations

The explosive energy generated during blasting sets up a seismic wave within the surface, which may affect the structures and cause discomfort to the human population. When an explosive charge is fired in a hole, stress waves traverse in various directions, causing the rock particles to oscillate. Blasting also generates ground vibrations and instantaneous noise. Various measures have been recommended to minimize the adverse impacts due to blasting:

- Proper design of blast hole to be developed.
- Use of noiseless trunk delays to minimize the noise due to air blast.
- Use of the non-electric system of blasting for true bottom-hole initiation.
- Use of muffling mats to arrest the dust and fly rock.

f) Impacts on Labour

The effect of high noise levels on the operating personnel must be considered as cause of health & safety. It is known that continuous exposures to high noise levels above 90 dB(A) affect the hearing ability of the workers/operators and hence, should be avoided. To prevent these effects, it has been recommended by Occupational Safety and Health Administration (OSHA) that the exposure period of affected persons be limited as in **Table 4.4**.

Table 4.4: Maximum Exposure Periods Specified by OSHA

Maximum equivalent continuous noise level dB(A)	Unprotected exposure period per day for 8 h/day and 5 days/week
90	8
95	4
100	2
110	½
120	¼

Source: <https://www.osha.gov/noise>

g) Impacts on Wildlife

Noise in and around the construction site may affect the wildlife in the nearby areas. It is expected that wildlife in the area will move away from the noise source and eventually return to the area when the blasting operations are over. There is no major wildlife observed in and around the project construction site during the EIA studies and hence this may not be a significant issue.

4.1.2.2 Operation Phase Impacts

No major impacts are envisaged on the noise environment during the project operation phase.

4.1.3 Water Environment

Various sources of water pollution in the project area during the construction phase include disposal of effluents with high turbidity from crushers commissioned at various sites, sewage disposal from the labour camp, blasting and other land clearing activities, washing of oil, grease, and other chemicals from diesel generator sets, vehicles, and other machinery, etc.

4.1.3.1 Impacts of water pollution

The effect of construction activities on surface and ground water sources may be temporary or permanent in nature. The major impacts of water pollution are given as under:

- The civil and hydro-mechanical work at the site will lead to stockpiling and excavation activity on-site, thereby exposing the base soil to erosion. The runoff from this site and muck disposal sites may contain a high quantity of Suspended Solids which may add to the inorganic load of water bodies and drainages in the area. However, the impact of runoff may not be very significant except during the rainy season.
- During the construction phase, wastewater, sewage, etc. shall be generated from the labour camp and workshops. If disposed of untreated, this would substantially deteriorate the surface and groundwater quality in the area.
- The oil and grease released from the project-related activities may also change the physico-chemical characteristics of water, if disposed off without proper treatment.

4.1.3.2 Construction Phase Impacts

The major sources of water pollution during the project construction phase are as follows:

- Sewage from Construction work camps/colonies
- Discharge of wastewater from Construction Plants and Workshops

a) Sewage from Construction worker Camps

The project construction will last for 44 months. About 500 semi-skilled/unskilled, skilled, and supervisor staffs are likely to work during the peak project construction phase. Most of the employees/ workers during the construction phase are likely to be employed from outside the project area. The construction phase also leads to mushrooming of various allied activities to meet the demand of immigrant construction workers in the project area. Additionally, drivers and labours associated with the transportation of material will also stay in the area temporarily.

The domestic water requirement for the construction worker and the technical staff migrating into the project area will be of the order of approx. 40 cum/day @ 70 lpcd. With 80% of this quantum to be generated as wastewater, the quantity of 32 cum/day is considered significant and requires planned disposal otherwise it will lead to water pollution, increased coliforms, and other pathogens, which can lead to incidence of water-borne diseases. Therefore, project proponents would be taking appropriate measures to check such disposal into the natural water bodies. To avoid any deterioration in water quality due to disposal of untreated wastewater from labour camps, appropriate sewage treatment facilities, soak pits & septic tanks will be provided in the labour camps, and only treated wastewater will be discharged following "General Discharge Standards".

b) Discharge of waste water from Construction Plants and Workshops

As discussed earlier, construction plants viz. aggregate processing and concrete mixing and workshops will be established. Water is used in these construction plants and wastewater may be generated with high suspended solids. Similarly from workshops, major pollutants released will be oil and grease. Discharge of untreated wastewater may affect the surface and groundwater quality. To minimize the impact, such effluent will be passed through sediment tank and oil separator then treated *in-situ* before discharge to any water body or for land application.

c) Discharge of wastewater from Crushers

Since local crushers in the vicinity of the project are not capable to provide required construction material, hence one 240 TPH Aggregate Processing Plants (APP) and 2 nos. of 90 Cum/hr Batching and mixing Plant are proposed to cater to the initial requirement of works. Water is required to wash the boulders and to lower the temperature of the crushing edge. The wastewater from the crusher would contain high suspended solids. The effluent, if disposed off without treatment can lead to an increase in the turbidity levels in the surface water. Therefore, it is proposed to treat the effluent from crushers in the settling tank before disposal to ameliorate impacts likely to accrue on this account.

d) Disposal of Muck

The water quality may get impacted when the muck is disposed of along the water bodies and natural drainage system. The unsorted waste going into the channels/ water bodies can contribute to the turbidity of water. The high turbidity is known to reduce the photosynthetic efficiency of primary producers in the water bodies and as a result, the biological productivity will get reduced. However, muck disposal in line with the Muck Disposal Plan, as given in Environment Management Plan (Chapter 10) will avoid such impacts on water quality.

e) Impact on Aquatic Life

During the construction phase a large quantity of construction material like stones, pebbles, gravel and sand would be needed for which quarry sites have been identified, out of which 2 are river shoal sites. The extraction of construction material may lead to an increase in turbidity levels. The turbulence and increase in turbidity may affect the fish habitat in the area. In addition to fish species the aquatic flora and fauna comprising benthos i.e., phytobenthos & zoobenthos and macro-invertebrates which are found attached to the stones, boulders, etc. will get dislodged and may be carried away downstream by turbulent flow.

4.1.3.3 Operation Phase Impacts

During the operation phase, due to the absence of any construction activity, the cause and source of water pollution will be much different. Since only a small number of O&M staff will reside in the area in a well-designed colony with a sewage treatment plant and other infrastructural facilities, the problems of water pollution due to disposal of sewage are not anticipated. The treated sewage will be reused for gardening and green belt around the colony.

f) Impact of Reservoir Creation

The Uri-I Stage-II HEP will utilize the existing reservoir of Uri-I Stage-I HEP (Uri-I Power Station) with the gross head of about 250m between FRL as 1491 m at barrage and TWL as 1241m at TRT outlet. The reservoir has been under operation since 1997. As the reservoir has been operational for the last 25 years, the aquatic communities have already adapted to the altered environment. Hence with the operation of Uri-Stage-II HEP there will be no modification in the existing structure and hence the water environment will remain unchanged.

During sampling for aquatic ecology 33 species of phytoplankton, 17 species of periphytons, 12 species of Zooplanktons and 10 genera of Macro-invertebrates were recorded from the five sampling sites on Jhelum River including upstream of reservoir, reservoir area, downstream of reservoir area and one sampling site at Boniyar nala. The presence of aquatic life in the stretch of project area shows that the aquatic flora and fauna have sustained and adapted to the altered environment.

In addition to benthic diatoms, zooplanktons and Macro-invertebrates, it has been found that the study area also harbors great diversity of fish species mainly represented by *Schizothorax sp.* *Schizothorax sp.* are well known for their migratory nature. For the migration of fish species Uri Power Station barrage is designed with provision of fish ladder. After commissioning of Uri Power Station University of Kashmir, Srinagar undertook a study "Effect of Uri and Lower Jhelum Barrages on spawning and migration of fish *Schizothorax sp.*"¹ Fish tagging experiment revealed that the fish ladder in Uri Power Station Barrage is suitable for fish migration when sufficient quantity of water was available in the fish ladder and downstream area, particularly for *Schizothoracine* species. The study also recommended that minimum water level in the river Jhelum, between barrage and tail water discharge outlet in general and between barrage and Boniyar Nala in particular be maintained so that the fish species are able to migrate during migratory season.

The richness and diversity of macro-invertebrates and productivity of Jhelum River in this stretch performs a very important ecological function providing resource inputs for the sustenance of fish in this section of Jhelum River. It is therefore very crucial to maintain environment flow in the downstream of diversion structure to sustain the existing biological diversity.

g) Environment Flow

Uri-I Stage-II HE Project is the extension of Uri-I Power station (480 MW). Uri-I Power station a purely run-of-the river scheme which was allotted to NHPC Limited and was commissioned in 1997 and since then operating successfully on River Jhelum. The Project has a Powerhouse with TRT outlets proposed at about 16 km downstream of the Barrage.

Based on the study carried out by Institute of Fresh Water Research, Sweden in association with Department of Zoology, University of Kashmir, Srinagar, Environmental flow of provision of 2.5 cumec as downstream discharge through fish ladder of barrage of Uri Power Station had been maintained.

¹ "Effect of Uri and Lower Jhelum Barrages on spawning and migration of fish *Schizothorax sp.*" University of Kashmir, 1997-98.

I. E-flow study for proposed Uri-I Stage-II H.E. Project

As per Scoping clearance issued by Ministry of Environment, Forest & Climate Change (MoEF&CC) on 10th June 2021, following stipulations for e-flows were proposed:

“In view of recent NGT order, provision of e-flow as 15% of average of inflow in the lean season, needs to be made in dam/barrage of existing power plant. Accordingly, 15% of average inflow of all the water series in the lean season i.e., during Oct-Jan has been calculated as 13.05 cumec. There is already a provision of 2.5 cumec downstream discharge through fish ladder of Uri power station. As such, provision of additional downstream discharge of 10.55 cumec as e flow has been kept from the barrage of Uri power station.”

Above proposed 13.05 cumec has been updated based on more recent flow data available.

For Uri-I stage-II HE Project, no separate dam/barrage is envisaged. Barrage of Uri power station shall be common for both the projects (i.e. Uri and Uri-I stage-II). There is already a provision of 2.5 cumecs downstream discharge through fish ladder of barrage of Uri power station. However, in view of recent NGT order vide OA no- 425/2019 for e-flow releases, provision of e-flow of 15% of average lean season (four months, i.e. Oct. – Jan.) flow of Jhelum river at Uri Barrage as per average 10 daily flow series (1976-77 to 2019-20) worked out as 14.2 cumecs. As such, an additional downstream discharge of 11.70 cumecs as e-flow, is being released from the barrage of Uri Power station. As the reservoir of both the Stages of Uri-I Stage-I & Uri-I Stage-II is same, no additional environmental release is considered in power potential studies of Uri-I Stage-II HEP.

The most critical reach below barrage site is of about 1.3 km; below which Boniyar Nala with a catchment of 164 sq. km joins Jhelum river on left bank. In the present section, an assessment has been made for the adequacy of e-flow releases based on the habitat requirement of the aquatic life or downstream uses, if any. A hydro-dynamic modelling on MIKE 11 has been carried out for **13.05 cumec** e-flow release as specified in the scoping clearance issued by Ministry of Environment, Forest & Climate Change (MoEF&CC) as well as updated e-flow release of **14.2 cumec** worked out based on more recent data as mentioned in above paragraphs to assess flow width, depth and velocity indicators for habitat adequacy.

Lateral inflow from Boniyar Nala has been worked out on catchment area proportion basis as 1.25 cumec which joins Jhelum River on left bank below 1.3 km downstream of barrage.

II. Establishing Water Requirement

To study various biological and physico-chemical characteristics of river in the study area of proposed project, sampling was carried out at few locations near diversion site. This is important to establish water requirements for aquatic ecological and downstream use considerations. Biological and physico-chemical characteristics have been presented in Chapter 3, Section 3.2.10 & 3.2.13.

Fish and Fisheries

During the field surveys, experimental fishing was undertaken to know the type of fishes available in Jhelum River. Local people were interviewed about the type of fish found in Jhelum River. According to them and data gathered from literature fishes found are Snow

trouts like *Schizothorax curvifrons*, *Schizothorax esocinus*, *Schizothorax labiatus*, *Schizothorax plagiostomus*, *Glyptosternon reticulatum*, *Glyptothorax pectinopterus*, *Triplophysa Spp.* are reported from the river. Snow trouts are known to perform local movement. To cope with the fall in the water temperature in winter months, they descend to the lower stretches. When temperature rises from freezing levels to 10°C-17°C in May and June then they ascend to upper stretches and tributaries to lay their eggs. Fish species reported in this stretch of Jhelum River are listed in **Table 4.5**.

Table 4.5: List of fish species reported in the study area

S. No.	Family	Name of Species
ORDER: CYPRINIFORMES		
1	Botiidae	<i>Botia birdi</i>
2	Cyprinidae	<i>Bangana diplostoma</i>
3	Cyprinidae	<i>Carassius carassius</i>
4	Cyprinidae	<i>Crossocheilus diplochilus</i>
5	Cyprinidae	<i>Cyprinus carpio communis</i>
6	Cyprinidae	<i>Cyprinus carpio specularis</i>
7	Cyprinidae	<i>Oncorhynchus mykiss</i>
8	Cyprinidae	<i>Puntius conchoni</i>
9	Cyprinidae	<i>Salmo trutta fario</i>
10	Cyprinidae	<i>Schizothorax curvifrons</i>
11	Cyprinidae	<i>Schizothorax esocinus</i>
12	Cyprinidae	<i>Schizothorax labiatus</i>
13	Cyprinidae	<i>Schizothorax niger</i>
14	Cyprinidae	<i>Schizothorax plagiostomus</i>
15	Nemacheilidae	<i>Schistura punjabensis</i>
16	Nemacheilidae	<i>Triplophysa kashmirensis</i>
17	Nemacheilidae	<i>Triplophysa marmorata</i>
ORDER: CYPRINODONTIFORMES		
18	Poeciliidae	<i>Gambusia holbrooki</i>
ORDER: SILURIFORMES		
19	Sisoridae	<i>Glyptosternon reticulatum</i>
20	Sisoridae	<i>Glyptothorax kashmirensis</i>
21	Sisoridae	<i>Glyptothorax pectinopterus</i>

III. Flow Requirement Based on the Aquatic Life

Fish species need relatively unaltered or pristine habitat during their life cycles to ensure optimal growth and survival rates. Fish migration, spawning, incubation and rearing are various life cycle stages requiring particular habitat for survival. Environmental conditions of the habitat include temperature, water depth, velocity, turbidity, dissolved oxygen, substrate and food supply. To work out the water requirement based on needs of aquatic life, it is important to understand the variations caused in the environmental conditions of the habitat due to availability of lesser quantity of water in the downstream stretch; relate it to the requirement of fish species available in the region and establish the minimum water required to be released during different seasons to ensure their survival, migration, spawning, incubation and rearing etc.

Baseline status of Fish and Fisheries in the study area has been discussed in above sections. Based on the discussion above, indigenous species, snow trout (*Schizothorax plagiostomus*) is predominantly available in the study area. Therefore, flow release requirement

established to meet habitat requirement of snow trout should be adequate for other species as well.

Several scientific studies have been done in past to establish fish habitat and to study impacts on fish species due to habitat alteration either by natural reasons or human interference. Most of the work has been done on Snow trout, which have wide range distribution in the Himalayan region. Wildlife Institute of India (WII) has carried out a CIA study for Bhagirathi and Alaknanda Basins (2012). In the report, they have compiled minimum habitat requirement of trout species in terms of feeding habits, habitat preference, breeding/spawning characteristics. Data is sourced from WII document and used for the environment flow release study for Uri Stage II HEP (Table 4.6).

Table 4.6: Habitat requirement of Snow trout (*Schizothorax spp.*)

Parameters	Adults	Juveniles	Spawning	Incubation & Larval development
Depth	>0.5 m	0.1 - 1 m	0.5 - 1.00 m	0.1 - 1.00 m
Velocity	Low to high (0.5-1.5 m/s)	Low to medium (0.5-1.0 m/s)	Low to medium (0.5 -1.0 m/s)	Low (0.1-0.5 m/s)
Habitat	Riffles, pools, glides,	Riffles, glides, closer to the banks	Low gradient riffle Glides	Backwater pools and bank undercuts
Substratum	Boulders, Cobbles, Pebbles, Gravel	Cobbles, boulders, pebbles, gravel	Cobbles, pebbles, gravel	Cobbles, gravel
Temperature	4-20 °C	4-20 °C	<15 °C	4-15°C
Dissolved Oxygen (mg/l)	8-12 mg/l	8-12 mg/l	8-12 mg/l	8-12 mg/l
Food	Large portion of periphytic algae and diatoms. Also feed on benthic invertebrates	Periphytic algae and diatoms.	Not applicable	Diatoms
Breeding Period	April to September			
Passage requirement	This species is a migrant species, moves from river to upstream and adjoin streams for spawning.			
Migration timing	April to September			
Migration Cues	Movement is believed to be triggered by the variation in water temperature and flow			
Other flow related needs	Flow may be a crucial factor for the migration of this species.			

In addition, habitat requirement of snow trout is also discussed in following scientific papers:

- Coldwater Fish and Fisheries in the Indian Himalayas: Rivers and Streams by K. L. Sehgal
- Fish Diversity, Habitat Requirement, Environmental Limitations and Conservation of Freshwater Fish Resources of Garhwal Himalaya by Ramesh C Sharma

Based on WII report and above research papers, habitat requirement can be established as: during lean season, an environmental flow to maintain a water depth of 0.50 m at all time and a velocity of about 1.25 m/s should be considered as minimum requirement.

IV. Flow Requirement Based on the Downstream Users

Diversion of water for power generation would lead to the change in flow regime in the river stretch downstream of dam. No village in downstream reach is directly dependent upon main river for their water use requirement. A field survey was carried out to establish the water requirement of downstream users and the following observations were made:

- i) There are few fishermen in the area. Most of the activities for fisheries development have been taken up by government agencies however there are licenses issued to common man also are able to take economic benefit from fish farming. The fish culture activities on a very large commercial scale were not observed in the river.
- ii) No village in the downstream reach uses the river water for drinking, daily needs and agriculture. They usually depend on rain and stream water for their needs.

In view of the above observations, water requirement from the main river is not there for the locals residing in the region along the river stretch downstream of barrage. Therefore, no significant impact is foreseen downstream of the barrage on the water requirement of the people living in this stretch and no quantified water requirement needs to be established. Water requirement based on the needs of aquatic life should govern the criteria for release of minimum flow.

V. Flows Assessed

- **13.05 cumec:** Stipulated as per Scoping clearance issued by Ministry of Environment, Forest & Climate Change (MoEF&CC) on 10th June 2021.
- **14.2 cumec:** However, as per NGT's order vide OA no- 425/2019 for e-flow release, 15% of average lean season (four months i.e., Oct – Jan) flow of Jhelum River at Uri Barrage as per average 10 daily flow series (Database: 1976-77 to 2019-20) is 14.2 cumec.

VI. Simulation of Releases from the barrage

Hydro-dynamic simulation has been carried out for immediate downstream reach of about 1.3 km which is most critical due to altered flow regime in view of diversion of water. Boniyar Nala which has a substantial catchment area of 163.94 sq km joins River Jhelum on left bank below 1.3 km from diversion site contributing significant inflows in downstream reach. Hence, the initial 1.3 km are considered most critical for e-flow release point of view. Subsequently, four more major streams join River Jhelum on right bank between diversion site and tail race outlet thus contributing more flows shown below in **Table 4.7 and Figure 4.1**. Total river length between barrage and tail race outlet is 17.95 km and the intermediate catchment area is 377.16 sq km.

Table 4.7: Details of tributaries between Barrage and Powerhouse of URI-I Power Station

At Left Bank			At Right Bank		
Name of Tributary	Distance from Diversion Site (km)	Catchment Area (sq km)	Name of Tributary	Distance from Diversion Site (km)	Catchment Area (sq km)
Boniyar Nala	1.29	163.96	Islamabad Nala	5.52	11.45
			Bagna Nala	6.71	8.02
			Katha Nila Nag	8.04	95.78
			Maidan Nala	12.02	34.89

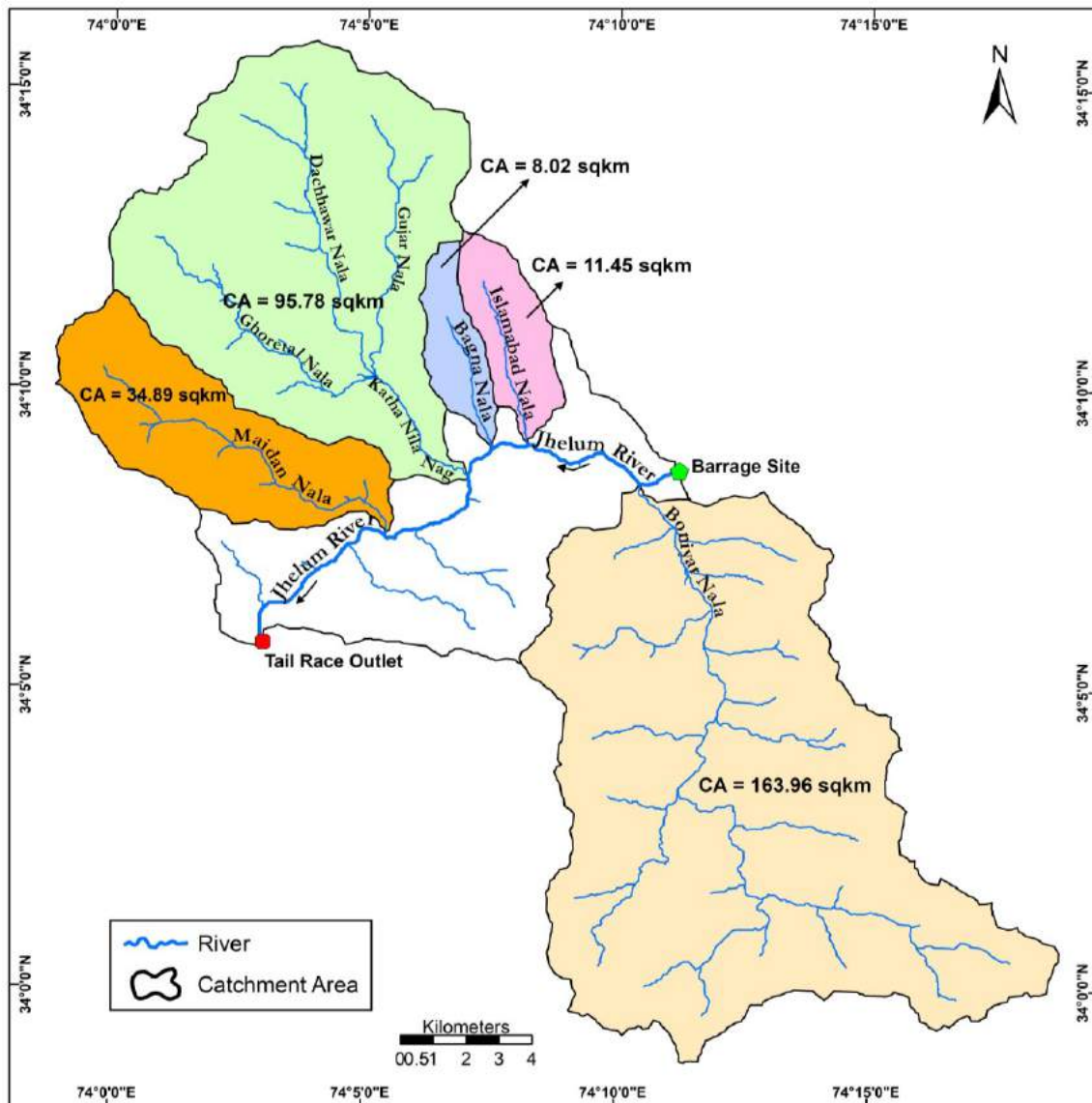


Figure 4.1: Intermediate catchment between barrage and powerhouse of Uri-I Power Station

Few critical sections within this reach downstream of dam were taken for modeling study to simulate the flow, velocity and corresponding water depth so as to establish the requirement of release from the dam. Modeling has been carried out on MIKE 11 software. River cross section at this location was taken and various flow releases were simulated to work out the depth and velocity during different release scenarios. Manning's coefficient has been taken as 0.04. Modelling results as MIKE 11 simulation output for different attributes are shown below:

For 13.05 cumec release

Reach d/s of barrage	Q Total (m ³ /s)	Bed Elevation (m)	Water surface Elevation (m)	Water depth (cm)	Flow Velocity (m/s)	Flow Top Width (m)
JHELUM 190.00	13.05	1475.00	1475.27	27.27	0.86	61.00
JHELUM 390.00	13.05	1473.14	1473.65	50.78	1.20	35.93
JHELUM 590.00	13.05	1470.80	1471.51	70.87	1.95	19.42
JHELUM 790.00	13.05	1468.00	1468.24	24.35	0.89	59.28
JHELUM 990.00	13.05	1465.62	1466.25	62.96	2.10	19.52
JHELUM 1190.00	13.05	1460.00	1460.67	67.23	2.30	13.88
JHELUM 1300.00	13.05	1454.14	1454.72	58.28	2.14	21.55
			Average	51.68	1.63	32.94

For 14.2 cumec release

Reach d/s of barrage	Q Total (m ³ /s)	Bed Elevation (m)	Water surface Elevation (m)	Water depth (cm)	Flow Velocity (m/s)	Flow Top Width (m)
JHELUM 190.00	14.2	1475.00	1475.27	27.30	0.89	62.05
JHELUM 390.00	14.2	1473.14	1473.65	50.50	1.24	36.34
JHELUM 590.00	14.2	1470.80	1471.50	70.10	2.00	20.10
JHELUM 790.00	14.2	1468.00	1468.26	25.70	0.96	59.66
JHELUM 990.00	14.2	1465.62	1466.25	62.50	2.24	20.19
JHELUM 1190.00	14.2	1460.00	1460.70	70.30	2.67	15.11
JHELUM 1300.00	14.2	1454.14	1454.84	69.80	1.50	26.86
			Average	53.74	1.64	34.33

VII. Environment Flow Release Recommendations

Following can be concluded from the above hydrodynamic modeling exercise:

For the most critical reach of initial 1.3 km downstream of barrage, average water depth, flow velocity and flow width for 13.0 cumec e-flow release, work out to 51.68 cm, 1.63 m/s and 32.94 m respectively and for 14.2 cumec e-flow release; while, same work out to 53.74 cm, 1.64 m/s and 34.33 m respectively. Thus, as per the habitat requirement assessed in above paragraphs, both 13.05 cumec as well as 14.2 cumec e-flow release meet the downstream needs. However, to comply with NGT's order for e-flow release, updated flow release worked out as 14.2 cumec based on more recent flow data available and being 15% of average lean season (four months i.e., Oct – Jan) flow of Jhelum River at Uri Barrage as per average 10 daily flow series has been adopted as e-flow release. Subsequently, 1.25 cumec inflow during corresponding lean period from Boniyar Nala; joining Jhelum River of left bank at 1.3 km downstream of barrage and additional contributions from intermediate catchment would make habitat furthermore favorable as per requirement assessed.

Hence, 14.2 cumec release is recommended and adopted as e flow release for the project based upon present habitat based hydrodynamic simulation study. The barrage is equipped with a Fish Pass between bay No. 6 and bay No. 7 to release discharge of 2.5 cumec continuously. Balance e flow discharge of 11.7 cumec is provisioned to pass through the Silt excluder gate on a continuous basis.

h) Sewage from Project Colony

During the project operation phase, the cause and sources of water pollution will be much different. Since only a small number of O&M staff will reside in the area in a colony with facilities like a sewage treatment plant, the problem of water pollution due to disposal of sewage is not anticipated. During the operation phase, around 150 persons engaged in operation of Uri-I Stage-II HEP will be residing in the existing project colony of Uri-I Power Station at Gingal where provisions for additional manpower has already been made. The colony has adequate waste collection and sewage treatment facilities to accommodate additional staff. Therefore, no adverse impacts on this count are envisaged.

i) Risk of Eutrophication

There are many agricultural fields on the right bank slopes of the river in the reservoir area, the problem of eutrophication occurs mainly due to the disposal of nutrient-rich effluents from the agricultural fields.

As the proposed project is envisaged as a run-off-the-river scheme, with significant diurnal variations in reservoir water level, the residence time would be of the order of few days, which is too small to cause any eutrophication. Thus, during the operation phase, problems of eutrophication, which is primarily caused by the enrichment of nutrients in the water, were not observed during study.

j) Sediments

The sediment load at barrage site has also been calculated on the basis of observed sediment data from 2003-2020. Based on this data the average annual sediment (including 8% bed load) works out to be (suspended load of 2.88 + Bed load of 0.23) 3.11 Million tons per year.

It is a run of the river scheme and project utilizes water coming from Lower Jhelum H.E. Project for power generation after releasing mandated e-flow and remaining water spills over the barrage as there is no live capacity in the reservoir. The reservoir has no significant changes over 22 years of operation (i.e. from 1997 onwards) as sediment laden water passes downstream through barrage spillway gates.

4.1.4 Land Environment

4.1.4.1 Construction Phase Impacts

For the development of the Uri-I Stage-II HEP, no surface area would be acquired for construction of project components, reservoir area creation, muck dumping, quarrying operations, construction camps, and colonies. The required 97.0335 ha non-forest land is already under possession of NHPC and 17.0 ha forest land is required for underground work.

a) Impact due to change in land-use

In general, the major impact of land acquisition is a permanent change of land use, which is unavoidable. Private land acquisition has impacts on the local population by way of loss of their agricultural land. However, in the proposed scheme no such impact has been anticipated as no surface land shall be acquired for the project.

b) Impacts due to Muck Generation

The construction activities would involve 11,58,300 cum of soil and rock excavation. About 24% of excavated material (2,80,000 cum) is expected to be used for producing coarse and fine aggregate for concrete production and in fillings for developing areas for construction facilities. The total quantity of excavated muck would have to be disposed of in designated muck disposal areas. Thus, considering swell factors as adopted from CWC Guidelines and redeposit compaction factor of 83%, the total muck disposal area should have a capacity of about 8,78,300 cum. The designated sites will be fully rehabilitated and restored on completion of muck dumping.

Muck, if not securely transported and dumped at a pre-designated site, can have serious environmental impacts, such as:

Can be washed away into the natural water bodies which can cause negative impacts on surface and groundwater quality. If muck is stacked without adequate stabilization

measures, the muck may move along with runoff and creates soil erosion-like situations. Muck disposal, if done at low-lying areas, which get filled up due to stacking of muck, can sometimes affect the natural drainage pattern of the area leading to accumulation of water or partial flooding of some areas which can provide ideal breeding habitat for mosquitoes.

Disposal of muck needs to be carefully planned or else it becomes a major impact on the construction of the project. Such a plan is prepared and included in the Environment Management Plan (Chapter 10).

c) *Impacts Due to Waste Generation*

The construction of the proposed Uri-I Stage-II HEP will involve different categories of manpower like labour, technical, other officials, and service providers. Most of these technical and non-technical workers will be temporary and will leave the region as soon as the construction phase of the project is over, which is estimated as 44 months. Some of the workers will be accompanied by their families. The total migrant population of workers and their families has been estimated as 500 persons during peak construction time. These people will be living in temporary and permanent colonies/ settlements. The main sources of waste generation can be categorized as:

- Municipal waste (includes commercial and residential wastes generated in either solid or semi-solid form excluding industrial hazardous wastes and bio-medical wastes)
- Construction and demolition debris (C&D waste)
- Bio-medical waste
- Hazardous waste (generated from construction machinery and equipment)
- e-Waste (computer parts, Printer cartridges, electronic parts, etc.).

The solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management to dispose of, as warranted under the Solid Wastes Management Rules (SWM) 2016. For that, an efficient waste management system will be required to be put in place to keep the environment of the region clean and healthy.

These colonies and temporary settlements will also require an adequate water supply for drinking and cleaning. The camp sites will be provided with a properly maintained and operated sewage system including septic tanks and sewage disposal facilities. The project authorities will ensure sewage generated from labour colonies and site office is treated and disposed of as per the JK Pollution Control Committee guidelines.

d) *Impacts due to Quarrying.*

In hilly terrain, quarrying is normally done by cutting the face of the hill. A permanent scar is likely to be left, once quarrying activities are over. Over time, the rock from the exposed face of the quarry under the action of wind and other erosion forces gets slowly weathered and after some time, they become a potential source of landslide. Therefore, it is necessary to implement appropriate slope stabilization measures to prevent the possibility of soil erosion and landslides in the quarry sites. The mitigation measures have been accordingly suggested in Chapter 10, Environmental Management Plan.

e) Impacts on Forests and Forest Land

For the proposed scheme, 17.0 ha of underground forest land will be diverted for the underground construction work of the project components. Therefore, no tree felling or clearing of vegetation cover will be undertaken for the proposed project.

The loss due to diversion of underground forest land will be compensated through implementation of the Compensatory Afforestation Plan through J&K forest department.

4.1.5 Flora and Fauna

4.1.5.1 Construction Phase

a) Impact on Terrestrial Flora

The direct impact of construction activity will be limited in the vicinity of the construction sites. As mentioned earlier, a population of 500 including technical staff, workers, and other groups of people are likely to congregate in the area during the peak project construction phase. It can be assumed that the technical staff will be of higher economic status and will live in a more urbanized habitat, and will not use wood as fuel if adequate alternate sources of fuel are provided. However, workers and other population groups residing in the area may tend to use fuelwood, if no alternate fuel is provided. Hence, to minimize such impacts, it is proposed to provide alternate fuel for cooking e.g. LPG/ kerosene to the construction workers. The other alternative is to provide community kitchens on a cooperative basis by the contractors. The details of the same have been covered in Chapter 10, Environmental Management Plan.

Other major impacts on the flora in and around the project area may be due to increased level of human interference i.e. the workers may also tend to cut trees to meet their requirements for the construction of houses, furniture, and space heating. Normally in such situations, a lot of indiscriminate use or wastage of wood is also observed, especially in remote or inaccessible areas. Thus, it is necessary to provide alternative fuel, training and awareness; and implement adequate surveillance to mitigate the adverse impacts on terrestrial flora during the project construction phase.

b) Impact on Terrestrial Fauna***i) Disturbance to Wildlife***

For proposed scheme no deforestation will be required, only 17.0 ha underground land shall be acquired for HRT, TRT and Powerhouse. Hence there will not be any disturbance due to acquisition of land on wildlife habitat in the area. However, during the construction period, a large number of machinery and construction workers shall be mobilized, which may create disturbance to the wildlife population in the vicinity of the project area. The operation of various equipment and other activities will generate significant noise and vibration which may also affect the fauna of the area. However, it will be temporary and shall last till the construction phase only. During the construction phase, accessibility to the area will lead to an influx of workers and the people associated with the allied activities from outside will also increase. An increase in human interference will have an impact on the terrestrial ecosystem.

The impact of blasting needs to be mitigated by adopting controlled blasting and a strict surveillance regime and the same is proposed to be used in the project. This will reduce the noise level and vibrations due to blasting to a great extent.

Vegetation cover in the vicinity of the proposed project work sites and their immediate vicinity is comprised of coniferous forest associated with broad-leaved forest. 22 species of mammals and 25 species of avifauna have been compiled from the study area, as discussed in the Environmental Baseline chapter. Therefore, adequate measures will be required during the construction phase not to cause any adverse impact on the terrestrial and avifaunal population.

4.1.5.2 Operation Phase Impacts

As discussed earlier the Uri-I Stage-II HEP utilize operational barrage of Uri Stage-I Power Station. Operation phase impacts on flora and fauna will be positive due to restoration of construction areas, restoration of the muck disposal area, green belt development, implementation of Biodiversity Management and Wildlife Conservation Plan, etc. The increase of greenery and increased moisture due to the creation of the reservoir will have a positive impact on avifauna.

Other than impact on terrestrial fauna, the operation of hydroelectric project has impact on fisheries resources. *Schizothorax* species, a fish species migratory in nature was observed by the study team in the upstream and downstream of Uri Power Station barrage site. During aquatic EIA study of Uri Stage-I Power Station, impact on fish migration was anticipated due to construction of barrage. Boniyar nala, a tributary of Jhelum River in the downstream of barrage site has been recognized as spawning ground for *Schizothorax* species in the project area. However, for migration of fish species, fish ladder has been provided in both Uri Power station barrage and Lower Jhelum HEP as well as at Boniyar nala.

The principal ecological sustainability issue of the Uri hydroelectric project was related to fish migration, principally *Schizothorax* species (snow trout). For mitigation, a fish pass (fish ladder) has been incorporated in the barrage structure. The fish pass is of the pool type with orifices and notched overflows connecting the pools. It is sited in almost the centre of the barrage. Looking downstream, the fish pass is sandwiched between six spillway gates on its right bank side and three spillway gates and the power scheme intake on the left bank.

Since commissioning of the project in 1997, manual observation and fish tagging surveys (1997, 1998, 1999), commissioned by NHPC and conducted by Professor Yousuf (University of Srinagar) have confirmed that fish enter and pass through the Uri fish pass in the principal melt water and upstream spawning migration months of April, May and June. (Sida Evaluation 2008:41: Uri Hydro-Electric Project, India: Evaluation of the Swedish Support)

The study confirmed that the successful migration of fish species in both the operational barrages, when enough flow of water is maintained through fish ladder in the downstream area. Therefore, the impact of the project on fish migration is not envisaged due to the operation of Uri Power Station barrage. In addition to ladder, fish pass for easy upstream

movement of fish species along the rapids and steep slopes on Boniyar nala has been also constructed and maintained regularly with the help of State Fisheries Department.

4.1.6 Impacts on Socio-economic Environment

A project of this magnitude is likely to have both positive as well as negative impacts on the socio-cultural fabric of the area.

a) Positive Impacts on Socio-Economic Environment

The following positive impacts are anticipated on the socio-economic environment of the local people of villages of project area during the project construction and operation phases:

- i) Several marginal activities and jobs were likely to be available to the locals during the construction phase.
- ii) Project will bring large-scale investment to the area and local area development activities and benefit will be reaped by locals.
- iii) Education, medical facility, road & transportation network, and other infrastructural facilities will improve.
- iv) The availability of alternative resources provided by developers in the rural areas will reduce the dependence of the locals on natural resources.
- v) Petty jobs and R&M works shall be awarded to the locals as per NHPC policy.

b) Negative Impacts on Socio-Economic Environment

Such projects, in addition to the positive impact on the socio-economic environment, may also bring certain negative impacts due to the influx of outside population. The workforce will reside in that area for around 44 months and there will be an influx of labours and other workers temporarily. This influx of people in an otherwise isolated area can lead to various social and cultural conflicts during the construction stage. However, such negative impacts are likely to be localized and temporary. Developers need to take the help of local leaders, Panchayat, and NGOs to ensure minimum impact on this count. However, such negative impacts are likely to be localized and temporary.

Increased incidence of Diseases

Large scale activity in the area due to the proposed project may cause the spread of different types of diseases in the project area due to the following reasons:

- The project requires input of the labour from outside the area.
- The project involves the creation of large, temporary construction camp(s).
- Increases mobility of people in and out of the area (job seekers, formal and informal service providers).

However, in the case of proposed project the impacts going to be short term as the construction period of proposed project is only 44 months.

4.2 MEASURES FOR MINIMIZING/ OFFSETTING ADVERSE IMPACTS

Pollution generation mainly during the construction phase will be in the form of air, water, and noise pollution, which will be mitigated by adopting various mitigation measures during construction activities as discussed in a later section under the head, "Mitigation Measures".

Impacts of projects such as muck generation, worker's health, and safety, waste generation from labour colonies, impact of tree cutting for fuel, impact on the physical environment due to material handling and operation of construction machinery, etc. will be minimized by implementing various management plans. Environmental Management Plans Viz. Catchment Area Treatment Plan, Compensatory Afforestation Plan, Muck Management Plan, Landscaping & Restoration Plan, Fisheries Management Plan, maintaining of Environmental flow (e-flow) in the downstream of barrage site, Sanitation and Solid Waste Management Plan, Green Belt Development Plan, Disaster Management Plan, Public Health Delivery Plan, Energy Conservation Measures and Biodiversity and Wildlife Conservation & Management Plan have been prepared to address these specific impacts to minimize adverse impacts. Detailed Management Plans have been discussed in Chapter 10, Environmental Management Plan.

4.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF ENVIRONMENTAL COMPONENTS

The Uri-I Stage-II HEP is envisaged as a run of the river scheme, the existing structures like barrage, the surface water conveyance system consisting of Head regulator upto HRT intake of Uri-I Project shall be utilized for Uri-I Stage-II HEP. The construction of underground structures like 10.472 km long HRT, surge shaft, pressure shaft, an underground powerhouse complex and 2.28 km long TRT are proposed for Uri-I Stage -II Project.

Irreversible environment components or resources are those, whose use limits the future use options and Irretrievable components are those whose use eliminates the future use options. Typically, in the context of infrastructure projects, Irreversible and Irretrievable commitments of environmental components are due to the use of non-renewable resources in project construction and operation.

During the construction stage of the project, raw materials will be consumed as resources, which are in abundant supply. No impact is identified on any of the flora or fauna species that will make them extinct by the project. Land required for the project will undergo a permanent change of land use. Forest land required only for the underground structures will be compensated by compensatory afforestation. Presently no private land is required for the proposed project, no acquisition of private or community assets and displacement of the population is not involved. However, in future if any private land is required by the project will be compensated as per the provisions of the relevant act. During the project operation, water will be the main raw material for power generation. Therefore, the project does not have any significant irreversible and irretrievable impacts on environmental components.

4.4 ASSESSMENT OF SIGNIFICANCE OF IMPACTS

Impacts of construction and operational phase of proposed project are discussed in this chapter, along with the suggested mitigation/management measures. It is not possible to quantify each impact, however, to understand the relative severity of each impact and effectiveness of mitigation and management measures, matrix has been prepared for

impact quantification based on collective rating of each activity w.r.t. to environment components getting impacted.

The matrix has been prepared based on Leopold *et al.* (1971) design, which quantifies each impact linked to a particular project activity based on its magnitude and significance. Magnitude is rated on a scale from 1-5 (min to max) and significance from -2 to 2 (beneficial to detrimental; with zero value for insignificant impact). A product of magnitude and significance gives the final score. Exercise is done for without EMP and with EMP scenario and results are compared to assess the effectiveness of EMP implementation. Please note that lower the value the lesser the impact and negative value will indicate beneficial impact. Matrix of Environment Impact is given at **Table 4.8**.

The scores resulted by analyzing the results of matrix on Physical, biological and Socio-Economic environment of proposed project were compared for significance of implementation of Environmental Management Plan (**Table 4.9**). The analysis shows that the anticipated impact due to project during construction phase can be significantly reduced if mitigation measures are implemented effectively.

Since the Uri-I Stage-II HEP utilizes the existing barrage and reservoir of Uri-I Stage-I HEP (Uri-I Power Station) without any change in FRL and TWL. The barrage and reservoir have been under operation since 1997. All the mitigation/ management measures to reduce the impact of reservoir and barrage operation viz. Reservoir Rim Treatment, Fish Ladder, Environmental flow are already in place. Therefore, magnitude and significant ratings have been done, keeping in view the existing infrastructure of Uri-I Power Station and impact of additional infrastructure for Uri-I Stage-II HEP. Additional water diversion for Uri-I PS and Uri-I Stage-II HEP, reducing discharge in Jhelum River downstream of Uri Power Station barrage has been flagged as significant impact, however considering the water requirement in the downstream of Uri-I Power Station barrage, provision of e-flow releases has already been made in view of directions of Hon'ble NGT order vide OA no. 498 of 2015 and OA no- 45/2019.

Table 4.8: Impact Assessment Matrix

MATRIX OF ENVIRONMENTAL IMPACTS - WITHOUT EMP																			
Parameters	Magnitude (m)		Construction Phase								$E(mi \times ci)$	Operation Phase						$E(mi \times oi)$	$E(mi \times oi)$
		Significance/ Importance (s)	Excavation and Civil Construction	Operation of DG Sets, APP & BMP	Material Handling, Transportation and Storage	Muck Generation	Workers Colonies - Generation of solid waste and sewage				Construction	Dam across river	Creation of Reservoir	Operation of Powerhouse			Operation	overall	
Physical	Air Quality-Workplace		5	4	5	4	2				38	1	1	1			1	39	
	Air Quality-Surrounding Areas		4	3	4	4	1				28	1	1	1			1	29	
	Noise Levels - Workplace		4	4	4	3	1				31	1	1	1			1	32	
	Noise Levels - Surrounding Areas		3	2	3	2	1				13	1	1	1			1	14	
	Surface water (Jhelum River)		4	2	3	4	4				32	5	3	3			22	54	
	Ground water		4	2	2	1	4				22	1	1	1			0	22	
	Soil Quality		3	2	3	3	3				23	1	2	2			7	30	
Biological	Terrestrial Flora		2	2	3	2	2				22	1	3	2			9	31	
	Terrestrial Fauna		4	4	4	2	4				36	1	1	1			2	38	
	Aquatic Ecology		3	2	3	4	3				22	4	2	3			18	40	
Socio-economic	Health & Safety - Workers		5	4	5	5	3				41	2	2	2			8	49	
	Locals Health & Safety		3	3	3	3	3				27	3	3	2			14	41	
	Socio-economic - PAF		1	1	1	1	1				0	1	1	1			0	0	

MATRIX OF ENVIRONMENTAL IMPACTS - WITHOUT EMP																			
Parameters	Magnitude (m)	Significance/ Importance (s)	Construction Phase								$E(mi \times si)$	Operation Phase						$E(mi \times si)$	$E(mi \times si)$
			Excavation and Civil Construction	Operation of DG Sets, APP & BMP	Material Handling, Transportation and Storage	Muck Generation	Workers Colonies - Generation of solid waste and sewage	Construction	Dam across river	Creation of Reservoir	Operation of Powerhouse	Operation	overall						
Socio-economic-Community			4	3	4	4	3	36	1	1	1	0	0	0	0	0	0		
Agriculture			2	1	2	3	1	11	1	1	1	0	0	0	0	0	0		
Cultural/Religious			1	1	1	1	3	9	2	1	2	0	0	1	1	2	11		
Historical/ Archaeological			1	1	1	1	1	0	1	1	1	0	0	0	0	0	0		

MATRIX OF ENVIRONMENTAL IMPACTS – WITH EMP																												
Parameters	Magnitude (m)	Significance/ Importance (s)								Construction Phase		$\Sigma (mi \times si)$		Operation Phase				$\Sigma (mi \times si)$		$\Sigma (mi \times si)$								
	Construction													Operation								overall						
		Excavation and Civil Construction	Operation of DG Sets, APP & BMIP	Material Handling, Transportation and Storage	Muck Generation	Workers Colonies - Generation of solid waste and sewage							Dam across river	Creation of Reservoir	Operation of Powerhouse													
Physical	Air Quality-Workplace	3	2	2	3	2	2	1	22	1	1	1	1	0	0	1	23											
	Air Quality-Surrounding Areas	3	2	2	3	2	1	0	18	1	1	1	1	0	0	1	19											
	Noise Levels - Workplace	2	1	2	3	2	1	1	17	1	1	1	1	0	0	0	17											
	Noise Levels - Surrounding Areas	3	2	3	2	2	1	0	16	1	1	1	1	0	0	0	16											
	Surface water (Jhelum River)	2	1	2	3	2	2	2	19	2	2	2	2	1	2	8	27											
	Ground water	1	1	1	1	2	0	2	7	1	1	1	1	-1	0	-1	6											
	Soil Quality	2	1	2	3	2	1	1	12	1	2	2	2	1	1	5	17											
Biological	Terrestrial Flora	1	2	2	1	1	2	2	10	1	1	1	1	2	1	4	19											
	Terrestrial Fauna	2	1	2	1	2	1	1	8	1	1	1	1	1	1	2	10											
	Aquatic Ecology	1	1	2	2	2	2	1	11	2	2	2	2	2	1	10	21											
Socio-Econo	Health & Safety - Workers	2	2	2	2	1	2	15	1	1	1	1	1	1	3	18												

MATRIX OF ENVIRONMENTAL IMPACTS – WITH EMP																			
Parameters	Magnitude (m)									$\Sigma (mi \times si)$		Operation Phase						$\Sigma(mi \times si)$	$\Sigma (mi \times si)$
	Construction Phase											Dam across river	Creation of Reservoir	Operation of Powerhouse	$\Sigma(mi \times si)$	overall			
	Significance/ Importance (s)	Excavation and Civil Construction	Operation of DG Sets, APP & BMP	Material Handling, Transportation and Storage	Muck Generation	Workers Colonies - Generation of solid waste and sewage	Construction												
Locals Health & Safety		1	1	2	2	2		12	1	1	2		4	16					
Socio-economic - PAF		1	1	1	1	1		0	1	1	1		0	0					
Socio-economic-Community		1	1	1	1	2		6	1	1	1		-2	4					
Agriculture		1	1	1	1	1		5	1	1	1		0	5					
Cultural/Religious		1	1	1	1	2		4	1	1	1		0	4					
Historical/ Archaeological		1	1	1	1	1		0	1	1	1		0	0					

Table 4.9: Impact Assessment Matrix with & without EMP

MATRIX OF ENVIRONMENTAL IMPACTS					
Parameters	Impacts	Construction Phase		Operation Phase	
		Without EMP	With EMP	Without EMP	With EMP
Physical	Air Quality-Workplace	38	22	39	1
	Air Quality-Surrounding Areas	28	18	29	1
	Noise Levels - Workplace	31	17	32	0
	Noise Levels - Surrounding Areas	13	16	14	0
	Surface water (Jhelum River)	32	19	22	8
	Ground water	22	7	0	-1
	Soil Quality	23	12	7	5
Biological	Terrestrial Flora	22	10	9	4
	Terrestrial Fauna	36	8	2	2
	Aquatic Ecology	22	11	18	10
Social Economics	Health & Safety - Workers	41	15	8	3
	Locals Health & Safety	27	12	14	4
	Socio-economic - PAF	0	0	0	1
	Socio-economic-Locals	36	6	0	-2
	Agriculture	11	5	0	0
	Cultural/Religious	9	4	2	0
	Historical/ Archaeological	0	0	0	0

4.5 MITIGATION MEASURES

Mitigation of construction-related impacts shall be implemented by the project proponent (through its contractors). Air and water are two major environmental factors that are directly affected by any kind of construction activity. Transportation of material, storage, and handling of material and construction operations may lead to air and noise pollution. During the construction period generation and release of effluents from the construction sites, workshops, sewage disposal from labour camp, blasting and other land clearing activities, washing of oil, grease, and other chemicals from diesel generator sets, vehicles, and other machinery, etc. may cause water pollution and could affect the quality of surface as well groundwater.

The major air pollutants, which could be generally released during various construction activities and vehicular movements are Particulate Matter (PM), SO_x, and NO_x. In addition, construction activities also generate noise due to the use of heavy machinery, heavy vehicles, blasting, etc. which have varying impacts on humans as well as the wildlife of the area.

4.5.1 Air Pollution

The various sources causing air pollution during the construction phase are as follows.

- **Particulate Matter (PM):** Various activities such as blasting, crushing, transportation of material in open trucks, open dumping in muck disposal sites, vehicle movements, operation of Diesel Generator Sets, etc.

- **Oxides of Sulphur (SO_x):** SO_x is released into the air from vehicular exhaust, Diesel Generator Sets, coal-burning *chullahs*, etc.
- **Oxides of Nitrogen (NO_x):** Motor vehicles and fuel-burning are generally responsible for the release of oxides of nitrogen into the ambient air.

4.5.1.1 *Impacts of Air Pollution*

The various impacts of air pollution associated with PM, SO_x, and NO_x are as under:

- **Impacts of PM:** High quantities of PM in the ambient air can cause emphysema, bronchial asthma, and eye irritation which in some cases can also result in cancer. PM containing lead particles (emitted from automobiles) is considered responsible for anemia as it affects hemoglobin formation. Dust settled on the leaves of plants reduces photosynthesis and reduces plant growth.
- **Impacts of SO_x:** The oxides of Sulphur irritate mucous membranes of the respiratory tract. Higher concentration may cause bronchitis. Plants are particularly sensitive to high concentrations of SO₂ and may cause chlorosis, metabolic inhibition, plasmolysis, etc.
- **Impacts of NO_x:** Oxides of nitrogen can combine with hemoglobin to reduce the oxygen-carrying capacity of the blood. This can irritate the alveoli of the lungs and high concentrations may even cause acute bronchitis.

4.5.1.2 *Control of Air Pollution*

For the control of air pollution during the construction phase of the project, it is suggested that it should be made mandatory for the contractor/s engaged in the construction works to ensure the following conditions:

- The crushers should be provided with air pollution control devices as per the rules laid down by the pollution control board, to minimize the release of PM into the atmosphere.
- The chimneys of the Diesel Generator Sets should be kept at appreciable height (as per the CPCB guidelines). The DG sets should be properly maintained and with valid certificates of Type Approval and valid certificates of Conformity of Production.
- Regular water sprays at the crushing sites, dumping sites as well as on roads should be ensured. A necessary clause shall be incorporated in the contractor's agreement.
- Masks should be provided to the workers and staff.
- Proper ventilation facilities shall be provided inside the tunnel and at all the residential complexes of the staff and labour.
- Ambient Air quality shall be monitored seasonally during the construction phase at different locations with the help of a NABL accredited lab.
- Controlled blasting during construction activities will be ensured.
- Paving and metalling of roads and avenue plantation.
- All vehicles should be good working conditions with valid PUC certificate.

4.5.2 Noise Pollution

Various sources of noise pollution in the project area during the construction phase include vehicular movement, operation of heavy machinery, blasting, crushing, aggregate processing plants, diesel generator sets, etc.

4.5.2.1 *Impacts of Noise Pollution*

Noise is generally harmful and is a serious health hazard. It has far-reaching consequences and has many physical, physiological as well as psychological effects on human beings and animals. Continuous noise exposure may result in temporary or permanent shifting of the hearing threshold depending upon the level and duration of exposure. The immediate and acute effect of noise may cause impairment of hearing (total deafness). The major impacts of noise pollution are given as under:

- It may cause headache and increased heartbeat.
- It may cause anxiety, eyestrain, memory loss, and muscular strain.
- It may also cause fatigue, loss of sleep, and emotional disturbance.
- In case of wild animals and avifaunal species, noise pollution has been observed to interfere with their breeding efficiencies/ cycles (<https://dx.doi.org/10.5061/dryad.qz612jmb1>).

4.5.2.2 *Control of Noise Pollution*

Since continuous noise exposure is detrimental to health, it is essential to control noise pollution. Various measures for control of noise pollution in the project area are suggested below:

- Diesel Generator sets should have acoustic enclosures to reduce the noise as per the CPCB guidelines.
- Ear protection aids such as earplugs, earmuffs, must be provided to the workers who must continuously work in the high noise area.
- Proper and regular maintenance/lubrication of machines should be done.
- Noise-producing stationary machines (such as crushers, aggregate processing plants, etc.) should be provided with sound barriers, if close to habitation.
- Quieter machines and vehicles with high-quality silencers should be used.
- Afforestation around the residential colonies and office complexes should be done as proposed under the Green Belt Development Plan under Chapter 10, Environmental Management Plan.
- Ambient noise should be monitored periodically at different locations as outlined in Chapter 6, Environmental Monitoring Program.
- Roads should be paved and metalled to avoid noise generation during transportation.

4.5.3 Water Pollution

Various likely sources of water pollution in the project area during the construction phase include disposal of effluents from crushers commissioned at various sites, sewage disposal from the labour camp, blasting and other land clearing activities, washing of oil, grease, and other chemicals from diesel generator sets, vehicles, and other machineries, etc.

4.5.3.1 *Impacts of water pollution*

The construction activities may affect the surface and ground water sources in the area. The impact may be temporary or permanent in nature. The major impacts of water pollution are given as under:

- The construction of civil and allied structures could lead to stockpiling and excavation activity on-site, thereby exposing the base soil to erosion. The runoff from this site and muck disposal sites may contain a high quantity of Suspended Solids which may add to the inorganic load of water bodies and drainages in the area. However, the impact of runoff may not be very significant except during the rainy season.
- During the construction phase, wastewater, sewage, etc. shall be generated from the labour camp and workshops. If disposed of untreated, this would substantially deteriorate the surface and groundwater quality in the area.
- The oil and grease released from the project-related activities may also change the physico-chemical characteristics of water.

4.5.3.2 *Control of water pollution*

To avoid deterioration of water quality of the receiving water body following measures are suggested.

- During the Construction phase provision of portable STP/septic tank/ soak pit etc. of adequate capacity for labour camp, project colony, offices and working sites, so that untreated sewage is not discharged into the water bodies.
- Construction of settling tank to settle the suspended impurities from various sources i.e., Hot Mix Plant (HMP)/ crushers, etc. before discharging into the main river channel.
- During operation, suitable treatment facilities like STP at Uri-I Power Station colony at Gingal to treat the sewage generated from the colony & offices shall be upgraded.
- Provision of sedimentation cum grease traps at the outer mouth of drains located near the workshops, fuel filling stations, diesel generator rooms, etc. to prevent the entry of contaminants to the water bodies.
- Oil interceptors shall be provided for refueling areas, vehicle parking, washing areas, etc. All spills and collected petroleum products should be disposed of following SPCB guidelines.

A lump-sum budget of **Rs. 40.00 lakh (@Rs. 10.00 lakh/year for 4 years)** has been proposed for the mitigation measures for control of air, noise, and water pollution during the project construction phase.

Chapter 5

ANALYSIS OF ALTERNATIVES

5.1 INTRODUCTION

Uri-I Stage-II HEP is an extension scheme of Uri-I Stage-I HEP Project (Uri-I Power Station), which is in operation since 1997. The provisions of Stage-II were laid in the DPR of Uri Power Station and accordingly HRT intake, an intimal reach of about 30m HRT and part of powerhouse central gullet have already been excavated during the construction of Uri-I Stage-I HEP.

5.1.1 Previous Surface & Subsurface investigations

Investigations of Uri-I HE Project as a combined scheme were started by J&K Power Development Department in 1972. The geological investigation was conducted in association with Geological Survey of India during 1973-77. Further detailed project report (Geology volume) was submitted in 1977 for development of Stage-I project with a provision to develop Stage-II. TEC of the said project was accorded in 1979.

As per provisions kept in DPR and clearances from CWC/CEA, construction of Uri-I Stage-I was completed along with construction of intake and 30m long HRT for Stage-II project. Proposed structures of HRT, TRT and powerhouse complex are located within the same geological regime that was encountered during the construction of similar structures of Stage-I project.

5.1.2 Alternative Study

Diversion structure of URI-I Power station i.e. Barrage, Head regulator, desilting basin, power channel, Surplus escape, Boniyar Intake structure, Boniyar nala culvert structure and Power intake structures which is already constructed and are utilized for Uri-I Stage II H.E. Project, hence no Alternative study for diversion structure is required for URI-I Stage-II H.E. Project.

Intake Structure: Power intakes structure for URI-I Stage-II are already constructed hence alternative studies are not required.

Dam: Barrage of Uri-I PS is already constructed which is also utilized for diversion structure of Uri-I Stage-II and hence alternative studies are not required.

River Diversion Arrangements: Barrage of Uri-I PS is already constructed which is also utilized for diversion structure of Uri-I Stage-II hence alternative studies for river diversion arrangement is not required.

Head Race Tunnel: All the surface water conveyance system for URI-I Stage II Project from Head regulator to the Intake of HRT has been already constructed. A separate HRT parallel to existing HRT of Uri-I Power Station has been proposed to be constructed. Uri-I Power Station HRT shall be in continuous operation. Hence proposed HRT for Uri-I Stage II H.E is located in valley side with sufficient lateral cover from existing HRT as well as adequate

vertical and lateral rock cover in valley side. Experience gained from the construction of existing HRT shall be valuable during construction of proposed HRT.

In view of the above, no other Alternative alignment study is envisaged for HRT. Size of HRT is proposed to be 6.5m finished Horseshoe considering the alternative studies for different sizes of HRT and study of economical dia. of HRT.

Surge Shaft: Underground surge shaft is proposed similar in line with the existing underground surge shaft of URI-I Power Station. Construction Adit/ Access tunnels at surge shaft top and bottom can be constructed as on extension to the existing construction adits of URI-I Power station and these Adits are of short length (about 100-150m). In addition, the proposed Surge shaft is in the same geological setup as existing underground surge shaft which is functioning well since commissioning. Alternatively surface (open to sky) Surge shaft is considered by shifting the surge shaft d/s where ground level is approximately same as top of surge shaft. However, road to surge shaft is not available for construction of Surge shaft. Road shall be required to be constructed from the ground level of EL 300 to EL 1550 approx which require about 2-3 km road length. In addition to that the area below surge shaft is inhabited and construction of road involves greater difficulty considering the blasting of rock mass near vicinity besides other socioeconomic issues. In view of the above underground surge shaft is proposed for URI-I Stage-II H.E. Project.

Powerhouse and Transformer Cavern: Underground Powerhouse caverns are proposed similar in line with the existing underground power house of URI-I Power station as the existing topography is suitable for underground structures. Separate Powerhouse caverns are proposed near by the existing powerhouse cavern keeping the optimum rock cover considering the constructability of the new structure along with the continuous operation of the existing structures. Access tunnels/ Adits constructed for URI-I are also available and short extension to these Adits/ Access tunnels can be constructed which shall also optimize the cost of the project. In view of the above underground powerhouse and transformer cavern is proposed for URI-I Stage-II H.E. Project

Tail Race Tunnel: Considering the Project layout plan with underground powerhouse as mentioned above and for optimum utilization of head for power generation, TRT is proposed in parallel to existing TRT with TRT outlet portal just u/s of existing TRT outlet of Uri-I PS.

Accordingly, keeping in view the topographical conditions and available geological data, existing structures, proposed layout (**Figure 5.1**) of the Stage-II scheme was reviewed and the new layout of said scheme was finalized and no further alternatives studies are required.



**Chapter
6****ENVIRONMENTAL MONITORING
PROGRAM****6.1 TECHNICAL ASPECTS OF MONITORING THE EFFECTIVENESS OF MITIGATION MEASURES**

Environmental monitoring provides feedback about the actual environmental impacts of a project. Monitoring results helps to judge the success of mitigation measures in protecting the environment. They are also used to ensure compliance with environmental standards and to facilitate any needed project design or operational changes.

Monitoring shall be performed during all stages of the project (construction and operation) to ensure that the impacts are not greater than predicted, and to verify that the environmental impact mitigation measures implemented are effective. The monitoring program will indicate where changes to procedures or operations, if required, in order to reduce impacts on the environment or local population. The monitoring program for the proposed project will be undertaken to meet the following objectives:

- To monitor the environmental conditions of the project area and nearby villages;
- To check on whether mitigation and benefit enhancement measures that have been adopted are proving effective in practice;

To provide information on the actual nature and extent of key impacts and the effectiveness of mitigation and benefit enhancement measures which, through a feedback mechanism, can improve the planning and execution of future, similar projects.

The monitoring will be carried out by an NABL accredited laboratory for a period of 4 years during the project construction phase or extended if the project construction period gets extended. For estimating the budget of monitoring, 4 years period has been taken. First set of monitoring will start just before the start of construction work.

Monitoring locations/frequency will be adjusted, as required, to meet the environment clearance conditions as mentioned in the EC letter issued by MoEF&CC. On completion of project construction, a fresh budget will be prepared, and monitoring will continue as per environment monitoring requirement set out by MoEF&CC/Pollution Control Board.

6.1.1 Water Quality

The surface water quality monitoring should be carried out in seasonal intervals three times a year viz., Pre-monsoon (April-May), Monsoon (July-August), and Lean period (November-December). 7 water samples will be taken – Five sampling locations for surface water viz. Jhelum River: upstream of Reservoir area, Jhelum River: reservoir area near barrage site, Boniyar Nalla: downstream of barrage site, Jhelum River: Near Gingal Village, Jhelum River: Downstream of Tailrace Outfall and 2 ground water samples (springs) from project surrounding villages keeping in view the project impact area.

At each location water quality samples will be collected and analysed three times a year for the entire duration of construction phase till commissioning of project. Therefore, budget has been prepared for 4 years monitoring period. After commissioning locations of monitoring and parameters will be altered, keeping in view the EC and Consent compliances.

Parameters to be monitored for water quality - both surface water and ground water are:

- (i) Physical parameters (pH, temperature, electrical conductivity, TSS);
- (ii) Chemical parameters (Alkalinity, Hardness, BOD, COD, NO₂, PO₄, Cl, SO₄, Na, K, Ca, Mg, Silica, Oil & Grease, phenolic compounds, residual sodium carbonate) and
- (iii) Bacteriological parameter (Total Coliform).

6.1.2 Air Quality

Ambient air quality is to be monitored at four locations: one at the barrage site and 3 spread at an angle of 120 degree covering upwind and downwind directions. The locations should be judiciously selected based on construction activity area, accessibility to the area and should cover surrounding habitation. Monitoring should be carried out thrice a year for the following three seasons;

- Winter (November/ March)
- Pre – monsoon (April- May)
- Post – monsoon (September-October)

The frequency of monitoring shall be twice a week for four consecutive weeks at each station in each season. The parameters to be monitored are PM₁₀, PM_{2.5}, Sulphur dioxide (SO₂) and Nitrogen Oxides (NO_x).

Air quality will be monitored for entire duration of construction phase till commissioning of project. Budget has been prepared for 4 years monitoring period. After commissioning locations of monitoring will be altered, keeping in view the EC and Consent compliances.

6.1.3 Noise

Sound levels will be recorded with the help of handheld sound level meter near major construction areas generating noise. The first location will be close to the source or area where equipment/operations are making noise and subsequent 5-6 locations will be covered by moving away from source towards nearby settlements. Readings will be recorded with distance from source. Such monitoring exercises should be undertaken once every 4 months for the entire duration of construction phase up to commissioning of project. Lumpsum budget provision for 4 years has been prepared.

6.1.4 EMP Implementation Monitoring

Environment Management Plans and mitigation measures have been planned and suggested as part of EIA report for entire construction and also for operation phase with a view to minimize and eliminate the impacts. As is indicated by the impact assessment matrix (in Chapter 4), rating of all the impacts have reduced by implementing these measures. Therefore, thorough monitoring is required to ensure that all the plans and

measures suggested are implemented and their performance remain effective throughout the period of implementation. Following measures/plans will be monitored:

- 1) Biodiversity and Wildlife Conservation and Management Plan – All the activities suggested under the plan will be initiated with the help of forest and wildlife department and implemented. Records will be created for implementation with photographic evidence at least every six months.
- 2) Fisheries Conservation and Management Plan – A schedule of implementation will be prepared with the fisheries department and work progress monitored with evidence of progress every 6 months.
- 3) Reservoir Rim Treatment – To be monitored as planned and progress recorded on six monthly intervals till completion
- 4) Muck Disposal Plan – Muck disposal monitoring will cover the following aspects:
 - a) Adequacy of retaining structures and access to sites
 - b) Record of quantity of muck generated, reused and dumped
 - c) Air pollution aspect at muck generation, temporary storage and transportation location.
 - d) Air pollution aspect at muck dumping sites and need for control measures
 - e) Closure of site and progress monitoring of restoration measures. Six monthly reports will be generated covering above aspects with evidence.
- 5) Restoration Plan for Quarry Areas.
- 6) Data Interpretation and Analysis for Water, Air and Noise monitoring and take appropriate corrective and preventive action if mitigation measures are not effective.
- 7) Monitoring of health and safety aspect of construction labour requires development of work instructions, training and awareness of labour, ensuring use of PPEs, preparation and implementation of emergency management plan including mock trials, etc. An officer with expertise in safety and emergency need to be engaged for this work either on contract or one full time trained person to monitor, control and implement all the safety measures.
- 8) Sanitation and Solid Waste Management Plan – Plan implementation including providing infrastructure, training and ensuring that instructions of waste segregation, transportation and disposal are implemented will be done I regular intervals during construction period.
- 9) Energy conservation measures – As planned these measures are implemented and monitored for effectiveness every six months.
- 10) Multidisciplinary committee comprised of member of district administration, local governing bodies, village representatives and representatives of NHPC shall be constituted to monitor implementation of proposed Environmental Management Plan.

Monitoring of environmental parameters will be carried out by J&K Pollution Control Committee or an NABL accredited laboratory contracted by NHPC Ltd. Uri-I Stage-II HEP in coordination with Environment & Diversity Management Division will undertake the responsibility of implementation and monitoring of Environmental Management Plan. The officer-in-charge at project site will be responsible for filing six monthly monitoring reports post environment clearance as per clause 10 of EIA Notification of September 2006.

6.1.5 Financial Requirement

Remuneration and other benefits to NHPC team working in EMC will not be booked under project expense and therefore not budgeted here.

A sum of **Rs. 46.60 lakh** have been allocated to implement various activities and programmes envisaged under EMP, the details are given in **Table 6.1**.

Table 6.1: Cost Estimates for Environmental Monitoring Program

S. No.	Activities	Units (Samples x Season x Year)	Price per unit (Rs)	Cost (Rs. lakh)
1	Water quality - surface water	7x3x4	5000.00	4.20
2	Air quality	4x8x3x4	10000.00	38.40
3	Noise	Lumpsum for 4 years		2.00
4	Monitoring & Evaluation Documentation & Reporting- Six monthly reporting	For 4 years	0.50	2.00
	TOTAL (1-4)			46.60

**Chapter
7****ADDITIONAL STUDIES**

As per the Terms of reference issued by MoEF&CC, and Generic Structure of EIA Document as per Appendix III of EIA Notification, following are covered under the Additional Studies:

7.1 REHABILITATION AND RESETTLEMENT PLAN (R&R)

No private land is required for the construction of various components of proposed Uri-I Stage-II HE Project. Hence, requirement of preparation of Resettlement & Rehabilitation Plan is not envisaged in the present case.

7.2 LOCAL AREA DEVELOPMENT ACTIVITIES (LADA)

It deals with the provisions being made by project proponent to benefit the local population. This plan will help improve quality of life of local population in project surrounding areas. The budget proposed will form part of Environment Management Plan.

7.3 PUBLIC CONSULTATION

On completion of draft EIA report and its executive summary in English and vernacular language (Hindi), report will be submitted to Jammu & Kashmir Pollution Control Committee to initiate the process of Public Consultation. On completion of Public Consultation process and issue of report by J&K Pollution Control Committee, major issues raised during Public Consultation process and response will be covered in this section.

**Chapter
7.1****REHABILITATION AND RESETTLEMENT****7.1.1 INTRODUCTION**

The proposed Uri-I Stage-II HEP is located on the Jhelum River in Uri and Boniyar Sub-Division of Baramulla District. The land requirement of Uri-I Stage-II HEP has been meticulously planned to minimize the impacts. No afresh private land is required for the construction of various components of proposed project. The required non-forest land of 97.0335 ha is already in possession of NHPC.

Therefore, no acquisition of private land and displacement of families is involved in the proposed project.

7.1.2 LAND REQUIREMENT

For the development of Uri-I Stage-II HEP, land would be acquired for construction underground structures, job facility areas and disposal of excavated muck. Based on the final project layout, the total land requirement for the project is **114.0335 ha**, out of which **17.0 ha** is underground forest land required for underground work and the remaining **97.0335 ha** is non-forest land.

7.1.3 RESETTLEMENT & REHABILITATION PLAN

No private land will be acquired for the proposed project; therefore, no family is affected due to the acquisition of land for the proposed project. Hence, requirement of preparation of Resettlement & Rehabilitation Plan is not envisaged in the present case.

Chapter 7.2

LOCAL AREA DEVELOPMENT PLAN

7.2.1 INTRODUCTION

Keeping in view one of the additional conditions stipulated with ToR accorded by Expert Appraisal Committee (EAC), referring MoEF&CC OM dated 30.09.2020, provision has been made to contribute financial assistance for Local Area Development Fund (LADF) under Local Area Development Plan (LADP). The activities proposed under the Local Area Development Plan (LADP) will be refined after Public Consultation/ Public Hearing meeting. Activities to be implemented will be discussed with the District Administration and finalized by the Multidisciplinary Committee.

7.2.2 AFFECTED AREA FOR LADP ACTIVITY

Proposed Uri-I Stage-II HEP is in Baramulla District of Union Territory of Jammu & Kashmir. The affected village near to the project area which comes under Uri and Boniyar Tehsils of Baramulla District. Therefore, the above affected tehsils and all its habitations in general and Project activities in particular will be direct beneficiaries for the Local Area Development schemes. Further based on the need the local area development activity will also be extended to the Project tehsils and the Project District appropriately.

7.2.3 FOCUS AREAS FOR LADP

Based on the local consultations in project affected villages, the focus areas covering many important components of the sustainable development such as social, economic, livelihoods and environment are identified and set of development activities proposed under each focus area for the benefit of the local people under the Project. The **Table 7.1** below presents the broad thrust area and the nature of activity considered as part of the LAD Plan.

Table 7.1: Focus Area and Nature of Local Area Development Activity

Focus Area	Nature of Activity
Education	• Need based infrastructure support for existing Schools • Support for basic amenities in existing Schools • Support for teaching and learning materials • Support for improving quality of education • Support for meritorious students
Health Care	• Support for general and specialized health camps • Support to existing health facility • Support through mobile health care services • Support for emergency health care services • Awareness on Health and Hygiene
Animal Husbandry & Irrigation Facilities	• Support for Irrigation facilities • Conduct awareness and training on modern agriculture methods • Promote natural farming/ organic farming • Conduct Veterinary Camps for livestock • Construction of a Veterinary Clinic • Construction of drinking water ponds for Livestock
	• Support for strengthening existing roads • Support for existing transportation services

Focus Area	Nature of Activity
Infrastructure Development	• Support for Drinking Water facilities • Support in garbage collection/disposal • Support for Street Lighting facilities • Support for Community Toilet facilities
Skill Development and Training	• Skill Training of local youth for Job skills • Support for Vocational Training in market trades • Support for capacity building of local Teachers
Livelihood Enhancement	• Support to un-employed youth for small enterprises • Support to local youth for self-employment • Support to local women for household enterprises • Support to local artisans • Support for training and capacity building of local women
Environment	• Plantation along all approach roads/open spaces/ waste lands • Plantation in available village level institutions (schools, religious places, offices etc)
Sports	• Support the local schools with play material and equipment • Support for local Anganwadi Centers with play equipment • Support for developing play grounds • Support the local sports events • Support the performing local sports persons
Common Interest Activity	• Support for Community Infrastructure • Promoting local culture and traditions • Support for protection of local art forms • Support for protection of local heritage

7.2.4 LADP BUDGET

The provisional budget allocated for implementing the various local area development activities and programs envisaged under above focus areas under LADP in affected area around the project is **Rs. 2.50 Crore**. List of activities under Local Area Development Plan will be prepared based on the concerns raised and discussion during public hearing and in consultation process with the local competent authorities.

Chapter 8

PROJECT BENEFITS

8.1 INTRODUCTION

Hydropower is a clean renewable and environmentally friendly source of energy. It provides valuable peaking power with the ability to start and stop quickly with instantaneous load acceptance/rejection making it suitable for meeting peaking power demand for enhancing grid reliability and stability. The increasing energy demand of the country and requirement of peaking power can be met sustainably by having a fair share of hydropower in the grid. Hydropower projects provide additional benefits in terms of recreation, tourism, pisciculture, etc.

The northern region of India has been experiencing acute power shortage during the last decade due to rapid industrialization, developing irrigation network & urbanization. It is obviously not possible to meet rapidly growing power demands of industry and agriculture from the existing power stations. Electrical energy being the basic ingredient for economic upliftment through industrial and agricultural development, power shortage has slowed down the wheels of progress and put a curb on development activities in the region. By commissioning Uri-I Stage-II HEP, energy and peaking problems would be considerably improved in the region.

It is an undoubted fact that Hydropower projects are the boon to the society. With the construction of hydroelectric project, there is visible socio-economic development in the region. Medical/ Health, education, communication and other infrastructure/civic amenities are strengthened. Such facilities of the project are also extended to the locals, which directly benefits them. Work/ self-employment opportunities for the locals are also generated due to the emergence of new markets and other commercial establishments in the area. Thus, social benefits accruing from the construction of a hydroelectric project in the area are manifold and lead to improved quality of life of the local people in and around the project area/ surroundings.

8.1.1 Minimal impact on Environment and Forest Aspect

Uri- I Stage II HE project will utilize the already completed structures of existing Uri I Power Station which includes Barrage, Cut and Cover Culvert, Desilting Basin, Open Power Channel, Adits. It involves construction of HRT, Powerhouse and TRT only. There is minimal Forest Land involved in the construction of the Project. Besides, the non-forest land is already available with the existing Uri-I Power Station for disposal of muck generated from the project and also for installation of machinery and mobilization of manpower required for the construction of the project.

There is no requirement of additional private and revenue land for the construction of the said project. The Forest land involved for the construction of HRT, Powerhouse and TRT is underground and hence there is no involvement of trees in their alignment of the structures.

8.1.2 R&R Aspect/ No displacement of the Population

For the development of proposed project, the land required for the construction of the project is already available with the existing Power station and hence, there is no involvement of the additional revenue land due to which the local population shall not be affected. Also, the project will utilize the already completed structures of existing Uri-I Power Station which include Barrage, Cut and Cover Culvert, Desilting Basin, Open Power Channel, Adits and there will be no submergence of any forest/revenue land.

8.1.3 Optimum Utilization of the additional Kishanganga Water

Kishanganga Hydroelectric Project (KGHEP) was commissioned in May-2018. It is inter-basin transfer river and after commissioning of KGHEP its water comes to Uri-I Barrage site through Bonar Nallah- Madhumati Nallah- Wular Lake- Jhelum. This flow utilized by machines after generation is being released in the Bonar Nallah/ Wular Lake, which reaches to Uri-I Power Station. With the construction of proposed Uri-I Stage-II HE Project, NHPC would be able to make optimum utilization of this surplus water that is being otherwise discharged through the barrage gates without having any utility. By tapping this water, NHPC will be able to generate additional electricity that would be beneficial to the nation.

8.1.4 Generation of Local Employment and other indirect benefits

With the construction of proposed project local manpower under various categories viz Unskilled, semi-skilled and skilled categories shall be required during construction activities. Besides manpower, inspection vehicles shall also be deputed for various inspection works. In addition to that hiring of various services will also require during the construction activities. In order to benefit the local population NHPC has framed a policy to cater local/PAF population which will benefit the immediate local surroundings. In this regard PAF/local are preferred for all the categories of manpower based on the skillset available with the local population, hiring of vehicles will be reserved exclusively for the PAFs of the project. Also, preference will be given to locals/ PAFs contractors during hiring service contracts and other small contracts. As per the extant PAF policy of NHPC a contract upto the value of Rs 60.00 lakh has been kept reserved for locals/ PAFs contractors so that the immediate surrounding shall be benefitted. It is to mention here that the PAFs of existing Uri I Power Station shall also benefit with the PAF policy of NHPC.

8.1.5 Benefits to farmers

Uri- I Stage II HE Project shall be beneficial to farmers. Implementation of Catchment Area Treatment shall reduce soil erosion, maintain soil moisture, increase sub-surface water and fertility of fields.

8.1.6 Hydropower: A climate resilient power

Hydropower, being a renewable energy, is main factor in the global energy transition towards mitigating anthropogenic climate change. Conventional hydroelectric power is a potentially important alternative to coal-based power stations in the country in terms of avoided carbon emissions. In the case of Uri-I Stage-II HEP out of total 114.0335 ha of required land 97.0335 ha is under NHPC possession and remaining 17.0 ha of underground forest land is needed only for underground work. No major deforestation activity is involved in the proposed project.

8.1.7 Socio economic and Other Benefits

For the development and strengthening of basic infrastructure and amenities in the surrounding area of proposed project financial provision of Rs. 2.50 crore has been made under Local Area Development Plan during construction phase of proposed project. It needs to be pointed out that local area development activities are being implemented which have been highlighted in subsequent paragraph. Proposed Rs. 2.5 crore towards this head is in addition to that.

In addition, as per norms/guidelines, free Power to the Union territory of J&K has been considered @ 13.0% including post commissioning LADF @ 1% from the date of Scheduled Commercial Operation Date i.e., from first year of generation for the useful life of project, i.e., 40 years.

8.1.8 Hydropower: An efficient Power

Hydropower projects are known to have a long life. Projects constructed in the past many years are still working in an efficient manner which do not vouch the assertion that hydropower is an in-efficient power. Pertinent here to mention that hydropower is a renewable source of energy and saves scarce fossil fuels. It is relatively non-polluting and hence an environmentally benign source of power generation.

8.1.9 The future is Clean Ethical Energy

Enormous hydropower potential is available in Union Territory of Jammu & Kashmir, the harnessing of which can help in overall growth in the UT of J&K and country as well. Construction of Uri-I Stage-II HEP will not only help in tapping the unutilized vast hydro-potential of the Union Territory of Jammu & Kashmir but will also help in providing strategic strength to the country in the Northern region. Hydropower is the demand of the hour for grid security in India. Hydroelectric Project is designed for expected extreme conditions and all the concerns are adequately addressed at every stage of project design, planning and execution.

8.1.10 Socio-economic benefits/CSR being catered by existing Uri –I PS

As mentioned above, it needs to be pointed out that local area development activities catering socio-economic benefits under CSR in operational Uri-I Stage-I Project (Uri-I Power Station) operated by NHPC are being implemented which have been highlighted as below:

A. Employment

During construction stage of Uri-I Stage-I project, 216 number of PAFs/Locals individuals were provided employment on regular payroll of NHPC. Also, 113 number of PAFs/Locals have been hired on a contract basis.

Indirect Employment: Various works and service contracts are required from time to time for which local contractors/PAFs are given opportunities to carry out the works and services as per requirement. During the period 2015-16 to 2021- 22 a total of 124 number of Contracts have been awarded to Local/PAFs contractors by Uri-I Power Station.

As per NHPC's policy, at present, services of 25 number of Vehicle have been hired from Project Affected Families of Uri-I Stage-I Project.

B. Medical facilities

NHPC Project hospital of Uri-I Power Station at Gingal has catered medical facilities to 30632 individuals from locals around Power Station between 2015-16 to March 2023.

During the period between 2013-14 to 2019-20, a total amount of Rs. 15.71 Lakh has been incurred by NHPC Uri-I Stage-I Project to organize medical camps and vaccination camps through CSR.

NHPC Uri-I Stage-I Project under CSR activities has provided Rs. 703.41 lakh to District Authorities for availability of medical equipment to local Health Centres/hospitals to strengthen the medical facilities in the area. It includes:

- Procurement of Urine Analyser for Primary Health Centre, Boniyar (2017-18).
- Providing various medical equipment (Diagnostic and OTT) for upgradation of various hospitals in Baramulla District (2018-19).
- Creation of Isolation/Quarantine Centres (2019-20).
- Providing for machinery equipment in various health care centres of Districts (like PHC/CHC and Sub District hospitals) viz. USG Colour Doppler, X-ray Machine, Urine Analyzer, Cardiac Monitor, Oxygen Concentration, Generator Set, CR System, Dental Chain in District Baramulla (J&K) (2020-21).
- Civil Works and Machinery equipment for Health Care Centres, Sopore, District- Baramulla (J&K) (2020-21).
- Civil Works and Machinery equipment for Health Care Centres, Sopore, District- Baramulla (J&K) (2021-22).

C. Social Welfare Activities

CSR activities are being undertaken by NHPC under Uri-I Power Station in consultation with District Authorities, Baramulla so as to ensure effective implementation of various Schemes. CSR activities have been categorised into five broad areas viz Rural Development, Sport & Cultural activities, Environment, Health, Education. Year wise activities along with financial allocations are as follows:

Year	Activities	Amount in Lakh
2012-13	Vocational Skill Development and Education.	26.06
2013-14	Education, Health, Rural Development and CSR Capacity Building & other Initiatives.	45.48
2014-15	Health Care (Organising Medical Camp.	3.4
2015-16	Toilets constructed 187 (Swachh Bharat Campaign).	176.55
2016-17	Swachh Bharat, Health and rural Development	2.78
2017-18	Swachh Bharat, Health, Education and rural Development	18.92
2018-19	Swachh Bharat, and Health.	8.58
2019-20	Health, Education, Rural Development Women Empowerment.	130.18
2020-21	Health, Education & Skill Development Rural Development Disaster Management (Covid)	836.1
2021-22	Health, Education & Skill Development Swachh Vidhalya Abhiyan	161.18
		1409.23

D. Environment

During construction phase of Uri Power Station, plantations of about 1.57 lakh species of Ulmus (45000), Cupressus (3000), Robina (74000), Alianthus (32000), and Horse Chest nut (2000) with the surviving rate of 60% and 40,000 additional different species plants were planted. An expenditure of Rs. 25.8 lakh was incurred under this activity as Afforestation Program.

Children Park at Boniyar was developed for recreational purposes. The Park is still a point of attraction for the local populace especially children.

It can be pointed out that above mentioned local area development activities are being implemented through CSR by NHPC under operational phase of Uri-I Power Station. In addition, Rs. 2.5 crore more towards this head have been proposed for Uri-I Stage II HE Project.

8.2 CONCLUSION

Development, in all forms, is a gateway to economic sustainability and self-reliance. Ever increasing demands of the growing population, for meeting its basic needs, calls for greater and self-sustained economic growth. Hydropower projects have made an important and significant contribution in human development, and the benefits derived from them have been considerable. Extensive technological innovations now provide the capability to plan, design, build and operate hydropower projects with minimum undesirable environmental consequences. Government of India has taken many policy decisions to promote hydropower as a green and renewable source of power generation.

Chapter 9

COST BENEFIT ANALYSIS

9.1 BACKGROUND

Cost benefit analysis is a tool which modern financial analysts adopt before undertaking any financial operation or commercial activity. A cost-benefit analysis is done to determine how well a planned action will turn out. The analysis relies on the addition of positive factors and the subtraction of negative ones to determine a net result.

Environmental cost-benefit analysis, or ECBA, refers to the economic appraisal of policies and projects that have the deliberate aim of improving the provision of environmental services or actions that might affect (sometimes adversely) the environment as an indirect consequence (Atkinson and Maurato, 2008). It is one of the most widely used approaches to gain economic information about the social costs and benefits of hydropower (Johansson and Kristrom, 2018).

Environment cost benefit analysis is part of impact assessment process, where environment costs and benefits of the project are represented in monetary units, as far as possible with a view to have clear understanding of environment feasibility of the project. Ecological and environmental losses and socio-economic distress caused to the people who are displaced are weighted against economic and social gains.

9.2 GUIDELINES FOR DETERMINATION OF ENVIRONMENT COST AND BENEFITS

The MoEF&CC vide letter No. 7-69/2011-FC(Pt.), dated 1st August 2017, issued Guidelines for conducting Cost Benefit Analysis for projects involving diversion of forest land under the provisions of the Forest (Conservation) Act, 1980. Though it is applicable for conducting cost-benefit analysis for projects involving forest diversion, it provides a broad and self-explanatory methodology for assessing ecological and environmental losses and economic distress caused to the people who are displaced and weighted against economic and social gains.

For Uri-I Stage-II HEP, no surface forest land is proposed to be diverted, only 17.0 ha underground forest land is required for construction of underground structure. Environment cost benefit analysis has been carried out by following MoEF&CC guidelines in this regard, as applicable to this project. In addition, environmental cost, other than the cost of diversion of forest land has also been considered.

9.3 ENVIRONMENT COST

The MoEF&CC guidelines cover the cost benefit analysis due diversion of forest land only. It does not cover the environment costs and benefits due to other project related impacts due to acquisition of private land, landscape fragmentation, conversion of lotic to lentic aquatic ecosystem, barrier to upstream and downstream movement of fish, change of flow regime, sedimentation profile, reduced flow in intermediate stretch, Impairment of terrestrial species movement/ migration routes, limited free flowing stretch in cascade of projects, socio-economic and cultural impacts due to displacement of population, loss of

houses, agricultural land, etc., changed social mix due to arrival of migrant population, air and noise impacts, etc. Therefore, cost of mitigation of these impacts needs to be factored into assessing environmental costs.

9.3.1 Ecosystem Services Losses

As discussed in Chopra (2006) report the ecosystem services provided by forests include: i) Provisioning goods such as wood, non-timber forest products (NTFP), fuel, fodder, water and provision of services such as grazing, tourism, wildlife protection and life support, ii) Regulating Services like climate regulation, disease control, flood moderation, carbon sequestration and health of soils and water regimes, iii) Non-material benefits obtained from ecosystems like spiritual, recreational, aesthetic, inspirational, educational, communal, symbolic, and iv) Supporting Services like necessary for the production of all other ecosystem services: Biodiversity, Nutrient cycling, and Primary production.

Therefore, based upon Chopra (2006) report the Hon'ble Supreme Court of India has made it mandatory vide its order dated 28.03.2008 for the user agency to compensate for the diversion of forest land for non-forest use for developmental activities on the recommendations of Central Empowered Committee (CEC) to make payment of Net Present Value (NPV) of such diverted land so as to utilize this for getting back in the long run which are lost by such diversion. The economic value of loss of ecosystem services due to diversion of forests shall be the net present value (NPV) of forest land being diverted as per MoEF&CC Guidelines.

As per MoEF&CC guidelines dated 1.8.2017, the economic value of loss of eco-system services due to diversion of forests shall be the net present value (NPV) of forest land being diverted as prescribed by the Central Government (MoEF&CC). In case of National Parks, the NPV shall be ten (10) times the normal NPV and in case of Wildlife Sanctuary the NPV shall be five (5) times the normal NPV or otherwise prescribed by the ministry or any other competent authority.

In case of Uri-I Stage-II HE Project, no surface forest land shall be diverted for the project, however, 17.0 ha underground forest land is required for construction of underground components like HRT, TRT and Powerhouse. Ecosystem service cost is calculated accordingly.

9.3.2 Loss of Animal Husbandry Productivity, including Loss of Fodder

The diversion of forest land not only affects the forest dependent people but the livestock also. Livestock depend to a certain extent on fodder and grass of common property resources (CPR) and forest for their feed beside crop residue; in turn the animals return these feed resources to cropland via soil nutrients through manure and application of manure helps to improve soil texture and decompose litter more easily (Bajracharya, 1999).

The main source of fodder is the forest for majority of households. The green fodder includes the grazed green grass, hand cut green grass and leaves of many shrubs and tree leaves from trees. Moreover, rearing mechanism in rural area is integrated with forest

ecosystem due to their symbiotic dynamic relationship among the forest, livestock, and crops. According to MoEF&CC guidelines this loss is to be quantified and expressed in monetary terms or 10% of NPV applicable, whichever is maximum.

As diversion of overground forest land is not involved, this cost has not been considered and kept as zero.

9.3.3 Cost of Human Resettlement

The dam/barrages projects invariably require the acquisition of land – forest as well as private including community land and revenue land for various project components like submergence area, dam/barrage complex, residential colonies, powerhouse, storage yards, approach roads, etc. Despite best efforts to minimize displacement of people, compulsory acquisition of some extent of private and government land for the public purpose becomes necessary in many projects due to locational constraints. For this the acquisition of the land shall be in consonance with “The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 in force since January 1, 2014, conjointly with the provision of the State R&R Policy if any, for the Rehabilitation & Resettlement of displaced/project persons.

As per MoEF&CC guidelines dated 1.8.2017, the cost is to be quantified and expressed in monetary terms as per R&R Plan. However, in the present project, there is no acquisition of private land, therefore this cost is not counted.

9.3.4 Loss of Public Facilities and Administrative Infrastructure

Many a times, public infrastructure (Roads, buildings, schools, dispensaries, electric lines, railways, etc.) existing on private land or in forest land are to be lost under proposed acquisition/diversion for project works. These structures shall be relocated, the provision for which is generally made under sub-head “B-land” in the DPR. For relocation of such facilities likely to be diverted, forest land would be further required. Similarly, if located in non-forest land, these shall have to be relocated at appropriate location with the consent of stakeholders. As per MoEF&CC guidelines dated 1.8.2017, the replacement cost of such facilities has to be quantified and expressed in monetary terms as per actual cost basis at the time of diversion. As there is no loss of public facilities and administrative infrastructure, these costs are not counted.

9.3.5 Possession Value of Forest Land Diverted

The Forest land that is diverted for the project is unlikely to be returned and remains in the possession of the user agency. Therefore, as per MoEF&CC guidelines 30% of environmental costs (NPV) due to loss of forests or circle rate of adjoining area in the district should be added as a cost component of possession value of forestland, whichever is maximum.

9.3.6 Cost of Suffering of Oustees

The social cost of rehabilitation of oustees (in addition to the cost likely to be incurred in providing residence, occupation, and social services as per R&R plan) be worked out as 1.5 times of what oustees should have earned in two years had he not been shifted.

In the case of proposed project, the required 85.0 ha non-forest land is already under possession of NHPC. No private land shall be acquired for the project, therefore there is no displacement due to the construction of proposed project.

9.3.7 Cost of Habitat Fragmentation

Habitat fragmentation often refers to the reduction of continuous tracts of habitat to smaller, spatially distinct remnant patches, and habitat loss typically occurs concurrently with habitat fragmentation (Collinge 2009, Wilson et. al., 2016). The fragmentation is the process of breakdown of an environmental unit in fragments, more or less isolated. Around the reservoirs, for example, these fragments end up with very distinct environmental conditions than those existing before project construction. The creation of reservoirs modifies the natural landscape, transforming it into fragmented patches. This discontinuity in the landscape implies profound changes in population structure of flora and fauna (Lopes et. al., 2014). Fragmentation increases the vulnerability of patches to external disturbance with consequences for the survival of these patches and of the supporting biodiversity (Nilsson and Grelsson, 1995).

Creation of dams/barrages as barriers across the river come in the way of movement of fish fauna who move freely in flowing water. Migratory fish species, such as Snow trout (*Schizothorax* species) is present in Jhelum River in this stretch, which requires free movement upstream and downstream depending upon water temperature and discharge and use tributary habitat for breeding and spawning. Creation of barrages will change the habitat of fish species.

The quantitative estimation of habitat loss and fragmentation being a complex, multidimensional process is fraught with numerous difficult issues even though it has been attempted by IIRS, Dehradun in a study (Roy et. al., 2012). However, monetization of losses have not been attempted in these studies. In order to overcome the same, MoEF&CC has adopted straightforward rule that while the relationship between fragmentation and forest goods and services is complex, for the sake of simplicity the cost due to fragmentation has been pegged at 50% of NPV applicable as a thumb rule.

In the present case, the project is not creating any additional barrage/dam and will be using existing barrage of Uri I Stage I, therefore, these impacts are not accounted for in cost benefit analysis.

9.3.8 Compensatory Afforestation & Soil Moisture Conservation Cost

Compensatory afforestation refers to the practice of ensuring that when a forested area is diverted for non-forest purposes, another area is afforested to maintain biodiversity equilibrium. It is the provision which direct to do plantation of new trees to compensate loss of trees that happened during any infrastructure or development project activity. It is treated as a replacement cost of diverted forest land by way of either afforestation in equivalent new non-forest area or double of area diverted in a degraded forest area. The norms for raising plantation have been fixed by the MoEF&CC. The actual cost of Compensatory afforestation & soil moisture conservation and its maintenance in future at

the present discounted value shall be considered as substitution cost per MoEF&CC guidelines dated 1.8.2017.

9.3.9 Reduction of Flow in the Intermediate Stretch

The area downstream of a barrage is obviously impacted by reduced water flow. "Downstream of a dam, the river is starved of its structural materials and cannot provide habitat," according to the Hydropower Reform Coalition, a collection of 150 environmental groups. "Most dams don't simply draw a line in the water; they eliminate habitat in their reservoirs and in the river below."

Impact on river fishery due to changes in flow regime, effect of dam/barrage blocking fish migration, changes in water quality (e.g., loss of nutrients and sediments trapped by dam, silt free water, loss of pools and riffles, change and decrease in populations of macroinvertebrates the key indicators in river health).

These impacts can be valued through Willingness to Pay methodology. Though not fool proof, a rule based upon the same is recommended. To offset the adverse impact of reduced flow in the intermediate stretch in case of the run of river hydropower projects, a compensation @ Rs.0.50 lakh per MW power capacity and Rs. 0.50 lakh per km from diversion structure to the tail race outlet of the project is adopted by the Government of Himachal Pradesh.

In the present proposal, the existing structures like barrage, the surface water conveyance system consisting of Head regulator upto HRT intake of Uri-I Stage-I Project (Uri-I Power Station) shall be utilized for Uri-I Stage-II HEP.

The construction of underground structures like 10.4 km long HRT, surge shaft, pressure shaft, an underground powerhouse complex and 2.28 km long TRT are proposed for Uri-I Stage-II Project.

For stretch downstream of the Uri-I Power Station barrage up to the TRT outlet, which is about 17.0 km considered as the stretch with reduced flow.

9.4 BENEFITS

Hydropower is a clean renewable source of energy and relatively non-polluting and environment friendly. It provides valuable peaking power with the ability to start and stop quickly with instantaneous load acceptance/rejection making it suitable for meeting peaking power demand for enhancing grid reliability and stability.

9.4.1 Minimal impact on Environment and Forest Aspect

Uri- I Stage II HE project will utilize the already completed structures of existing Uri I Power Station which include Barrage, Cut and Cover Culvert, Desilting Basin, Open Power Channel, Adits. And it involves construction of HRT, Powerhouse and TRT only. There is minimal Forest Land involved in the construction of the Project. Besides, the revenue land is already available with the existing Uri Power Station for muck sites and also for installation of Machinery and mobilization of Manpower required for the construction of the project.

There is no requirement of additional private and revenue land for the construction of the said project. The Forest land involved for the construction of HRT, Powerhouse and TRT is underground and hence there is no involvement of trees in their alignment of the structures.

9.4.2 R&R Aspect/ No displacement of the Population

For the development of proposed project, the land required for the construction of the project is already available with the existing Power station and hence, there is no involvement of the additional revenue land due to which the local population shall not be affected. Also the project will utilize the already completed structures of existing Uri-I Power Station which include Barrage, Cut and Cover Culvert, Desilting Basin, Open Power Channel, Adits and there will be no submergence of any forest/revenue land.

9.4.3 Optimum Utilization of the additional Kishanganga Water

Kishanganga Hydroelectric Project (KGHEP) was commissioned in May-2018. It is an inter basin transfer project where water comes to Uri-I Barrage site through Bonar Nallah-Madhumati Nallah- Wular Lake- Jhelum. With the construction of proposed Uri-I Stage-II HE Project, NHPC would be able to make optimum utilization of this surplus water that is being otherwise discharged through the barrage gates. By tapping this water, NHPC will be able to generate additional electricity that would be beneficial to the nation.

9.4.4 Generation of Local Employment and other indirect benefits

With the construction of proposed project local manpower under various categories viz Unskilled, semi-skilled and Skilled categories shall be required during construction activities. Besides, inspection vehicles are also being deputed for various inspection works. In addition to that hiring of various services are also required during the construction activities. In order to benefit the local population NHPC framed a policy to cater local population which will benefit the surrounding community. Locals will be given preference for all the categories of manpower based on the skillset available with the local population, hiring of vehicles are being reserved exclusively for the local population. Also, other small contracts are given to local qualified contractors. As per the PAF policy of NHPC a contract upto the value of Rs 60.00 lac has been kept reserved for local contractor so that the immediate surrounding shall be benefitted.

9.4.5 Economic Benefit to Local Population

Local area development, creation of new infrastructure and updating of existing infrastructure, etc. Scope for ancillary industries due to increased agriculture production in the area along with opportunities for trade and commerce, etc. Increased opportunities for services sector like, transport, execution of small contracts, etc. Monetary value has been taken from the budget for Local Area Development i.e. Rs. 15.00 crore.

9.4.6 Environment Benefit due to Green Belt Development

The benefits from tree plantation in the area will accrue over next 50 years monetized and discounted to the present value to be included as benefits of plantation. For monetization of benefits of plantation, budget of plantation around degraded areas and green belt development around the project components have been taken i.e. Rs. 75.59 lakh. In

addition to this plantation over restored muck dumping sites is also proposed with financial provision of Rs. 57.42 lakh.

9.4.7 Other Benefits

In addition, there are several benefits that may accrue due to the implementation of the project such as flood control, water supply, fish production, recreational opportunities. These benefits are monetized based on budgets proposed for fisheries development plan, CAT plan and Biodiversity Conservation and Management Plan. **Table 9.1** provides the environment cost and benefit analysis for Uri-I Stage-II HE Project.

Table 9.1: Environment Cost and Benefits Analysis

S. No.	Environment Cost/ Benefit	MoEF&CC Guidelines for CBA of forest land diversion,2017	Parameters	Total Cost/Benefit (Rs lakh)
A	Environment Cost			
1	Eco-system services losses due to proposed forest diversion	Economic value of loss of eco-system services due to diversion of forests shall be the net present value (NPV) of forest land being diverted	Diversion of surface forest land is not involved for the project; only 17 ha of underground forest land will be diverted for underground structure such as HRT, TRT, Powerhouse, etc. Cost considered for NPV is Rs. 686205.0/ha (i.e. 50% of Rs. 1372410.0/ha)	116.65
2	Loss of animal husbandry productivity including loss of fodder	To be quantified and expressed in monetary terms or 10% of NPV applicable, whichever is maximum	As there is no diversion of surface forest land for the project, this cost is not applicable.	0.0
3	Cost of human resettlement	To be quantified and expressed in monetary terms as per R&R Plan	No private land is proposed to be acquired for the project.	0.0
4	Loss of Public facilities and administrative infrastructure (Roads, buildings, schools, dispensaries, electric lines, railways, etc.) on forest land, which would require forest land if these facilities were diverted due to the project.	To be quantified and expressed in monetary terms as per actual cost basis at the time of diversion.	The required non-forest land is already in possession of NHPC. There is no impact on public facilities, administrative infrastructure and common properties resources	0.0
5	Possession value of the forest land diverted	The Forest land that is diverted for the project is unlikely to be returned and remains in possession of the user agency. Therefore, as per MoEF&CC	For underground structure like HRT, TRT, Powerhouse 17.00 ha of underground forest land is required to be divert for non-forestry use.	35.0

S. No.	Environment Cost/Benefit	MoEF&CC Guidelines for CBA of forest land diversion, 2017	Parameters	Total Cost/Benefit (Rs lakh)
		guidelines 30% of environmental costs (NPV) due to loss of forests or circle rate of adjoining area in the district should be added as a cost component of possession value of forestland, whichever is maximum.	Cost considered for NPV is Rs.11665485/- therefore, possession value of the forest land diverted is 30% Rs.11665485/-	
6	Cost of sufferings to oustees	The social cost of rehabilitation of oustees (in addition to the cost likely to be incurred in providing residence, occupation and social services as per R&R plan) be worked out as 1.5 times of what oustees should have earned in two years had he not been shifted.	No private land is required for proposed project, due to which the local population shall not be affected.	0.0
7	Habitat fragmentation cost	While the relationship between fragmentation and forest goods and services is complex, for the sake of simplicity the cost due to fragmentation has been pegged at 50% of NPV applicable as a thumb rule.	In the present project, no surface forest land is diverted causing habitat fragmentation, therefore, this cost is not considered.	0.0
8	Compensatory afforestation & soil moisture conservation cost	The actual cost of compensatory afforestation and soil & moisture conservation and its maintenance in future at present discounted value	As 17.00 ha of underground forest land is diverted for underground components, therefore Compensatory afforestation on 17ha non forest land has been proposed. Estimated cost for Compensatory Afforestation is Rs. 71,19,383.55	71.2
9	Reduction of Flow in the intermediate stretch	To offset the adverse impact of reduced flow in the intermediate stretch. Based on Himachal govt guidelines for run of river hydropower projects, a compensation @ Rs.0.50 lakh per MW of power capacity and Rs.0.50 lakh per km of river stretch downstream of diversion up to tailrace outfall.	River length from Uri-I Power Station barrage up to TRT outlet is about 17.0 km. The generation capacity of proposed project is 240 MW. Therefore, the cost will be Rs. 120.0 lakh (240 MW x Rs. 50000) + Rs. 8.50 (17 km x Rs. 50000).	128.5
Total Environment Cost(A)				351.35
B	Environment Benefits			
1	Increase in productivity attribute to the specific project	To be quantified and expressed in monetary terms avoiding double counting	(i) Benefit from the power generation @ Rs. 3.38.00 per unit for 929.13 million units per annum which will be generated in 90% DY for a period of 40	12.56

S. No.	Environment Cost/ Benefit	MoEF&CC Guidelines for CBA of forest land diversion,2017	Parameters	Total Cost/Benefit (Rs lakh)
			years (life of hydropower project).	
2	Economic benefits due to direct and indirect employment due to the project.	Manpower requirement is sourced from the client information/DPR during construction and operation phase	(i) During peak stage of construction, employment will be generated for 500 skilled/semi- skilled/ unskilled labour. Assuming that on an average 500 persons are employed with an average minimum wage of Rs 15000/-pm for 4 years	3600.0
			(ii) After completion during operation about 150 people will get employment for O&M, routine upkeep/ maintenance of roads and buildings, etc earning an average salary of Rs. 50000 per month for a period of 40 years	0.36
3	Economic Benefit to Local Population apart from direct and indirect job opportunities	Project will benefit to the local population through a Local Area Development Plan where project affected and benefitted villages will reap benefit of welfare schemes budgeted as part of the project.	Local Area development plan has been prepared as part of the EIA report. This will be further refined after receiving inputs from local population during public consultation process. A budgetary provision of Rs. 2.5 crores have made towards this head.	250
4	Environment benefit due to Green Belt Development	Project has made provisions of green belt development around the project components and also plantations are proposed in command area as detailed in EIA report	Total green belt area, plantation over restored muck dumping site and other construction sites has been estimated to cover an area of about 25 ha. Budget has been covered in Greenbelt development Plan and Muck Management Plan.	133.01
5	Other benefits - CAT plan implementation, biodiversity conservation, fish production, etc.	Provisions have been made as part of EIA report for Catchment area treatment plan and biodiversity conservation and management plan to improve the environment. Fisheries conservation and management plan has also been proposed for promoting reservoir fisheries.	Budget of CAT plan implementation and biodiversity conservation plan has been considered under this head. Fisheries benefit has been taken @ Rs. 750/ha of the submergence area. Cost of CAT Plan Implementation is Rs. 874.39 Area under submergence of operational Uri-I Power Station is 6.19 ha, i.e., 6.19 ha x 750 = Rs. 0.047	874.44
Total Environment Benefit (B)				4870.37
Environment Benefit Cost Ratio (B/A)				13.86

9.5 SUMMARY/CONCLUSION

As can be seen from the above analysis, cost-benefit analysis is a complex process and methodology for such, and analysis is still evolving. Quite a few scientific studies have attempted to shed light on the economic importance of forest ecosystem services, where aggregate value is derived mainly from non-marketed services provided by non-consumptive uses, from future potential uses of genetic resources and the largest proportion from hydrological regulation and carbon cycling.

The complexity over the costs and benefits calculations on both sides of the divide limit the useful output of such studies especially on a smaller scale as part of EIA study. The cost-benefit analysis, with all its uncertainties and contingencies, can provide biased output in the absence of standard guidelines on inclusion of parameters on cost and benefits sides of the table and methodology of monetization.

Chapter 10

ENVIRONMENTAL MANAGEMENT PLAN

10.1 ENVIRONMENTAL MANAGEMENT PLAN

This chapter deals with the description of the administrative aspects of ensuring that mitigation measures are implemented, and their effectiveness monitored. NHPC Limited is the project proponent/implementing agency for design and execution of the work including its operation post commissioning. Institutional arrangement for planning and implementing various mitigation and management measures along with carrying out environment monitoring are given at **Table 10.1**. Once the project is accorded Environment Clearance by MoEF&CC, monitoring requirements as specified in the Environment Clearance letter will be adopted and followed for project construction and operation.

Table 10.1: EMP Implementation

S. No.	Activities	Implementing Agency	Monitoring/ Supervising/ Approving Agency
1	Catchment Area Treatment Plan	J&K Forest Department	J&K Forest Department/ NHPC Ltd.
2	Compensatory Afforestation Plan	J&K Forest Department	J&K Forest Department / NHPC Ltd.
3	Biodiversity Conservation and Wildlife Management Plan	J&K Forest Department	J&K Forest Department / NHPC Ltd.
4	Fisheries Management Plan	Department of Fisheries	J&K Department of Fisheries
5	Muck Management Plan	Contractor/ NHPC Ltd.	NHPC Ltd./ J&K Forest Department
6	Landscaping and Restoration of Quarry and Construction sites	Contractor/ NHPC Ltd.	NHPC Ltd./ J&K Pollution Control Committee
7	Reservoir Rim Treatment	NHPC Ltd.	J&K Forest Department/ NHPC Ltd.
8	Greenbelt Development Plan	Contractor/ NHPC Ltd.	J&K Forest Department/ NHPC Ltd.
9	Sanitation and Solid Waste Management Plan	Contractor/ NHPC Ltd.	NHPC Ltd./ J&K Pollution Control Committee
10	Public Health Delivery System	NHPC Ltd./ Contractor	NHPC Ltd./ District Administration (Health Department)
11	Energy Conservation Measures	Contractor	NHPC Ltd./ J&K Forest Department
12	Labour Management Plan	Contractor	NHPC Ltd./ District Administration
13	Disaster Management Plan	NHPC Ltd.	District Administration
14	Control of Air, Noise and Water Pollution*	Contractor/ NHPC Ltd.	NHPC Ltd./ J&K Pollution Control Committee
15	Environmental Monitoring**	NHPC Ltd.	J&K Pollution Control Committee/ MOEF&CC
16	Rehabilitation and Resettlement Plan [#]	NHPC Ltd./ District Administration	District Administration/
17	Local Area Development Fund [#]	District Administration	District Administration

*Discussed in Chapter 4; **Discussed in Chapter 6; #: Discussed in Chapter 7

NHPC Ltd. is committed to ensure that all possible adverse impacts are mitigated and ensure compliance to the National and State level regulatory requirements with a view to mitigate potential adverse environmental impacts resulting from the proposed project activities. The proposed Environment Management Plans (EMPs) aims at ensuring the

implementation of proposed mitigation and monitoring measures by the agency responsible for implementation.

EIA process has evaluated various impacts due to the proposed project and the proposed mitigation measures which have been suggested along with various management plans; will further reduce the severity of identified adverse impacts on environment due to the proposed activities.

The overall responsibility for implementation of the EMP measures rests with NHPC Ltd. through implementing agency and their contractors.

An Environmental Monitoring Cell (EMC) will be formed in order to assess and review the progress of the various mitigation measures suggested in the Environmental Management Plans and conditions stipulated in Environment and Forest clearance letters. The project level EMC would coordinate with necessary stakeholders for effective implementation of all environmental safeguard measures. The Project Level Environmental Monitoring Cell will comprise of the following members:

1. Head of Project (HOP)
2. In-charge of Environment Division
3. Sr. Manager (Civil/ Environment)
4. Manager / Dy. Manager/Asst. Manager/ Env. Officer

A Grievance Redressal Mechanism will be established, where complaints and grievances of the locals as well as of the labour force, will be directly addressed by Human Resource (HR) Division. Records of all complaints will be generated along with corrective and preventive action till closure. All records will be scrutinized as planned under Monitoring.

The roles and responsibilities of NHPC Ltd. shall be:

1. Inclusion of EMP provisions in contract documents for its implementation.
2. Participate in and facilitate consultations with stakeholders.
3. Participate in project meetings and report on the issues related to environmental management and social safeguards to provide for any mid-course corrections that may be required based on situation on the ground.
4. Establish a mechanism to resolve grievances of Project Affected Persons (PAPs).
5. Develop rapport with PAFs and between PAFs and project.
6. Carry out other responsibilities as required from time to time.
7. Coordinate on the training of locals and capacity building initiatives.
8. Ensuring the implementation of all the planned mitigation and management measures
9. Review the monitoring report and assess the effectiveness of mitigation and management measures.
10. Take preventive and corrective actions as and when required.

Oversee and report implementation of EMP provisions included in the works contract.

10.1.1 COMPONENTS OF EMP

As per the Standard TOR, various plans need to be prepared as part of EIA study to ensure mitigation and management of identified impacts.

In addition, water, air and noise management, environment safeguards during construction activities have been covered under Chapter 4, under mitigation measures. Environment Monitoring at Chapter 6 as per generic structure of EIA. Other EMP components are discussed in ensuing sections.

**Section
10.2****CATCHMENT AREA TREATMENT PLAN****10.2 CATCHMENT AREA TREATMENT PLAN**

It is a well-established fact that reservoirs formed by dams on rivers are subjected to sedimentation. The process of sedimentation embodies the sequential processes of erosion, entrainment, transportation, deposition and compaction of sediment. The study of erosion and sediment yield from catchments is of utmost importance as the deposition of sediment in reservoir reduces its capacity, and thus affects the water availability for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes braiding of river reach. The removal of top fertile soil from catchment adversely affects the agricultural production. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to ameliorate the above-mentioned adverse process of soil erosion.

Soil erosion may be defined as the detachment, transportation and deposition of soil particles from one place to other by means of transporting agents like water, air, winds etc. Soil erosion is mainly affected by rainfall intensity, slope gradient, length, soil erodibility and vegetation cover. Therefore, study of erosion and sediment yield from catchment are of great importance. Soil erosion leads to:

- loss in production potential
- reduction in infiltration rates
- reduction in water-holding capacity
- loss of nutrients
- increase in tillage operation costs
- reduction in water supply

The Catchment Area Treatment (CAT) plan highlights the management techniques to control erosion in the catchment area of a water resource project. The life span of a reservoir is greatly reduced due to erosion in the catchment area. Adequate preventive measures are thus needed for the treatment of catchment for its stabilization against future erosion.

In the present study, Catchment Area Treatment Plan has been formulated for the free draining catchment i.e. from the diversion site of upstream Lower Jhelum HEP till the proposed diversion site of Uri-I Stage-II HEP. The total area of the free draining catchment is 135.91 sq km.

The catchment area treatment involves

- Understanding of the erosion characteristics of the terrain and,
- Suggesting remedial measures to reduce the erosion rate.

10.2.1 Steps Involved in CAT Plan Preparation

CAT Plan essentially consist of following steps-

- i. Identification of highly erodible areas within catchment by calculation of Silt Yield Index (SYI) and sediment load for sub water sheds using GIS.
- ii. Prioritizing the areas for treatment.
- iii. Planning of suitable erosion control measures.
- iv. Cost of CAT Plan.

10.2.2 Methodology Adopted for the Study

In the present study, Silt Yield Index (SYI) method is used in which terrain is subdivided into various sub water sheds and erodibility is determined on relative basis. SYI method is widely used to provide comparative erodibility criteria of catchment (Low, Moderate, Severe, High etc.). The application of SYI model for prioritization of sub water in sheds in catchment area involves the evaluation of

- i. Climatic factor comprising precipitation.
- ii. Geomorphic factor comprising land forms, physiography, slope and drainage.
- iii. Surface cover factors governing flow hydraulic.
- iv. Management factor.

10.2.3 Catchment Area

River Jhelum, a major tributary out of five major tributaries viz. Satluj, Beas, Ravi, Chenab and Jhelum which are ultimately merging with river Indus in Pakistan is the west flowing river. The Jhelum is the main waterway of the Kashmir valley. Jhelum river originates from a magnificent spring called “Chashma Verinag”.

The total geographical area of Jhelum basin upto Indo-Pakistan border is about 34,775 sq. km. with a total length of 402 km. But the length of Jhelum in India upto existing ceasefire line is about 165 km. With a catchment area of about 17,622 sq. km. and lies 32°58'42” to 35°08'02” North latitude and 73°23'32” to 75°35'57” East longitude and is mainly confined within the Kashmir Valley in India. The river Jhelum runs in the Valley is surrounded by mountain ranges which rises to a height of 5487 m on the north-east. Peaks of these mountainous range is mostly covered by snow cover from the month of October to May. The valley is perched at an average elevation of 1829 m above sea level and is approximately 135 km. in length and 32 to 40 km. in breadth. The Kuti and Brahmasakal are the highest peaks at 4675 m. in elevation in the basin.

The topography of this alluvial valley is typical. The river banks as is usual with river running in alluvial plains are higher than the land behind them. The scenario of the valley of Jhelum basin looking downward shows that the main streams and its tributaries flow between high definite banks except small reach where the banks are low, ill defined and swampy, which causes the floods and loss of property.

The river Jhelum forms by the water of a spring viz. Cheshma Verinag situated at the foot hills accommodating Banihal pass in the south eastern corner of the Kashmir Valley and flows towards west through the Kashmir Valley. In the course upto Anantnag town, 3 major tributaries viz. Sandran river, Bringi river and Arapath joins on its right flank. Lidder, a biggest river of all the effluents that forms the head waters of river Jhelum and is fed by a number of glaciers from the high ranges, joins on its right flank at 2 km. downstream of

Khannabal town. River Vishow and Rambhara drains their water on its left flank at 4.82 km. upstream from Sangam town. Between Sangam and Srinagar, Jhelum river receives two small streams viz. Watlaha and Arapal on the right flank, and three small streams viz. Rambhara, Sasara, Romuhi on the left flank. Romushi river ordinarily in significant swells up considerably when it is joined by spill from Rambhara river. From Khannabal to Srinagar river Jhelum flows along the right side of the valley abutting close to the hills, in a zig zag manner. As already mentioned the levels of the banks higher than the land on its left, lowest of these forms swamps and are surrounded by cultivable land, when the river is in spate and overtops its banks thus damaging the crops in the cultivable land and causes a drastic damage to crops and property. Just before the river enters the main city of Srinagar which is situated on its banks it is joined near Shergari by a stream which drains from Dal Lake. For the flood protection of main city, there is a supplementary channel with a capacity of 500 cusecs just above Srinagar (near Kursu Padshahi Bagh) which functions only when the river discharge rises above the danger mark. Below the Srinagar city, the flow of Dudh-ganga combines with the river and down below nallah Sindh merges with it at Shadipora on the right bank. At Banyari 20 km. downstream the river joins with the water of Wullar Lakes and takes off from the lake at its south west corner and flows to the west south west direction through the alluvial plain for a length of 21 km. upto the bridge at Baramulla. At Baramulla the river enters a gorge in the hills. After flowing through this gorge for about 5 km. the fall out channel takes off a sharp bend towards the left. The end of the gorge at Khadanyar is marked by huge rock projecting into the river from the left side. Below Khadanyar river takes a sharp turn rushing over rapids from Wullar Lake to Khadanyar in a stretch of 26 km. number of streams viz. Wingle, Pohru, Vij meet the river. Map showing the drainage network and hydro power projects in the Jhelum basin within Indian Territory is given at **Figure 10.1**.

10.2.3.1 Free Draining Catchment

Free draining catchment has been delineated as intercepting catchment area falling between diversion site of upstream Lower Jhelum HE Project and diversion site of proposed Uri-I Stage-II HE Project on Jhelum river. Area of the free draining catchment thus delineated is 135.91 sq km. Total length of the Jhelum river in the free draining catchment is about 11 km. Major right bank tributaries of the Jhelum river in the free draining catchment are Brijh Nala (confluence with Jhelum river at 34°10'57.32"N, 74°16'8.97"E), Gori Nala (confluence with Jhelum river at 34°10'46.79"N, 74°15'6.75"E), Katha Nala (confluence with Jhelum river at 34°9'4.21"N, 74°12'13.21"E) and Limbar Nala (confluence with Jhelum river at 34°8'45.05"N, 74°11'15.03"E). Major left bank tributary of the Jhelum river in the free draining catchment is Sank Nala (confluence with Jhelum river at 34°9'30.41"N, 74°13'18.08"E). The drainage system of free draining catchment of Uri-I Stage-II HEP is given in **Figure 10.2**.

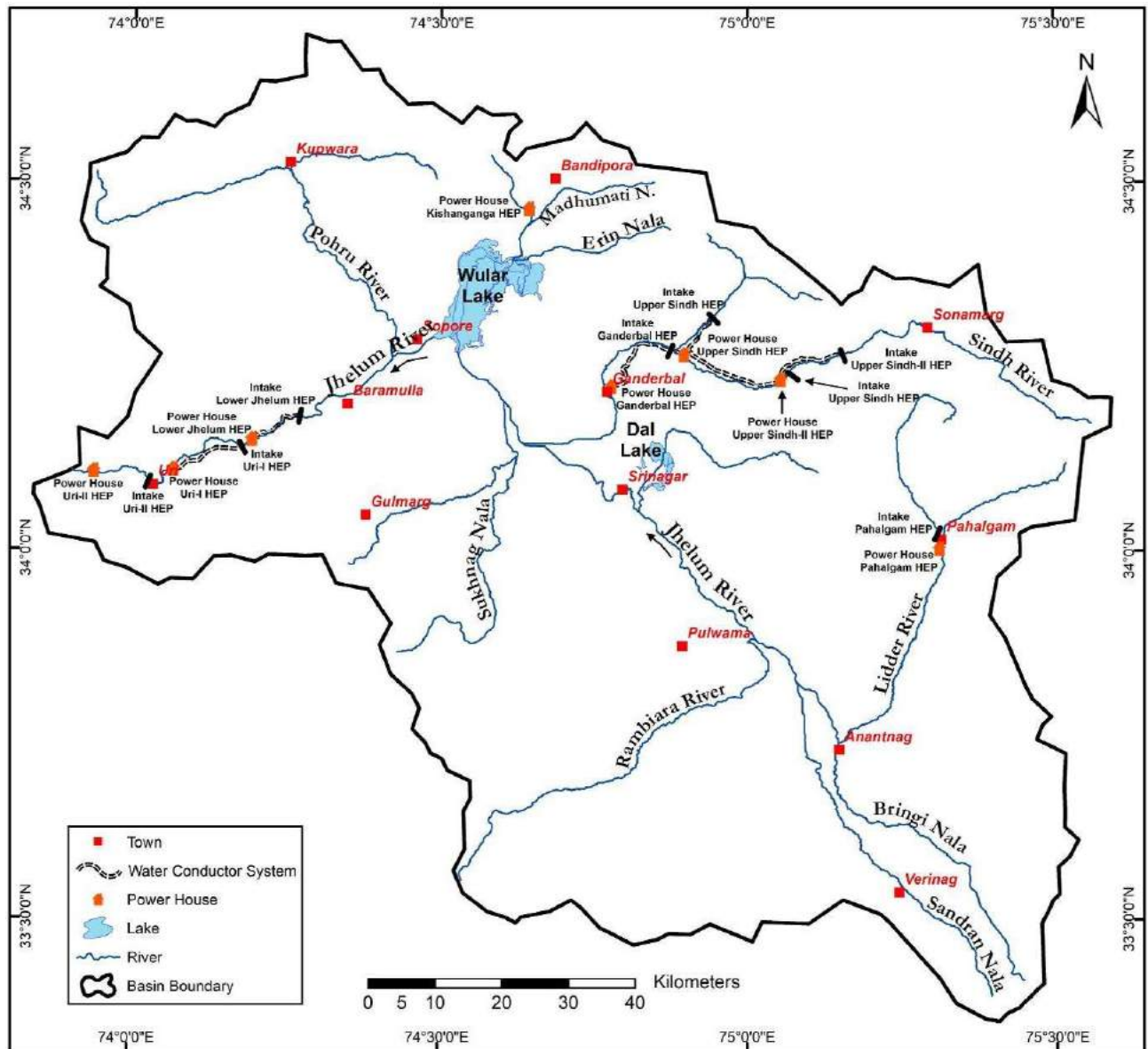


Figure 10.1: Catchment Area Map of Jhelum River within India

10.2.3.2 Delineation of Sub-Watersheds

In order to plan watershed management and to formulate action plans it requires sub-watershed delineation, therefore, free draining catchment area was further delineated into sub-watersheds. For the delineation of sub-watershed, Watershed Atlas of India prepared by Soil and Land Use Survey of India (SLUSI) has been referred.

Soil and Land Use Survey of India (SLUSI) has Watershed Atlas of India under digital environment using GIS and produced a Digital Watershed Atlas (DWA) where the delineation and codification of watersheds in the country has been undertaken in GIS environment. The delineation for DWS has been done in seven stages starting with Water Resource Regions and their subsequent division and subdivisions into Basins, Catchments, Sub-catchments, Watershed, Sub-watershed and Micro-watersheds in decreasing size of the delineated hydrologic unit.

As per Watershed Atlas of India, the free draining catchment area falls in 3 Sub-Watersheds. The nomenclature of Sub-Watersheds has been assigned as follows: Indus

Region (coded as 1); Jhelum Basin (coded as 1E); Lower Jhelum Catchment (coded as 1E1); Sub-Catchment (coded as 1E1B); Limbar and Sank Watersheds (coded as 1E1B5 and 1E1B6 respectively) and 3 Sub-Watersheds (coded as 1E1B5g, 1E1B5h and 1E1B6h). The detail of Sub-Watersheds delineated for the free draining catchment area is given below (**Figure 10.2 and Table 10.1**).

Table 10.2: Names and Codes of Sub-watersheds Delineated in the Free Draining Catchment of Uri-I Stage-II HEP

S. No.	Water Resource Region	Basin	Catchment	Sub-Catchment	Watershed	Sub-Watershed	Sub-Watershed Area (sq km)
1.	Indus (1)	Jhelum (1E)	Lower Jhelum (1E1)	1E1B	1E1B5 (Limbar)	1E1B5g	41.83
2.						1E1B5h	52.92
3.					1E1B6 (Sank)	1E1B6h	41.16
TOTAL							135.91

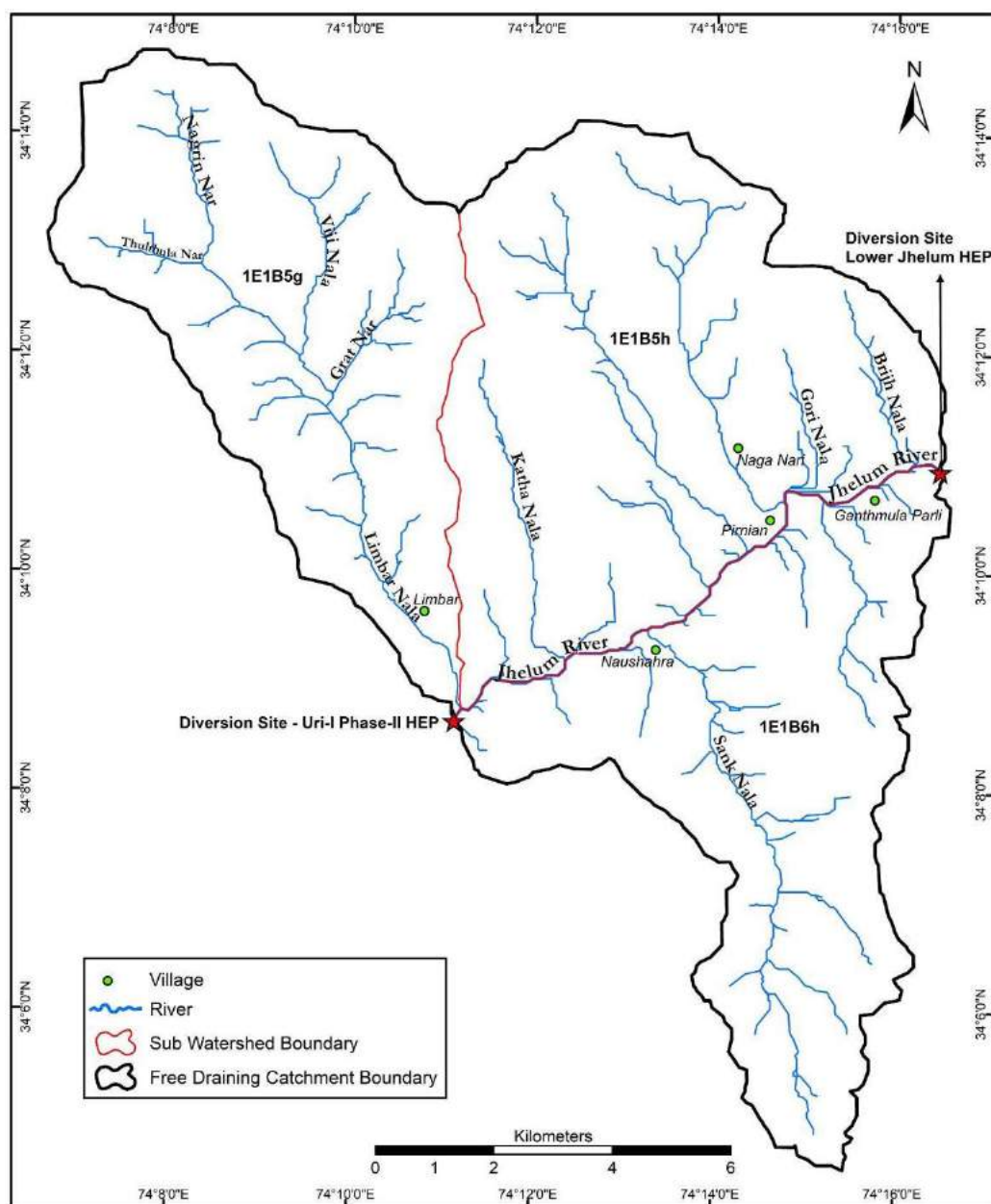


Figure 10.2: Sub-Watershed Map of Uri-I Stage-II HEP Free Draining Catchment Area

10.2.4 Approach for the Study

A detailed database on natural resources, terrain conditions, soil type of the catchment area, socio-economic status, etc. is a pre-requisite to prepare treatment plan keeping in view the concept of sustainable development. Various thematic maps have been used in preparation of the CAT plan. Geographic Information System (GIS) is a computerized resource data base system, which is used to store, analyze and display various spatial data. GIS has a capacity to perform numerous functions and operations on the various spatial data because of its special hardware and software characteristics. In order to ensure that latest and accurate data is used for the analysis, satellite data has been used for deriving land use data. Ground truth studies, too, have been conducted. The various steps, covered in the study, are as follows:

- Definition of the problem
- Definition of data requirement
- Data acquisition and preparation
- Modeling
- Output presentation

The above-mentioned steps are briefly described in the following paragraphs:

10.2.4.1 Definition of the Problem

The requirements of the study were defined and the expected outputs were finalized. The various data layers of the free draining catchment area to be used for the study are as follows:

- Free Draining Catchment Area Map
- Land use Classification Map
- Slope Map
- Soil Map
- Rainfall Intensity

10.2.4.2 Data Acquisition and Preparation

The data available from various sources has been collected. The ground maps, contour information, etc. were scanned, digitized and registered as per the requirement. Data was prepared depending on the level of accuracy required and any corrections required were made. All the layers were geo-referenced and brought to a common scale (real co-ordinates), so that overlay could be performed. A computer program using standard modeling techniques was used to estimate the soil loss. The formats of outputs from each layer were formed to match the formats of inputs in the program. Ground truthing and data collection was also included in the procedure.

10.2.4.3 Land Use/ Land Cover

For the preparation of land use/ land cover map of the study area, land use/ land cover map prepared by National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO) of Dept. of Space, Govt. of India with Ecology, Environment & Remote Sensing, Govt. of J&K as partner under Natural Resource Census (NRC) project of National Natural Resource Repository (NRR) programme have been used. The data was further refined using information from False Colour Composite (FCC) generated using bands 8, 4

and 3 of Sentinel-2 digital satellite data of Tile T43SDT dated 24th June 2022, ground truth collected during field surveys and latest imagery of the study area on Google Earth Pro. The classified land use map of the free draining catchment area, considered for the study, is shown as **Figure 10.3**. The land use pattern of the free draining catchment area as well as of sub-watersheds is summarized in **Table 10.3**. The land use/ land cover map of the free draining catchment of Uri-I Stage-II HE Project was classified into ten classes. Out of these ten classes, area under evergreen/ semi evergreen forest is the highest, while area under barren rocky land is least.

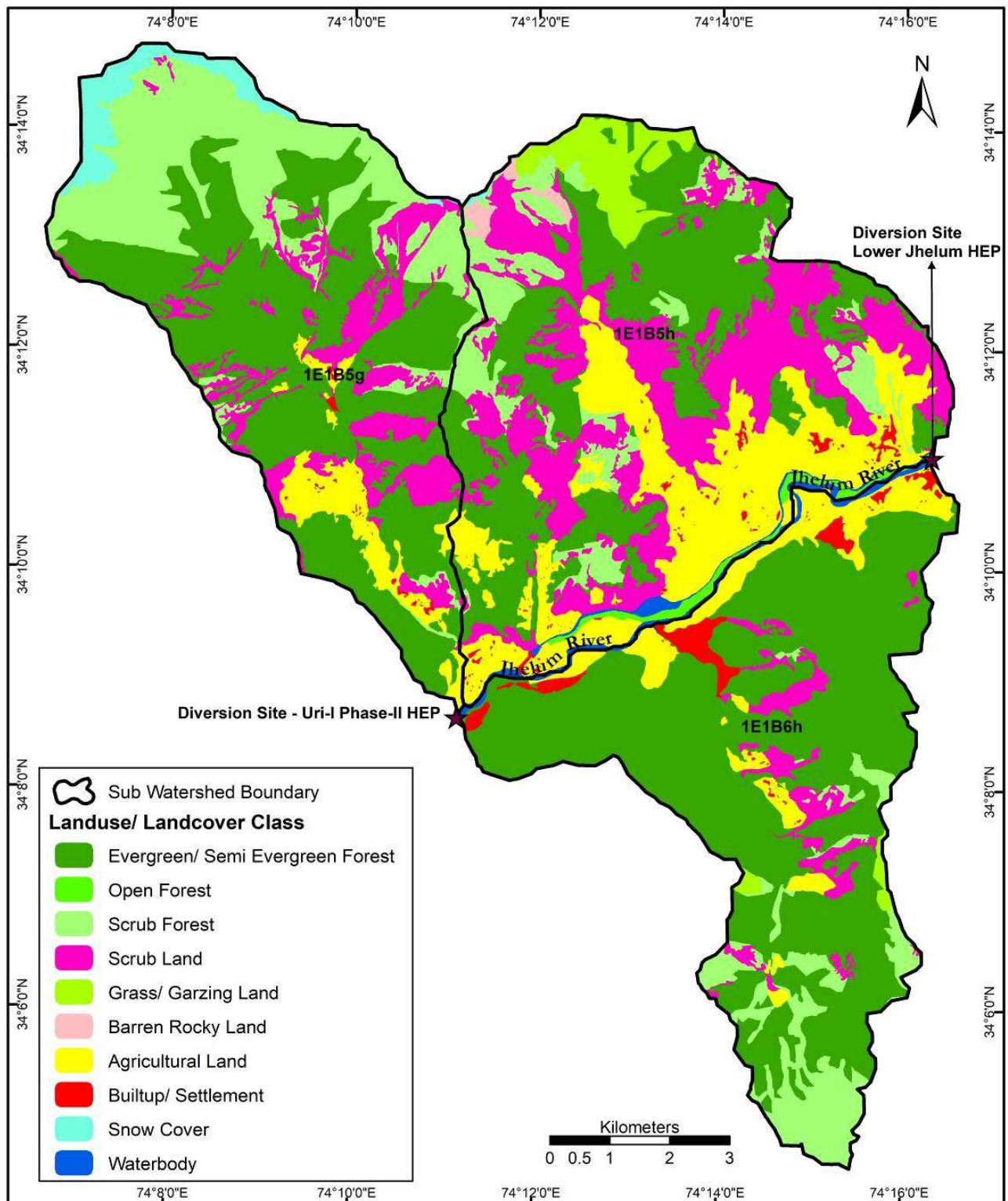


Figure 10.3: Land Use/ Land Cover Map of Uri-I Stage-II HEP Free Draining Catchment Area

Table 10.3: Land Use/ Land Cover Classification for Uri-I Stage-II HEP Free Draining Catchment Area

Landuse/ Landcover Class	Sub-Watersheds						Total	
	1E1B5g		1E1B5h		1E1B6h			
	Area (sq km)	Area (%)	Area (sq km)	Area (%)	Area (sq km)	Area (%)	Area (sq km)	Area (%)
Evergreen/ Semi Evergreen Forest	20.27	48.47	16.38	30.95	28.75	69.86	65.41	48.12
Open Forest	0.00	0.00	0.70	1.31	0.02	0.05	0.71	0.53
Scrub Forest	11.07	26.46	4.95	9.35	4.52	10.99	20.54	15.11
Scrub Land	5.83	13.94	14.61	27.60	2.21	5.37	22.65	16.67
Grass/ Grazing Land	0.00	0.00	2.53	4.78	0.34	0.84	2.87	2.11
Baren Rocky Land	0.00	0.00	0.45	0.84	0.00	0.00	0.45	0.33
Agricultural Land	2.52	6.02	12.05	22.77	3.65	8.87	18.22	13.40
Builtup/ Settlement	0.12	0.28	0.41	0.78	1.22	2.97	1.75	1.29
Snow Cover	2.02	4.82	0.06	0.11	0.00	0.00	2.07	1.52
Waterbody	0.00	0.01	0.80	1.51	0.43	1.05	1.24	0.91
Total	41.83	100	52.93	100	41.16	100	135.91	100

10.2.4.4 Slope

Shuttle Radar Topography Mission (SRTM) 3 Arc-Second Global Digital Terrain Elevation Data (DTED) data was used for preparation of slope map. The data was downloaded in GeoTIFF format and using ArcGIS software a slope (in degrees) map was prepared. The degree slope was divided into different slope classes as per SLUSI. The areas falling under various slope categories in the Uri-I Stage-II HEP free draining catchment and Sub-Watersheds have been tabulated below in **Table 10.4**. The slope map is shown as **Figure 10.4**. As seen from the table (**highlighted cells**) and map majority of the area falls under two slope categories i.e. Moderately Steep and Steep.

Table 10.4: Areas Falling Under Different Slope Categories

Slope Categories (Slope in Degrees)	Sub-Watersheds						Total	
	1E1B5g		1E1B5h		1E1B6h			
	Area (sq km)	Area (%)	Area (sq km)	Area (%)	Area (sq km)	Area (%)	Area (sq km)	Area (%)
Gently Sloping (Up to 2°)	0.06	0.13	0.62	1.17	0.55	1.34	1.23	0.90
Moderately Sloping (2°- 8°)	0.50	1.20	4.37	8.25	2.27	5.52	7.14	5.25
Strongly Sloping (8°- 15°)	1.44	3.45	7.37	13.92	4.03	9.80	12.84	9.45
Moderately Steep (15°- 30°)	12.41	29.66	19.17	36.21	17.27	41.96	48.84	35.93
Steep (30°- 45°)	23.54	56.28	18.84	35.60	15.12	36.74	57.50	42.31
Very Steep (45°- 60°)	3.84	9.18	2.51	4.74	1.89	4.58	8.23	6.06
Extremely Steep (60°- 70°)	0.04	0.09	0.06	0.11	0.03	0.06	0.13	0.09
Escarpments (Above 70°)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	41.83	100	52.93	100	41.16	100	135.91	100

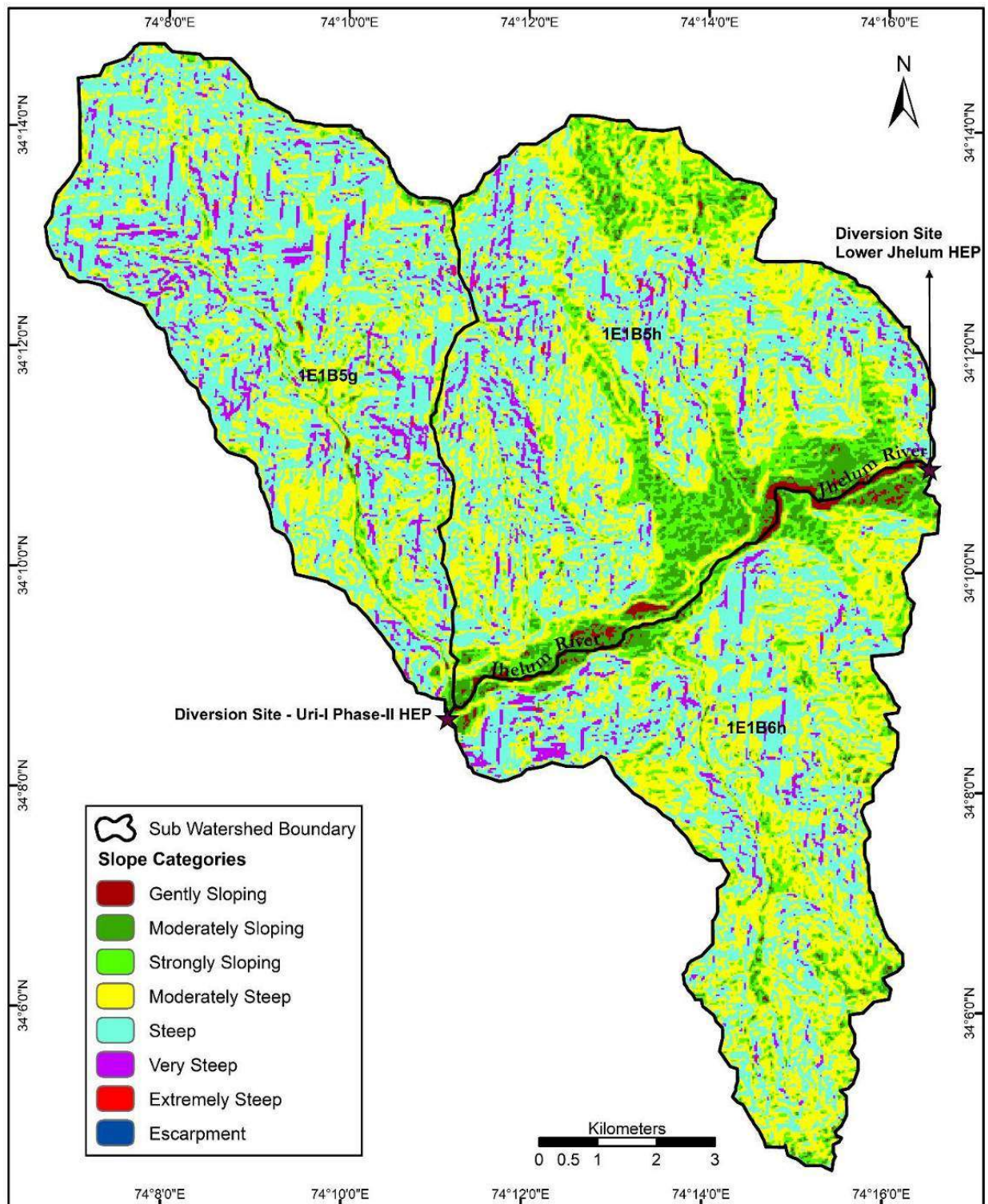


Figure 10.4: Slope Map of Uri-I Stage-II HEP Free Draining Catchment Area

10.2.4.5 Soil

Soil map has been digitized and produced using soil maps collected from National Bureau of Soil Survey & Land Use Planning, Regional Centre, New Delhi. Various layers, thus prepared, were used for modeling. Soil map has been shown in **Figure 10.5**. The legend for soil classes has been given in **Table 10.5**. As can be seen from the soil map and area under different soil units, maximum percentage area is covered soil unit 37. Majority of the soil type of the free draining catchment area is Shallow, somewhat excessively drained, mesic, loamy-skeletal soils on steep slopes with loamy surface, severe erosion and strong stoniness.

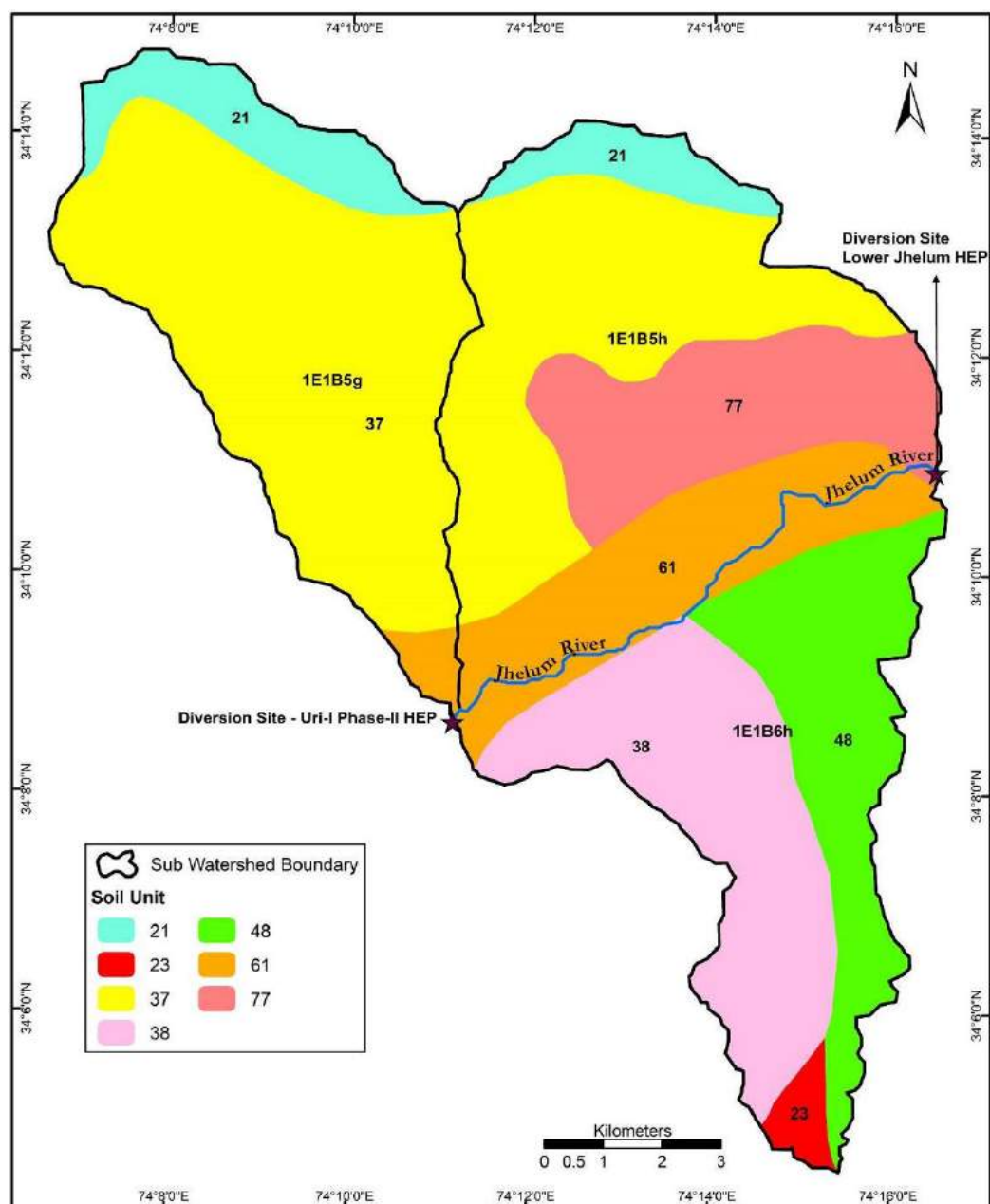


Figure 10.5: Soil Map of Uri-I Stage-II HEP Free Draining Catchment Area
(For details of Soil Unit legend refer Table 10.5)

Table 10.5: Soil Classes of Uri-I Stage-II HEP Free Draining Catchment Area

Soil Unit	Soil Type		Area (sq km)	Area (%)
21	Dominantly rock landscape; <i>associated with:</i> Very shallow, excessively drained, fragmental soils on very steep slopes with loamy surface, very severe erosion and strong stoniness.	• Lithic Cryorthents	9.67	7.11
23	Dominantly very shallow, excessively drained, fragmental soils occurring on very steep slopes with loamy surface, very severe erosion and strong stoniness; <i>associated with:</i> Rocky outcrops	• Lithic Cryorthents	1.45	1.07
37	Shallow, somewhat excessively drained, mesic, loamy-skeletal soils on steep slopes with loamy surface, severe erosion and strong stoniness; <i>associated with:</i> Medium deep, somewhat excessively drained, mesic, loamy-	• Lithic Udorthents • Typic	58.33	42.91

Soil Unit	Soil Type		Area (sq km)	Area (%)
	skeletal soils on moderately steep soils with loamy-surface, severe erosion and strong stoniness.	Udorthents		
38	Shallow, somewhat excessively drained, mesic, loamy-skeletal soils on moderately steep slopes with loamy surface, severe erosion and moderate stoniness; <i>associated with:</i> Medium deep, well drained, mesic, loamy-skeletal soils on moderately steep slopes with loamy surface, severe erosion and slight stoniness.	• Lithic Udorthents • Typic Udorthents	19.95	14.68
48	Medium deep, moderately well drained, mesic, fine-loamy soils on steep slopes with loamy surface and severe erosion; <i>associated with:</i> Deep, somewhat excessively drained, fine soils on steep slopes with loamy surface, severe erosion and slight stoniness.	• Fluventic Eutrochrepts • Dystric Eutrochrepts	15.52	11.42
61	Medium deep, well drained, loamy-skeletal soils on moderate slopes with loamy surface, severe erosion and strong stoniness; <i>associated with:</i> Medium deep, well drained, fine-loamy soils with loamy surface, moderate erosion and moderate stoniness.	• Typic Udorthents • Dystric Eutrochrepts	15.96	11.74
77	Deep, moderately well drained, fine-loamy soils on very gentle slopes with loamy surface and slight erosion; <i>associated with:</i> Medium deep, moderately well drained, calcareous, fine-loamy soils on moderate slopes with loamy surface and moderate erosion.	• Dystric Eutrochrepts • Typic Eutrochrepts	15.05	11.07
TOTAL			135.91	100

10.2.4.6 Modeling

Soil loss has been calculated through RUSLE (Revised Universal Soil Loss Equation) model which is computed by the following equation:

$$\text{Soil Loss (A)} = R * K * LS * C * P$$

Wherein;

A = Soil loss (Tons/ha/year)

R is Rainfall & Runoff Erosivity Factor (MJ mm/ha-1/h-1/year-1), which depends upon the annual average rainfall in mm. Data required for R factor is rainfall intensity.

K is Soil Erodibility Factor (Tons/ha/h/ha-1/MJ-1/mm-1), which depends on the organic matter, texture permeability and profile structure of the soil. Also, it is a constant value for each soil type. Data required for K factor is soil type.

LS is Topographic Factor (dimensionless) which depends upon flow accumulation and steepness and length of slope in the area. Data required for LS factor is slope length and slope gradient.

C = Vegetation Cover and Crop Management Factor (dimensionless), which is the ratio of bare soil to vegetation and non- photosynthetic material. It is a constant value for each land use category. Data required for C factor is land use/ land cover.

P is Conservation Supporting Practice Factor (dimensionless), which takes into account specific erosion control practices like contour bunding, bench terracing etc.

10.2.4.7 Soil Erosion Intensity

A thematic map for soil loss of the free draining catchment area has been prepared using RUSLE model mentioned in the above section. The free draining catchment area was then demarcated into different soil erosion intensity mapping units or classes based upon the extent of soil loss (see **Table 10.6 & Figure 10.6**). The free draining catchment area under different Erosion Intensity categories is given in **Table 10.6**. As can be seen from the figure and table, around 30% of the free draining catchment is prone to less than 1 tons/ha/annum soil erosion, i.e. under negligible erosion intensity category. 9.90% of its area is prone to Severe and Very Severe soil erosion.

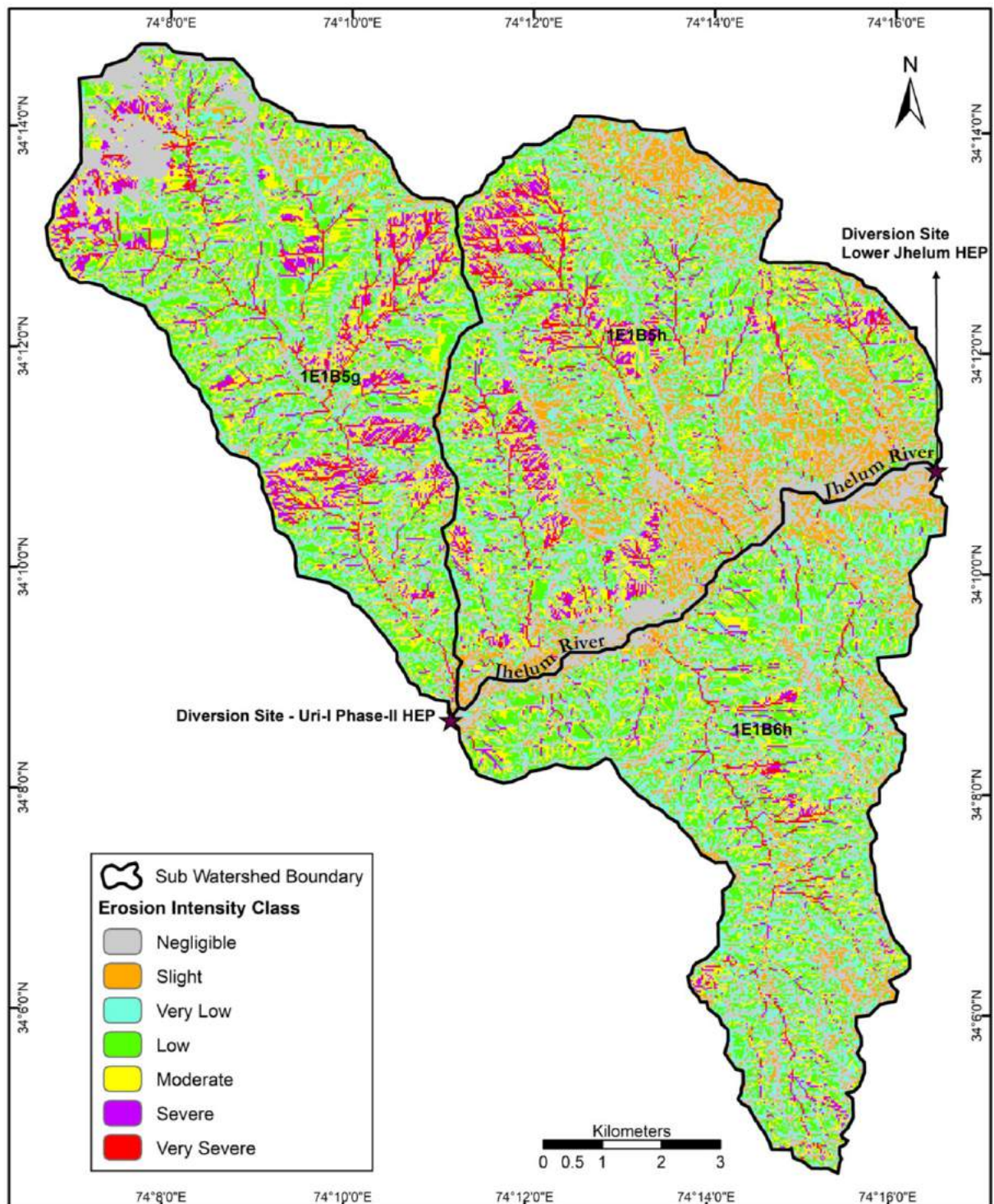


Figure 10.6: Soil Erosion Intensity Map of Uri-I Stage-II HEP Free Draining Catchment Area

Table 10.6: Sub-Watershed Wise Area Under Each Soil Erosion Category

S. No.	Erosion Intensity Category (Soil Loss in tons/hectare/annum)	Sub-Watersheds						Total	
		1E1B5g		1E1B5h		1E1B6h			
		Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)
1	Negligible (<1)	1028.79	24.60	1687.54	31.88	1260.43	30.62	3976.75	29.26
2	Slight (1-5)	157.03	3.75	891.36	16.84	305.89	7.43	1354.27	9.96
3	Very Low (5-10)	581.95	13.91	727.05	13.74	800.85	19.46	2109.85	15.52
4	Low (10-20)	997.44	23.85	832.35	15.73	972.88	23.64	2802.68	20.62
5	Moderate (20-40)	816.24	19.51	672.74	12.71	513.25	12.47	2002.23	14.73
6	Severe (40-80)	426.44	10.20	336.92	6.37	181.80	4.42	945.16	6.95
7	Very Severe (>80)	174.90	4.18	144.89	2.74	80.72	1.96	400.51	2.95
	Total	4182.79	100	5292.86	100	4115.82	100	13591.46	100

10.2.5 PRIORTISATION OF SUB-WATERSHEDS USING SILT YIELD INDEX (SYI) METHOD

'Silt Yield Index' (SYI), method has been used for prioritization of sub-watersheds in the catchment for treatment. The Silt Yield Index Model (SYI) considers sedimentation as product of erosivity, morphometry and delivery ratio of a particular sub-watershed and was conceptualized by Soil and Land Use Survey of India (SLUSI) as early as 1969 and has been operational since then to meet the requirements of prioritization of smaller hydrologic units within river valley project catchment areas.

Different Erosion Intensity classes are demarcated and defined as per the soil erosion intensity maps prepared above. Various categories, such as Very Severe, Severe, Moderate, Slight, Negligible and Nil were then used to calculate sub-watershed-wise SYI.

The Silt Yield Index (SYI) is defined as the Yield per unit area and SYI value for hydrologic unit is obtained by taking the weighted arithmetic mean over the entire area of the hydrologic unit by using suitable empirical equation.

The prioritization of smaller hydrologic units within the vast catchments is based on the Silt Yield Indices (SYI) of the smaller units. The boundary values or range of SYI values for different priority categories are arrived at by studying the frequency distribution of SYI values and locating the suitable breaking points. The watersheds/ sub-watersheds are subsequently rated into various categories corresponding to their respective SYI values.

The application of SYI model for prioritization of sub-watersheds in the catchment areas involves the evaluation of:

- Climatic factors comprising total precipitation, its frequency and intensity,
- Geo-morphic factors comprising landforms, physiography, slope and drainage characteristics,
- Surface cover factors governing the flow hydraulics and
- Management factors.

The data on climatic factors can be obtained for different locations in the catchment area from the meteorological stations whereas the field investigations are required for estimating the other attributes.

The various steps involved in the application of model are:

- Preparation of a framework of sub-watersheds through systematic delineation

- Rapid reconnaissance surveys on 1:50,000 scale leading to the generation of a map indicating erosion-intensity mapping units.
- Assignment of weightage values to various mapping units based on relative silt-yield potential.
- Computing Silt Yield Index for individual watersheds/sub-watersheds.
- Grading of watersheds/sub-watersheds into very high, high, medium, low and very low priority categories.

The area of each of the mapping units is computed and silt yield indices of individual sub-watersheds are calculated using the equations mentioned above.

10.2.5.1 Silt Yield Index

To calculate silt yield index, the methodology developed by Soil & Land Use Survey (Department of Agriculture, Govt. of India) has been followed, where each erosion intensity unit is assigned a weightage value. When considered collectively, the weightage value represents approximately the comparative erosion intensity. A basic factor of $K = 10$ was used in determining the weightage values. The value of 10 indicates a static condition of equilibrium between erosion and deposition. Any addition to the factor K ($10+X$) is suggestive of erosion in ascending order whereas subtraction, i.e. ($10-X$) is indicative of deposition possibilities.

Delivery ratios were adjusted for each of the erosion intensity unit. The delivery ratio suggests the percentage of eroded material that finally finds entry into reservoir or river/stream. Area of each composite unit in each sub-watershed was then estimated. Silt yield index (SYI) was calculated using following empirical formula:

$$SYI = \frac{\sum (A_i * W_i) * D_i * 100}{A_w} ; \quad \text{where } i = 1 \text{ to } n$$

where,

A_i	=	Area of i^{th} unit (EIMU)
W_i	=	Weightage value of i^{th} mapping unit
n	=	No. of mapping units
A_w	=	Total area of sub-watershed.
D_i	=	Delivery ratio

Delivery ratios are assigned to all erosion intensity units depending upon their distance from the nearest stream. The criteria adopted for assigning the delivery ratio are as follows:

Nearest Stream	Delivery ratio
0 - 0.9 km	1.00
1.0 - 2.0 km	0.95
2.1 - 5.0 km	0.90
5.1 - 15.0 km	0.80
15.1 - 30.0 km	0.70

Weightage values are assigned to the erosion intensity unit depending upon the soil erosion intensity and delivery ratio in a sub-watershed. Higher the soil erosion intensity and delivery ratio in the sub-watershed higher is the weightage value assigned to the erosion mapping unit. The weightage value assigned to erosion mapping unit in a sub-watershed ranges from 11-20. The SYI values for classification of various categories of priority are given in **Table 10.7**.

Table 10.7: Criteria for Priority Categories

Priority categories	SYI Values
Very high	> 1300
High	1200-1299
Medium	1100-1199
Low	1000-1099
Very Low	<1000

The objective of the SYI method is to prioritize sub-watershed in a catchment area for treatment. The sub-watersheds with very high and high priority category in the catchment are required to be treated on priority basis; however, the area under severe and very severe soil erosion category in all the sub-watersheds would be taken up for treatment measures. Thus, the prioritization will help in understanding which sub-watershed to be taken for priority during the 14 years CAT plan comprising of 2 years of implementation and 10 years of maintenance.

Hence, under the present CAT plan implementation, the sub-watersheds would be treated as per the priority defined in **Table 10.8** i.e. the sub-watershed falling in the high priority category would be taken up in the second year and sub-watershed falling in the medium priority category would be taken up in the third year (**Figure 10.7**).

Table 10.8: Prioritization of Sub-Watershed Falling in Uri-I Stage-II HEP Free Draining Catchment Area

Sub-Watershed	EIMU Area (ha)	SYI	Priority Number
High Priority (1200-1299)			
1E1B5g	4182.79	1278	1
1E1B5h	5292.86	1208	1
Medium Priority (1100-1199)			
1E1B6h	4115.82	1138	2

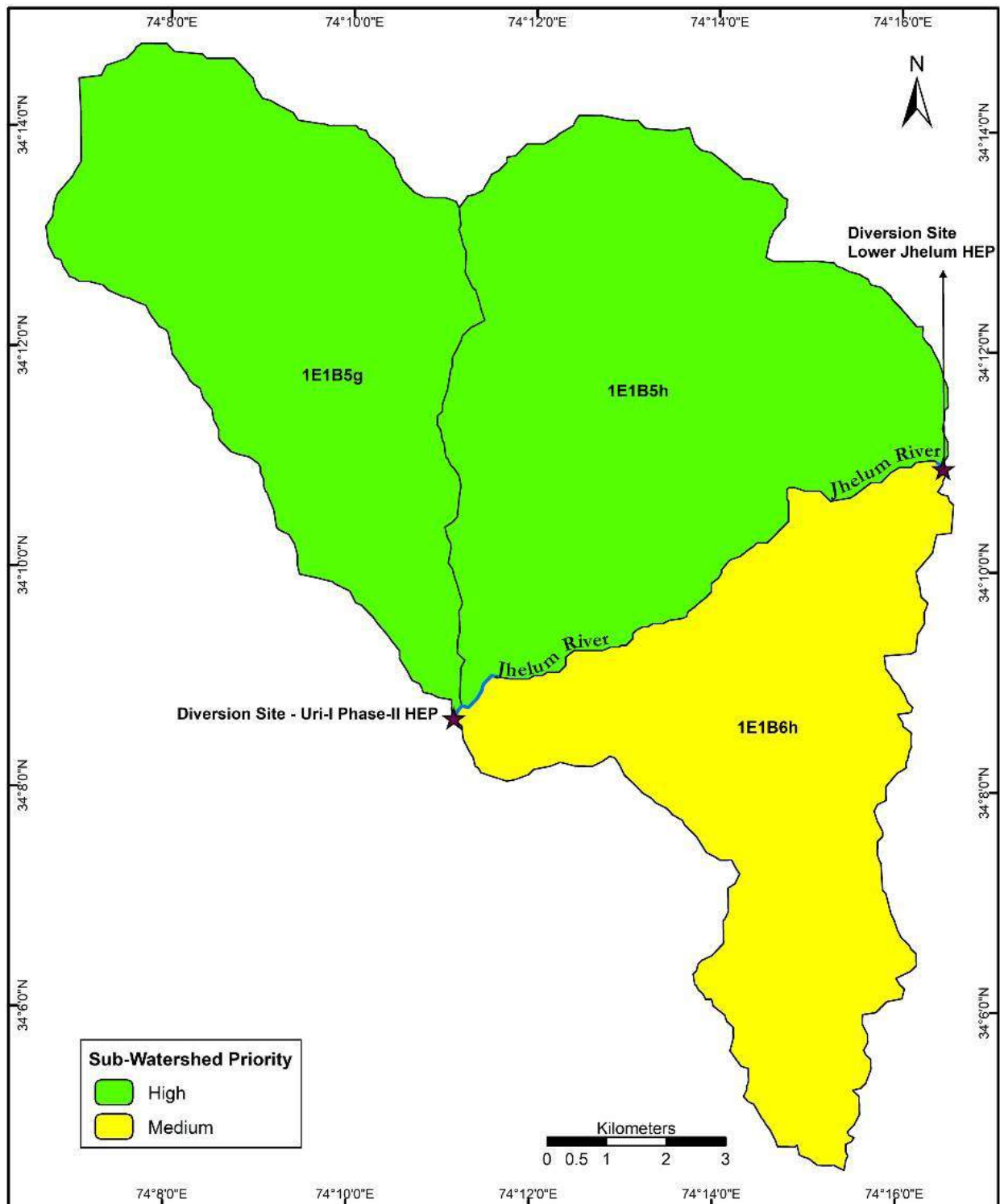


Figure 10.7: Sub-Watershed Prioritization of Uri-I Stage-II HEP Free Draining Catchment Area

10.2.6 Treatable Area

The sub-watershed wise treatable area was calculated in three steps, viz. i) assessment of area under severe and very severe erosion categories (**Table 10.9**); ii) assessment of area under severe and very severe erosion categories falling in the different land use/ land cover classes (**Table 10.10**); and iii) finally, area under severe and very severe erosion categories which falls under evergreen/ semi evergreen forest, open forest, scrub forest, scrub land and grass/ grazing land is considered as area available for treatment (**highlighted cells in Table 10.10**). Therefore, under the Catchment Area Treatment plan an area of 1295.91 ha will be taken up for treatment.

Table 10.9: Sub-watershed wise area under Severe and Very Severe Erosion Category

S. No.	Sub-Watershed	Severe (ha)	Very Severe (ha)	Total (ha)
1	1E1B5g	426.44	174.90	601.34
2	1E1B5h	336.92	144.89	481.81
3	1E1B6h	181.80	80.72	262.52
	Total	945.16	400.51	1345.67

Table 10.10: Sub-watershed wise area under Severe and Very Severe Erosion Category under different Land use/ Land cover Categories

Land use/ Land cover Class	Sub-Watershed Wise Area under Severe and Very Severe Erosion Category			
	1E1B5g	1E1B5h	1E1B6h	Total
	Area (ha)	Area (ha)	Area (ha)	Area (ha)
Evergreen/ Semi Evergreen Forest	145.62	70.87	124.33	340.82
Open Forest	0.00	2.13	0.08	2.21
Scrub Forest	205.25	70.37	50.82	326.43
Scrub Land	231.64	318.69	76.07	626.40
Grass/ Grazing Land	0.00	0.00	0.05	0.05
Baren Rocky Land	0.00	0.83	0.00	0.83
Agricultural Land	17.41	18.39	10.70	46.50
Builtup/ Settlement	0.32	0.00	0.31	0.63
Snow Cover	1.10	0.00	0.00	1.10
Waterbody	0.00	0.52	0.18	0.70
Total	601.34	481.81	262.52	1345.67

10.2.7 Watershed Management – Available Techniques

Watershed management is the optimal use of soil and water resources within a given geographical area so as to enable sustainable production. It implies changes in land use, vegetative cover, and other structural and non-structural action that are taken in a watershed to achieve specific watershed management objectives. The overall objectives of watershed management programme are to:

- increase infiltration into soil;
- control excessive runoff;
- manage & utilize runoff for useful purpose.

Following Engineering and Biological measures shall be suggested for the catchment area treatment depending upon the requirement and suitability:

10.2.7.1 Biological Measures

The biological measures will be undertaken under four different schemes as detailed below to make them specific to the needs of the areas being treated. The estimate for each of the four schemes is as per the norms provided by the office of Chief Conservator of Forests, Kashmir vide Letter No. 421/CCF(K)/Plg/2023-24/871-72 dated 19/07/2023, refer (Annexure IV).

- Normal Afforestation
- Enrichment
- Pasture development

- Assisted Natural Regeneration

Supplemented by

- Plant Production
- Maintenance of PB raised conifer saplings in nurseries
- Maintenance of NR saplings in nurseries
- Engagement of Labours as Watch and Ward

A) Normal Afforestation

A well-stocked forest plays a very important role in control of soil erosion. Thus, it is proposed to increase the vegetal cover in the area. For this purpose, barren areas, devoid of tree growth have been recommended to be brought under afforestation. This will include raising of multi-tier mixed vegetation of suitable local species on steep and sensitive catchment areas of rivers/streams with the objective of keeping such areas under permanent vegetative cover. 1100 plants per ha are proposed to be planted under this scheme. Angle iron fence post have been proposed to safeguard the plantation sites. The cost for afforestation excluding plant production cost and including Rs. 17,030/- for maintenance for a period of 3 years has been taken as Rs. 1,50,510/- per ha. The area to be brought under normal afforestation in different sub-watersheds is given at **Table 10.11**.

B) Enrichment

In areas where natural trees exist but are depleted due to excessive pressure of local population for timber, fuelwood and fodder are to be undertaken under enrichment. 800 plants per ha are proposed to be planted under this scheme. Angle iron fence post have been proposed to safeguard the plantation sites. The cost for enrichment excluding plant production cost and including Rs. 12,300/- for maintenance for a period of 3 years has been taken as Rs. 1,33,600/- per ha. The area to be brought under enrichment in different sub-watersheds is given at **Table 10.11**.

C) Pasture Development

As there are degraded patches of pasture in the area, this measure will be adopted to encourage development of new and healthy pastures for use of cattle of the area. Barren land with greater slopes has been recommended to be treated by developing pastures over them. 1100 plants per ha are proposed to be planted under this scheme. Angle iron fence post have been proposed to safeguard the plantation sites. The cost for afforestation excluding plant production cost and including Rs. 17,030/- for maintenance for a period of 3 years has been taken as Rs. 1,50,510/- per ha. The area to be brought under pasture development in different sub-watersheds is given at **Table 10.11**.

D) Assisted Natural Regeneration

It is important to enhance the establishment of secondary forest from degraded grassland and shrub vegetation by protecting and nurturing the mother trees and their wildlings inherently present in the area. Assisted natural regeneration is proposed to accelerate, rather than replace, natural successional processes by removing or reducing barriers to natural forest regeneration such as soil degradation, competition with weedy species, and recurring disturbances (e.g., fire, grazing, and wood harvesting). 400 plants per ha are proposed to be planted under this scheme. Angle iron fence post have been proposed to

safeguard the plantation sites. Cost for Assisted natural regeneration excluding plant production cost and including Rs. 6,150/- for maintenance for a period of 3 years has been taken as Rs. 1,11,160/- per ha. The area to be brought under assisted natural regeneration in different sub-watersheds is given at **Table 10.11**.

Table 10.11: Sub-watershed wise Biological Treatment Measures

S. No.	Biological Treatment Measures	Sub-Watershed			Total
		1E1B5g	1E1B5h	1E1B6h	
1	Afforestation (ha)	74	27	18	119
2	Enrichment (ha)	17	8	15	40
3	Pasture Development (ha)	31	42	11	84
4	Assisted Natural Regeneration (ha)	22	30	7	59

E) Plant Production

Having sufficient stock of plants is a pre-requisite for undertaking all the biological measures suggested above. Therefore, in order to ensure sufficient stock of plant following measures are proposed to be undertaken:

- Formation of new permanent nursery
- Raising of sapling in poly bag of size (9" x 6")
- Raising of naked root sapling

i. Formation of New Permanent Nursery

Nursery is defined as an area where plants are raised for eventual planting out in the forest area or elsewhere selected for plantation in field. In order to cater to the needs of biological treatment measures, one new nursery of 1 ha is proposed to be developed. The cost for the formation of nursery is Rs. 4,13,305.36. The cost for the formation of new nursery has been taken as per the norms provided by the office of Chief Conservator of Forests, Kashmir vide Letter No. 421/CCF(K)/Plg/2023-24/871-72 dated 19/07/2023, refer (**Annexure IV**).

ii. Raising of Sapling in Poly Bag

The total plants raised in poly bags to be planted in pits under different biological measures schemes are 83,670 (@ 330 plants/ ha for normal afforestation, 240 plants/ ha for enrichment, 330 plants/ ha for pasture development and 120 plants / ha for assisted natural regeneration). Before planting on sites, these plants will be raised as saplings in poly bag in the newly formed nurseries as mentioned above. Considering that all the saplings may not survive, 20% more saplings will be raised, which comes out to be 1,00,404, which further rounded off to 1,00,420. Therefore, total 1,00,420 saplings are proposed to be raised in poly bag of size (9" x 6"). The unit cost considered for raising sapling in poly bag is Rs. 10.97/ plant. The unit cost considered is as per the norms provided by the office of Chief Conservator of Forests, Kashmir vide Letter No. 421/CCF(K)/Plg/2023-24/871-72 dated 19/07/2023, refer (**Annexure IV**).

iii. Raising of Naked Root Saplings

Similarly, total naked root plants to be planted in pits under different biological measures schemes are 1,95,230 (@ 770 plants/ ha for normal afforestation, 560 plants/ ha for enrichment, 770 plants/ ha for pasture development and 280 plants / ha for assisted natural regeneration). Before planting on sites, these plants will be raised as saplings in the

newly formed nurseries. Considering that all the sapling may not survive, 20% more saplings will be raised, which comes out to be 2,34,276, which further rounded off to 2,34,280. Therefore, total 2,34,280 saplings are proposed to be raised as naked root. The unit cost considered for raising naked root sapling is Rs. 10.16/ plant. The unit cost considered for raising sapling in poly bag is Rs. 10.97/ plant. The unit cost considered is as per the norms provided by the office of Chief Conservator of Forests, Kashmir vide Letter No. 421/CCF(K)/Plg/2023-24/871-72 dated 19/07/2023, refer (**Annexure IV**).

F) Maintenance of PB raised Saplings in Nurseries

As 3 years maintenance has been proposed for all the plantation sites, therefore, it is necessary to ensure continuous supply of saplings raised in poly bags during this maintenance period. The total poly bag raised saplings proposed for maintenance in nurseries are 45,189. Out of which, 25,105 saplings (@25% of total 1,00,420 saplings raised in newly formed nursery) will be maintained during 1st year of planting. 15,063 saplings (@15% of total 1,00,420 saplings raised in newly formed nursery) will be maintained during 2nd year of planting. 5,021 saplings (@5% of total 1,00,420 saplings raised in newly formed nursery) will be maintained during 3rd year of planting. The unit cost considered for maintenance of poly bag raised sapling is Rs. 3.63/ plant for 1st year, Rs. 3.63/ plant for 2nd year and Rs. 5.23/ plant for 3rd year. The unit cost considered is as per the norms provided by the office of Chief Conservator of Forests, Kashmir vide Letter No. 421/CCF(K)/Plg/2023-24/871-72 dated 19/07/2023, refer (**Annexure IV**).

G) Maintenance of NR raised Saplings in Nursery

Since naked root (NR) saplings are being maintained for 1 year, therefore it is proposed to maintain 58,570 NR saplings (@25% of total 2,34,280 saplings raised in newly formed nursery). The unit cost considered for maintenance of NR sapling is Rs. 3.39/ plant. The unit cost considered is as per the norms provided by the office of Chief Conservator of Forests, Kashmir vide Letter No. 421/CCF(K)/Plg/2023-24/871-72 dated 19/07/2023, refer (**Annexure IV**).

H) Engagement of Labours as Watch and Ward

It is proposed to engage local people of labours to assist regular staff for the protection of the plantation sites. It is proposed to engage 3 labours i.e. 1 labour per sub watershed. The total period for the engagement shall be 4 years i.e. planting year and subsequent 3 maintenance years. The rate for engagement of the labour is Rs. 330 per day for the current year. Considering per year revision in the wage rate, an enhancement @ 7.76% per year on the previous year has been applied for calculating the wage rate enhancement. The base wage rate has been taken as per the norms provided by the office of Chief Conservator of Forests, Kashmir vide Letter No. 421/CCF(K)/Plg/2023-24/871-72 dated 19/07/2023, refer (**Annexure IV**).

10.2.7.2 Engineering Measures

Engineering measures are more effective in conserving soil and water when they are supplemented by vegetative methods. But in certain situations, only engineering measures can be proposed. Various engineering measures have been suggested for landslides/ landslips, treatment of nalas and soil and water conservation in private/ irrigated land in the catchment area. The engineering structures suggested are as follows:

- Dry Stone Masonry Check walls and Check dams
- Gabion Check walls and Check dams
- Silt Observation Points

I) Dry Stone Masonry Structures

Dry stone masonry structures can be made of boulders piled up across the gully if they are locally available. Structures for damming a gully or a stream to refine the flow velocity are called check dams. In order to maintain the structures, 25% of the total cost has been kept as maintenance cost after 3 years of implementation of the structures. The unit cost of construction of such structure is Rs. 2744.35/- per cum (Rate are as per PWD Schedule of Rates 2022, Code 7.3). The total quantity of DRSM structures suggested for each sub-watershed is given at **Table 10.12**.

II) Gabion Structures

If loose boulders are considered not to be stable in a particular reach of the stream, Gabion structures can be installed. These structures are not that easy to get erected as compared to DRSM structures because the terrain is stiff and the wire used for making gabion boxes has to be carried by human labour. Carrying the wire will be tedious and time consuming. Therefore, with proper judgment about the site conditions, these structures may be installed. In order to maintain the structures, 25% of the total cost has been kept as maintenance cost after 3 years of implementation of the structures. The unit cost of construction of such structure is Rs. 4716.85/- per cum (Rate are as per PWD Schedule of Rates 2022). The total quantity of gabion structures suggested for each sub-watershed is given at **Table 10.12**.

Table 10.12: Sub-watershed wise Engineering Treatment Measures

S. No.	Engineering Treatment Measures	Sub-Watershed			Total
		1E1B5g	1E1B5h	1E1B6h	
1	DRSM Structures (Cum)	2700	2900	2200	7800
2	Gabion Structure (Cum)	1080	340	610	2030

III) Silt Observation Points

Two silt observation locations for regular monitoring of silt load coming in tributaries have been suggested which should be established in consultation with state forest department. This would ensure monitoring efficacy of implementation various treatments measures suggested as in CAT plan. Monitoring would be undertaken for a period of 10 years. Cost towards this should be kept in project estimates and could be taken as below:

Cost of one laboratory = Rs. 10.00 lakh

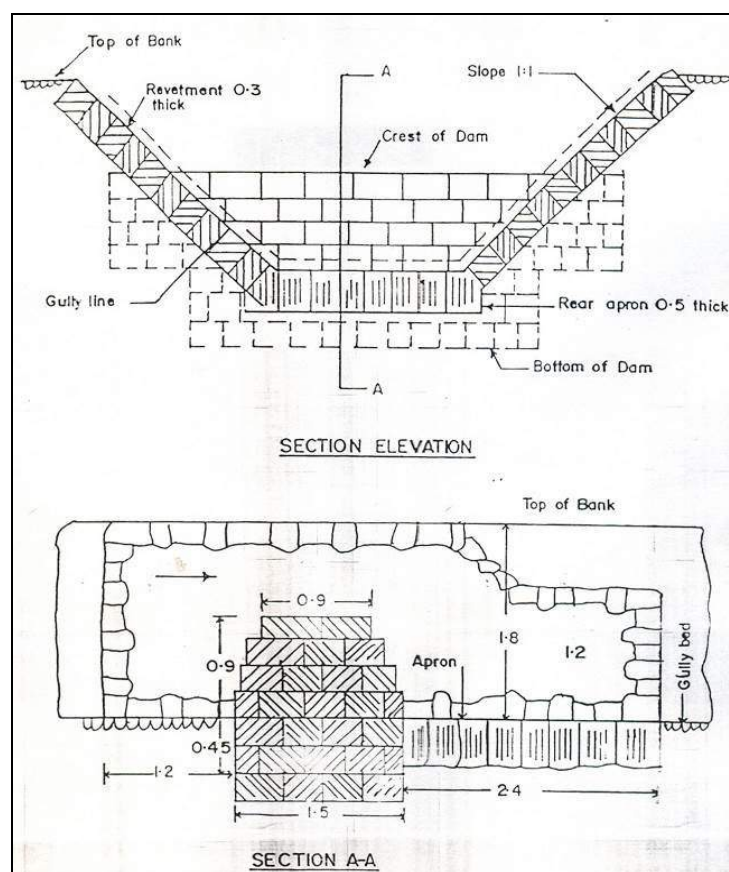
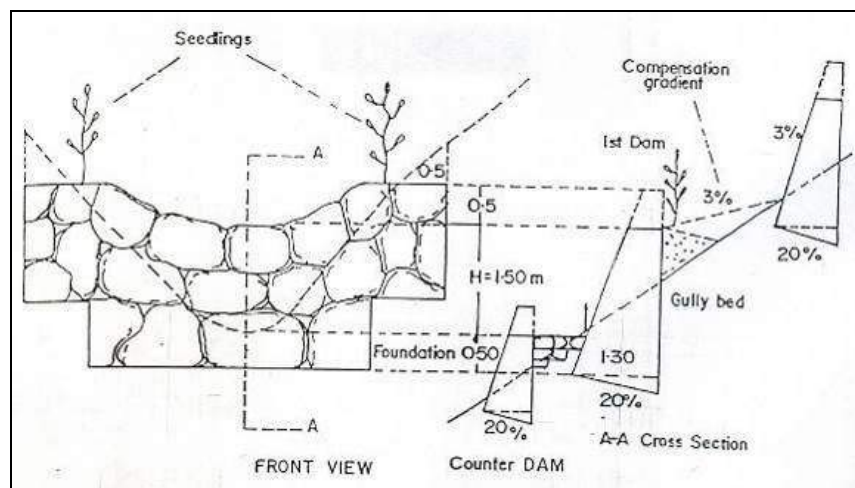
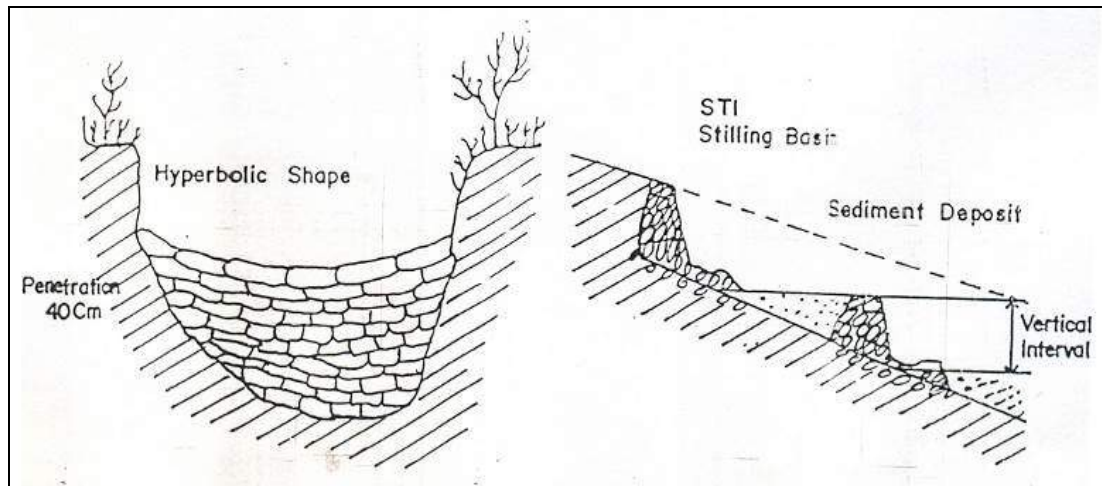
One hut at each site (@ Rs. 200,000/- lakh) = Rs. 4.00 lakh

Cost for hiring services of persons (@ two persons per site) = Rs. 69.79 lakh*

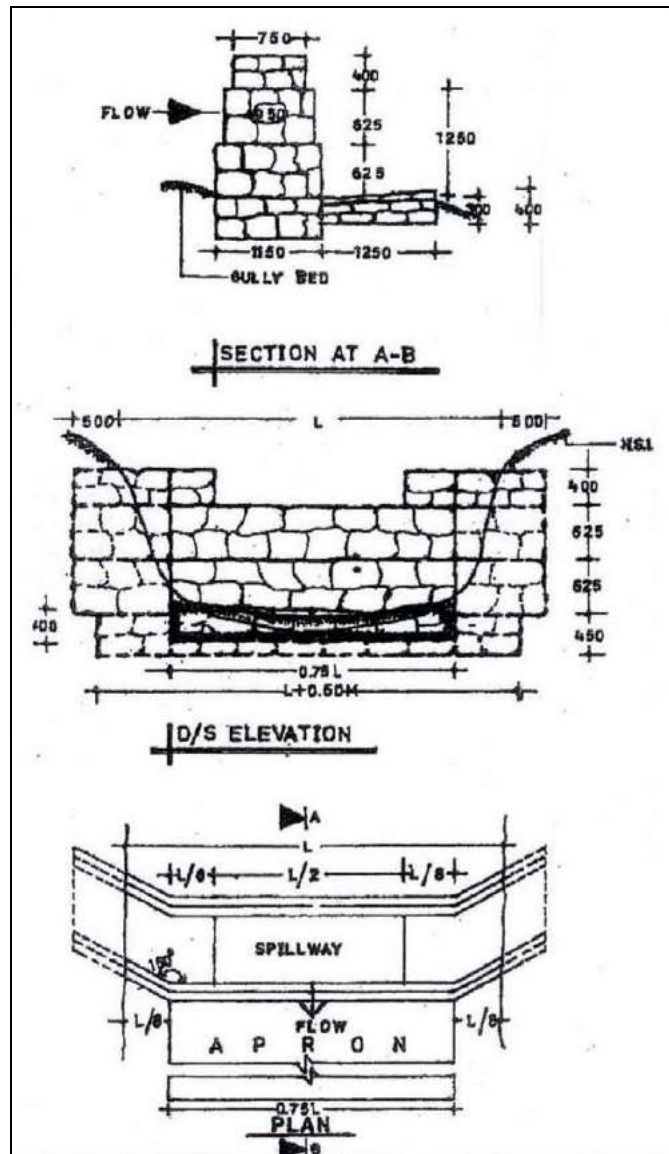
Consumables for the measurement Rs. 1.00 lakh per year for 10 years = 10.00 lakh

Total cost = Rs. 93.79 lakh

**The rate for engagement of the labour is Rs. 330 per day for the current year. Considering per year revision in the wage rate, an enhancement @ 7.76% per year on the previous year has been applied for the next 9 years for calculating the wage rate enhancement.*



Layout of Dry Stone Check Dam



Typical Layout of Gabion Structure

10.2.7.3 Other Components

Apart from the biological and engineering treatment measures in the catchment area there are other aspects of the CAT Plan to be addressed and their cost included in the overall cost estimate of the plan. The other components forming the integral ingredients which have to be considered and included while formulating the CAT plans are:

- Socio-economic
- Administrative Expenditure
- Micro Planning
- Wildlife Protection and Management
- Monitoring & Evaluation
- Contingencies

A) Socio-economic

The following measures would help in rejuvenating the ecosystem and in reducing the soil erosion in the region. It shall be carried out for local villages in free draining catchment area of Uri I Stage II Project.

- i. Plan for plantation in the village area.
- ii. Avenue plantation using fuel wood trees with suitable fencing in the villages.

- iii. Technical & Financial support for using alternate energy sources.
- iv. Maintenance of hygiene in the villages.
- v. Establishment of training, awareness programmes for water and soil conservation in the village areas
- vi. Establishing a rural technology support program
- vii. Awareness program for conservation of wildlife and natural resource.

A budgetary provision of **Rs. 29.94 lakh** has been kept under this component.

B) Administrative Expenditure

For an efficient management of forest resources, it is essential that operational support to the implementing agency is adequately developed. Similarly, in remote localities of the area there are no places for shelter for the staff, people and trekkers. Therefore, a budget provision of **Rs. 96.45 lakh** has been kept under this component.

C) Provision for Micro Plans

Based on the ground truth reality in each of the sub-watershed comprehensive micro plan for execution of the work has to be prepared as per norms. For this purpose a provision of **Rs. 15.00 lakh** is being made.

D) Wildlife Protection and Management

Since majority of the area at the right bank of the Jhelum river in the free draining catchment area falls under Limber and Kazinag Wildlife Sanctuary therefore a provision of **Rs. 96.45 lakh** is being made for the wildlife protection and management in the wildlife sanctuary areas.

E) Monitoring & Evaluation

Monitoring and evaluation will be developed as in-built part of the project management. Thus, a process of self-evaluation at specified intervals of time will ensure the field worthiness and efficacy of the CAT Plan. The emphasis would be on Monitoring and impact studies of the works done under the plan. A sum of **Rs. 48.23 lakh** has been provided for monitoring and evaluation.

F) Contingencies

A provision of **Rs. 96.45 lakh** has been kept under this component for some leeway to adjust any unforeseen expenditure.

10.2.8 Cost Estimate

The cost estimated for Catchment Area Treatment is **Rs. 1,346.05 lakh**. The details are given in **Tables 10.13**. The year wise physical and financial targets are given in **Table 10.14**. Sub-Watershed wise yearly physical and financial targets of proposed biological as well as engineering treatment measures are given in from **Table 10.15 to Table 10.20**.

CAT plan has already been appraised by State Forest Department and has been vetted by them. Total CAT plan cost agreed by them is **Rs. 12.97 Crore**. Biological treatment measures have been formulated by state forest department after keeping maintenance period as 3 years. CAT plan as vetted and approved by State Forest Department has been annexed as **Annexure IV**. Hence, a total amount of **Rs. 12.97 Crore** will be deposited with

the Jammu & Kashmir Forest Department for taking up proposed activities within the Catchment Area.

Table 10.13: Cost Estimate for Catchment Area Treatment of Uri-I Stage-II HEP

S. No.	Item	Rate (Rs)	Unit	Target	
				Physical	Financial (Rs in lakh)
A	Biological Measures				
1	Normal Afforestation including maintenance	1,50,510	ha	119.00	179.11
2	Enrichment Plantations including maintenance	1,33,600	ha	40.00	53.44
3	Pasture Development including maintenance	1,50,510	ha	84.00	126.43
4	Assisted Natural Regeneration including maintenance	1,11,160	ha	59.00	65.58
5	Plant Production				
a	Formation of New Permanent Nursery	4,13,305	ha	1	4.13
b	Raising of sapling in PB of size (9" x 6")	10.97	/plant	100420	11.02
c	Raising of NR sapling	10.16	/plant	234280	23.80
6	Maintenance of PB raised conifer saplings in nurseries of size (9" x 6")				
a	During 1 st Year of raising of plants	3.63	/plant	25105	0.91
b	During 2 nd Year of raising of plants	3.63	/plant	15063	0.55
c	During 3 rd Year of raising of plants	5.23	/plant	5021	0.26
7	Maintenance of NR sapling				
a	During 1 st year of raising of plants	3.39	/plant	58570	1.99
8	Engagement of Labours as Watch and Ward				
a	During Planting Year	330	/day	3	3.61
b	During 1 st Year of maintenance	355	/day	3	3.89
c	During 2 nd Year of maintenance	385	/day	3	4.22
d	During 3 rd Year of maintenance	415	/day	3	4.54
	Sub Total A				483.48
B	Engineering Measures				
9	DRSM Structures	2,744.35	Cum.	7800.00	214.06
a	Maintenance cost @ 25%				53.51
10	Gabion Structures	4,716.85	Cum.	2030.00	95.75
a	Maintenance cost @ 25%				23.94
11	Silt Observation Points		Nos.	2	93.79
	Sub Total B				481.05
I	Total A and B				964.53
II	Other Components				
12	Socio-economic Cost @3% of Total I				28.94
13	Administrative Expenditure Cost @ 10% of Total I				96.45
14	Micro Planning Cost				15.00
15	Wildlife Protection and Management @ 10% of Total I				96.45
16	Monitoring & Evaluation @ 5% of Total I				48.23
17	Contingency Cost @ 10% of Total I				96.45
	Total II				381.52
	Grand Total				1,346.05

Table 10.14: Year Wise Targets (Physical and Financial) for Catchment Area Treatment Plan

S. No.	Measures	Year I		Year II		Year III		Year IV		Year V		Year VI		Year VII		Year VIII		Year IX		Year X		Year XI		Total	
		Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.
A	Biological Measures																								
1	Afforestation (ha)			101	134.81	18	24.03																	119	158.84
	1 st Year maintenance					101	9.52	18	1.70															119	11.22
	2 nd Year maintenance							101	5.74	18	1.02													119	6.76
	3 rd Year maintenance									101	1.94	18	0.35											119	2.28
2	Enrichment Plantations (ha)			25	30.33	15	18.20																	40	48.52
	1 st Year maintenance					25	1.71	15	1.02															40	2.73
	2 nd Year maintenance							25	1.03	15	0.62													40	1.64
	3 rd Year maintenance									25	0.34	15	0.21											40	0.55
3	Pasture development (ha)			73	97.44	11	14.68																	84	112.12
	1 st Year maintenance					73	6.88	11	1.04															84	7.92
	2 nd Year maintenance							73	4.15	11	0.62													84	4.77
	3 rd Year maintenance									73	1.40	11	0.21											84	1.61
4	Assisted Natural Regeneration (ha)			52	54.61	7	7.35																	59	61.96
	1 st Year maintenance					52	1.78	7	0.24															59	2.02
	2 nd Year maintenance							52	1.07	7	0.14													59	1.21
	3 rd Year maintenance									52	0.35	7	0.05											59	0.40
5	Plant Production																								
	Formation of New Permanent Nursery	1	4.13																					1	4.13
	Raising of sapling in PB of size (9" x 6")	83600	9.17	16820	1.85																			100420	11.02
	Raising of NR sapling	195050	19.82	39230	3.99																			234280	23.80
6	Maintenance of PB raised conifer saplings in nurseries of size (9" x 6")																								
	During 1 st year of raising of plants			20900	0.76	4205	0.15																	25105	0.91
	During 2 nd year of raising of plants					12540	0.46	2523	0.09															15063	0.55
	During 3 rd year of raising of plants							4180	0.22	841	0.04													5021	0.26
7	Maintenance of NR sapling																								
	During 1 st year of raising of plants			48763	1.65	9808	0.33																	58570	1.99
8	Engagement of Labours as Watch and Ward																								
	During Planting Year			2	2.41	1	1.20																	3	3.61
	During 1 st year of maintenance					2	2.59	1	1.30															3	3.89
	During 2 nd year of maintenance							2	2.81	1	1.41													3	4.22
	During 3 rd year of maintenance									2	3.03	1	1.51											3	4.54
	Sub Total A		33.12		327.84		88.89		20.39		10.92		2.32												483.48
B	Engineering measures																								
9	DRSM Structures (cum)			2700	74.10	5100	139.96																	7800	214.06
a	Maintenance cost @ 25%											18.52		34.99											53.51
10	Gabion Structures (cum)			1080	50.94	950	44.81																	2030	95.75
a	Maintenance cost @ 25%											12.74		11.20											23.94
11	Silt Observation Points (no.)	2	19.82		6.18		6.62		7.06		7.57		8.08		8.67		9.25		9.91		10.64			2	93.79
	Sub Total B		19.82		131.22		191.39		7.06		7.57		39.34		54.86		9.25		9.91		10.64				481.05
I	Total A and B		52.94		459.06		280.28		27.45		18.49		41.67		54.86		9.25		9.91		10.64				964.53
II	Other Components																								
12	Socio-economic Cost @3% of Total I		9.65		9.65		9.65																		28.94
13	Administrative Expenditure Cost @ 10% of Total I		5.29		45.91		28.03		2.74		1.85		4.17		5.49		0.92		0.99		1.06				96.45
14	Micro Planning Cost		15.00																						15.00
15	Wildlife Protection and Management @ 10% of Total I		5.29		45.91		28.03		2.74		1.85		4.17		5.49		0.92		0.99		1.06				96.45
16	Monitoring & Evaluation @ 5% of Total I				2.65		22.95		14.01		1.37		0.92		2.08		2.74		0.46		0.50		0.53		48.23
17	Contingency Cost @ 10% of Total I		5.29		45.91		28.03		2.74		1.85		4.17		5.49		0.92		0.99		1.06				96.45
	Total II		40.53		150.01		116.68		22.25		6.92		13.42		18.54		5.52		3.43		3.69		0.53		381.52
	Grand Total (I and II)		93.47		609.07		396.96		49.70		25.41		55.09		73.40		14.77		13.34		14.32		0.53		1346.05

Note: Amount is in lakh

Table 10.15: Year-Wise Physical and Financial Targets of Afforestation to be Undertaken in Sub-Watersheds

S. No.	Sub-Watershed	Year II		Year III		Year IV		Year V		Year VI		Total	
		Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.
1	1E1B5g	74	98.78	74	6.98	74	4.20	74	1.42			74	111.38
2	1E1B5h	27	36.04	27	2.55	27	1.53	27	0.52			27	40.64
3	1E1B6h			18	24.03	18	1.70	18	1.02	18	0.35	18	27.09
	Total	101	134.81	119	33.55	119	7.43	119	2.96	18	0.35	119	179.11

*Note: Amount is in lakh***Table 10.16: Year-Wise Physical and Financial Targets of Enrichment to be Undertaken in Sub-Watersheds**

S. No.	Sub-Watershed	Year II		Year III		Year IV		Year V		Year VI		Total	
		Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.
1	1E1B5g	17	20.62	17	1.16	17	0.70	17	0.23			17	22.71
2	1E1B5h	8	9.70	8	0.55	8	0.33	8	0.11			8	10.69
3	1E1B6h			15	18.20	15	1.02	15	0.62	15	0.21	15	20.04
	Total	25	30.33	40	19.90	40	2.05	40	0.96	15	0.21	40	53.44

*Note: Amount is in lakh***Table 10.17: Year-Wise Physical and Financial Targets of Pasture Development to be Undertaken in Sub-Watersheds**

S. No.	Sub-Watershed	Year II		Year III		Year IV		Year V		Year VI		Total	
		Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.
1	1E1B5g	31	41.38	31	2.92	31	1.76	31	0.60			31	46.66
2	1E1B5h	42	56.06	42	3.96	42	2.39	42	0.81			42	63.21
3	1E1B6h			11	14.68	11	1.04	11	0.62	11	0.21	11	16.56
	Total	73	97.44	84	21.57	84	5.18	84	2.03	11	0.21	84	126.43

*Note: Amount is in lakh***Table 10.18: Year-Wise Physical and Financial Targets of Assisted Natural Regeneration to be Undertaken in Sub-Watersheds**

S. No.	Sub-Watershed	Year II		Year III		Year IV		Year V		Year VI		Total	
		Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.
1	1E1B5g	22	23.10	22	0.75	22	0.45	22	0.15			22	24.46
2	1E1B5h	30	31.50	30	1.03	30	0.62	30	0.20			30	33.35
3	1E1B6h			7	7.35	7	0.24	7	0.14	7	0.05	7	7.78
	Total	52	54.61	59	9.13	59	1.31	59	0.5	7	0.05	59	65.58

*Note: Amount is in lakh***Table 10.19: Year-Wise Physical and Financial Targets of DRSM Structures to be Undertaken in Sub-Watersheds**

S. No.	Sub-Watershed	Year II		Year III		Year VI		Year VII		Total	
		Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.
1	1E1B5g	2700	74.10				18.52			2700	92.62
2	1E1B5h	2900	79.59				19.90		0.00	2900	99.48
3	1E1B6h			2200	60.38				15.09	2200	75.47
	Total	5600	153.68	2200	60.38		38.42		15.09	7800	267.57

*Note: Amount is in lakh***Table 10.20: Year-Wise Physical and Financial Targets of Gabion Structures to be Undertaken in Sub-Watersheds**

S. No.	Sub-Watershed	Year II		Year III		Year VIII		Year IX		Total	
		Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.	Phy.	Fin.
1	1E1B5g	1080	50.94				12.74			1080	63.68
2	1E1B5h	340	16.04				4.01			340	20.05
3	1E1B6h			610	28.77				7.19	610	35.97
	Total	1420	66.98	610	28.77		16.74		7.19	2030	119.69

Note: Amount is in lakh

Section 10.3

COMPENSATORY AFFORESTATION PROGRAMME

10.3 COMPENSATORY AFFORESTATION PLAN

The Uri-I Stage-II HEP is being constructed in the jurisdiction of Jhelum Valley Forest Division in Baramulla district, UT of Jammu & Kashmir. The total land required for the construction of proposed project activities is approximately **114.0335 ha** out of which **97.0335 ha** is non-forest land and **17.00 ha** is forest land for underground work (Table 10.21).

Table 10.21: Details of the Land to be acquired for Uri-I stage-II HEP

S. No	Land Type	Area (ha)
1	Forest Land	17.00
2	Non-Forest Land	97.0335
Total		114.0335

10.3.1 Compensatory Afforestation Programme

The objective of the compensatory afforestation programme will be to develop natural areas in which ecological functions could be maintained on sustainable basis. Therefore, planting of indigenous species would be undertaken. Compensatory Afforestation is proposed to be done mainly in those forest blocks where degraded land and forest blanks are available for planting.

The Forest (Conservation) Act, 1980 stipulates strict forest protection measures and procedures (Guide Line 1/08-1 (ii)) for compensatory afforestation on acceptance of diversion of forestland for non-forestry purposes.

- i. If non-forest land is not available, compensatory plantation is to be raised on degraded forest land to the extent of twice the affected or lost forest area, and
- ii. If non-forest land is available, the extent of compensatory plantation will be equivalent of the affected or lost forest area.

The Compensatory Afforestation is proposed to be undertaken on non-forest land identified after consultation with the J&K Forest Department and District administration. The estimated cost of the Compensatory Afforestation Programme determined by J&K Forest Department is **Rs. 71,19,383.55**.

Table 10.22: Cost estimates of Compensatory Afforestation Plan

Particulars	Area (ha)	Rate Rs-Lakh/ha	Amount (Rs.)
Total Cost for compensatory afforestation (including maintenance and Contingencies)	17.0	4.18787.27	71,19,383.55

10.3.2 NET PRESENT VALUE (NPV)

The Hon'ble Supreme Court of India has made it mandatory vide its order dated 28.03.2008 for the user agency to compensate for the diversion of forest land for non-forest use for developmental activities on the recommendations of Central Empowered Committee (CEC)

to make payment of Net Present Value (NPV) of such diverted land so as to utilize this for getting back in the long run which are lost by such diversion.

For this purpose, CEC has classified the forest taking in view the ecological role and value of the forest, 16 major forest types have been further grouped into 6 ecological classes depending upon their ecological functions (refer. Revision of rates of NPV applicable for different class/category of forests 2014).

Eco-Class I	Consisting of Tropical Wet Evergreen Forests, Tropical Semi Evergreen Forests and Tropical Moist Deciduous Forests
Eco-Class II	Consisting of Littoral and Swamp Forests
Eco-Class III	Consisting of Tropical Dry Deciduous Forests
Eco-Class IV	Consisting of Tropical Thorn Forests and Tropical Dry Evergreen Forests
Eco-Class V	Consisting of Sub-tropical Broad Leaved Hill Forests, Sub-Tropical Pine Forests and Sub Tropical Dry Evergreen Forests
Eco-Class VI	Consisting of Montane Wet Temperate Forests, Himalayan Moist Temperate Forests, Himalayan Dry Temperate Forests, Sub Alpine Forest, Moist Alpine Scrub and Dry Alpine Scrub

The cost of Net Present Value (NPV) was calculated as per the revised NPV rates by MoEF&CC dated 6th January 2022. For non-forestry use/diversion of forest land, the NPV may be directed to be deposited in the Compensatory Afforestation Fund as per the rates given below (in Rs.).

Eco-Value class	Very Dense Forest	Dense Forest	Open Forest
Class I	1595790	1436670	1116900
Class II	1595790	1436670	1116900
Class III	1357110	1228590	957780
Class IV	957780	861390	670140
Class V	1436670	1292850	1005210
Class VI	1516230	1372410	1069470

Total forest land requirement for diversion for non-forest use i.e. for the underground activities is 17 ha. The forest in the project area fall in the Eco Class VI as being of type Himalayan Moist Temperate Forests, Himalayan Dry Temperate Forest with Dense Forest type. Therefore, as per the application submitted to MoEF&CC vide Proposal No.: FP/JK/HYD/144277/2021 (<http://forestsclearance.nic.in/viewreport.aspx?pid=FP/JK/HYD/144277/2021>) NPV of **Rs. 686205.0/ha** (i.e. 50% of Rs. 1372410.0/ha) would be required to be deposited in the Compensatory Afforestation Fund. The total cost of NPV has been determined by J&K forest department is **Rs. 1,16,65,485/-**.

Table 10.23: Cost Estimates of NPV

Eco Class	Rate (Rs.)	Forest Land (Area in ha)	NPV to be deposited (Rs.)
VI (Dense Forest)	Rs. 686205/ha (i.e. 50% of Rs. 1372410/ha)	17	116,65,485/-

10.3.3 ABSTRACT OF COST

The total cost of the compensatory afforestation plan, and NPV, is **Rs. 1,87,84,868.55**. The details are given in **Table 10.24**. Final Cost of CA and NPV shall be finalized as part of diversion proposal.

Table 10.24: Total Cost of Compensatory Afforestation and NPV

Sl. No.	Particulars	Amount (Rs.)
1	Compensatory Afforestation	71,19,383.55
2	Net Present Value (NPV)*	116,65,485.00
Total		1,87,84,868.55

*The cost of NPV shall come under the B-LAND in the DPR

Section 10.4

BIODIVERSITY CONSERVATION AND WILDLIFE MANAGEMENT PLAN

10.4 BIODIVERSITY CONSERVATION AND WILDLIFE MANAGEMENT PLAN

Uri-I Stage-II Hydro Electric Project is expansion of Uri-I Power Station (Uri-I Stage-I/ Uri-I Project), proposed to be developed on Jhelum River to harness the surplus water of Uri-I Power Station. The Uri-I Project was allotted to M/s NHPC Ltd. Uri-I Power Station was commissioned in the year 1997. The existing structures like 21.5m high barrage (from deepest foundation level), desilting basin, the surface water conveyance system consisting of Head regulator upto HRT intake of Uri-I Project shall be utilized for Uri-I Stage-II HEP. The construction of underground structures like 10.4 km long HRT, surge shaft, pressure shaft, an underground powerhouse complex and 2.28 km long TRT are proposed for Uri-I Stage -II Project.

10.4.1 Propose of Report

The proposed project does not fall in any protected areas like Wildlife Sanctuary/ National Parks etc. However, in reference to additional conditions of Terms of Reference (ToR) issued by Ministry of Environment, Forest, and Climate Change (MoEF&CC) via letter No. F. No. J-12011/08/2021-IA-I, dated 10th June 2021 (**Annexure-I**), directed to prepare Biodiversity Conservation Plan and Conservation Plan for the Scheduled I species reported from the study area and submit to State Forest Department for approval and implementation. In pursuant to the condition of ToR, The Biodiversity Management and Wildlife Conservation Plan along with conservation Measures of Schedule-I species is prepared. It is Pertinent to mention that none of the Schedule-I species were reported in the primary survey during EIA/EMP studies.

10.4.2 Description of Flora and Fauna In the Project Area

10.4.2.1 Forest Types in the Study Area

The project area falls in Jhelum Valley Forest Division of Jammu and Kashmir Forest Department. A large part of the vegetation is comprised of conifer forests especially in the surrounding of proposed project components. These forests in the study area can be classified following the 'A Revised Survey of the Forest Types of India' by Champion and Seth (1968) fall under **Group 12-Himalayan Moist Temperate Forest and Group 13-Dry Temperate Forest**. Further, forest in the area can categories under following four sub-group:

- 12/C1/f: Low-level Blue Pine Forest
- 13/C2b: Dry Deodar Forest
- 12/Ce: Moist Temperate Deciduous Forest
- 13/C3: West Himalayan Dry Temperate Deciduous Forest

10.4.2.2 Floral Diversity in Study Area

A total of 192 plant species, belonging 67 families, were reported in the study area. A brief description of number of plant species recorded in various taxonomic groups is given in the

following paragraphs. Details of plant species recorded during the field surveys within families are given at **Table 10.25**.

Table 10.25: Number of species of different plant groups reported from the study area

S. No.	Habit	No. of Families	No. of Genera	No. of Species
1	Angiosperms			
	Trees	15	23	26
	Shrubs	21	34	39
	Herbs	31	84	90
	Grasses	2	10	13
	Climbers	6	6	6
2	Gymnosperms			
	Trees	2	5	5
	Shrubs	2	2	3
3	Pteridophytes	2	3	3
4	Bryophytes	2	2	2
5	Lichens	4	5	5

i. Angiosperms

As per data collected during 3 seasons (monsoon, winter and pre-monsoon) field surveys, an inventory of 174 species of plants belonging to angiosperms was compiled which includes plant species found in forested areas, scrub land, near agricultural fields and settlements, abandoned land, etc. This list includes 26 species of trees, 39 species of shrubs, 90 species of herbaceous plants, 13 species of grasses and 6 species of climbers. Dominant families in the area are Asteraceae (27 species) and Rosaceae (20 species), followed by Poaceae (10 species), Lamiaceae (10 species) and Fabaceae (8 species). List of angiosperms recorded from the area is given in refer **Table 10.26**.

Table 10.26: List of Angiosperms recorded from the study area

S. No.	Family / Botanical Name	Habit	S. No.	Family / Botanical Name	Habit
	Acanthaceae			Asclepiadaceae	
1	<i>Justicia adhatoda</i>	Shrub	15	<i>Vincetoxicum hirundinaria</i>	Herb
2	<i>Strobilanthes attenuata</i>	Herb		Asteraceae	
	Aceraceae		16	<i>Ageratina adenophora</i>	Shrub
3	<i>Acer caesium</i>	Tree	17	<i>Artemisia nilagirica</i>	Shrub
	Adoxaceae		18	<i>Achillea millefolium</i>	Herb
4	<i>Viburnum cotinifolium</i>	Shrub	19	<i>Ainsliaea aptera</i>	Herb
5	<i>Viburnum grandiflorum</i>	Shrub	20	<i>Anaphalis contorta</i>	Herb
	Amaranthaceae		21	<i>Anthemis cotula</i>	Herb
6	<i>Achyranthes bidentata</i>	Herb	22	<i>Artemisia filifolia</i>	Herb
7	<i>Axyris hybrida</i>	Herb	23	<i>Aster thomsonii</i>	Herb
8	<i>Chenopodium album</i>	Herb	24	<i>Bidens pilosa</i>	Herb
9	<i>Gomphrena celosioides</i>	Herb	25	<i>Carduus edelbergii</i>	Herb
	Apiaceae		26	<i>Centaurea iberica</i>	Herb
10	<i>Angelica glauca</i>	Herb	27	<i>Cichorium intybus</i>	Herb
11	<i>Carum carvi</i>	Herb	28	<i>Cirsium wallichii</i>	Herb
12	<i>Chaerophyllum reflexum</i>	Herb	29	<i>Conyza aegyptiaca</i>	Herb
13	<i>Heracleum lanatum</i>	Herb	30	<i>Erigeron canadensis</i>	Herb
	Araliaceae		31	<i>Cousinia thomsonii</i>	Herb
14	<i>Hedera nepalensis</i>	Climber	32	<i>Dichrocephala integrifolia</i>	Herb

S. No.	Family / Botanical Name	Habit
33	<i>Erigeron bonariensis</i>	Herb
34	<i>Erigeron multiradiatus</i>	Herb
35	<i>Erigeron trilobus</i>	Herb
36	<i>Galinsoga parviflora</i>	Herb
37	<i>Inula racemosa</i>	Herb
38	<i>Saussurea costus</i>	Herb
39	<i>Jacobaea analoga</i>	Herb
40	<i>Sonchus mauritanicus</i>	Herb
41	<i>Taraxacum officinale</i>	Herb
42	<i>Youngia japonica</i>	Herb
	Balsaminaceae	
43	<i>Impatiens edgeworthii</i>	Herb
44	<i>Impatiens glandulifera</i>	Herb
	Berberidaceae	
45	<i>Berberis lycium</i>	Shrub
	Betulaceae	
46	<i>Alnus nitida</i>	Tree
47	<i>Corylus jacquemontii</i>	Tree
	Boraginaceae	
48	<i>Arnebia benthamii</i>	Herb
49	<i>Cynoglossum zeylanicum</i>	Herb
	Brassicaceae	
50	<i>Arabidopsis thaliana</i>	Herb
51	<i>Capsella bursa-pastoris</i>	Herb
52	<i>Rorippa indica</i>	Herb
	Cannabaceae	
53	<i>Celtis australis</i>	Tree
54	<i>Cannabis sativa</i>	Herb
	Caprifoliaceae	
55	<i>Lonicera angustifolia</i>	Shrub
56	<i>Sambucus wightiana</i>	Shrub
57	<i>Valeriana jatamansi</i>	Herb
	Caryophyllaceae	
58	<i>Arenaria serpyllifolia</i>	Herb
59	<i>Stellaria monosperma</i>	Herb
	Celastraceae	
60	<i>Euonymus lucidus</i>	Tree
	Convolvulaceae	
61	<i>Cuscuta reflexa</i>	Herb
	Cyperaceae	
62	<i>Carex infusata</i>	Grass
63	<i>Carex obscura</i>	Grass
64	<i>Eriophorum comosum</i>	Grass
	Dioscoreaceae	
65	<i>Dioscorea deltoidea</i>	Climber
	Elaeagnaceae	
66	<i>Elaeagnus umbellata</i>	Shrub
	Euphorbiaceae	
67	<i>Ricinus communis</i>	Shrub
68	<i>Euphorbia pilosa</i>	Herb
	Fabaceae	

S. No.	Family / Botanical Name	Habit
69	<i>Bauhinia variegata</i>	Tree
70	<i>Robinia pseudoacacia</i>	Tree
71	<i>Desmodium elegans</i>	Shrub
72	<i>Indigofera cassioides</i>	Shrub
73	<i>Spartium junceum</i>	Shrub
74	<i>Lespedeza cuneata</i>	Herb
75	<i>Oxytropis humifusa</i>	Herb
76	<i>Trifolium pratense</i>	Herb
	Geraniaceae	
77	<i>Geranium lucidum</i>	Herb
78	<i>Geranium nepalense</i>	Herb
79	<i>Geranium wallichianum</i>	Herb
	Grossulariaceae	
80	<i>Ribes glaciale</i>	Shrub
	Hippocastanaceae	
81	<i>Aesculus indica</i>	Tree
	Hydrangeaceae	
82	<i>Deutzia staminea</i>	Shrub
	Hypericaceae	
83	<i>Hypericum oblongifolium</i>	Shrub
	Iridaceae	
84	<i>Iris kashmiriana</i>	Herb
	Juglandaceae	
85	<i>Juglans regia</i>	Tree
	Lamiaceae	
86	<i>Caryopteris odorata</i>	Shrub
87	<i>Isodon rugosus</i>	Shrub
88	<i>Ajuga bracteosa</i>	Herb
89	<i>Clinopodium umbrosum</i>	Herb
90	<i>Elsholtzia ciliata</i>	Herb
91	<i>Lamium album</i>	Herb
92	<i>Nepeta laevigata</i>	Herb
93	<i>Origanum vulgare</i>	Herb
94	<i>Prunella vulgaris</i>	Herb
95	<i>Thymus linearis</i>	Herb
	Lythraceae	
96	<i>Punica granatum</i>	Shrub
	Malvaceae	
97	<i>Grewia optiva</i>	Tree
98	<i>Malva verticillata</i>	Herb
	Meliaceae	
99	<i>Toona ciliata</i>	Tree
100	<i>Toona sinensis</i>	Tree
	Moraceae	
101	<i>Ficus Palmata</i>	Tree
102	<i>Morus serrata</i>	Tree
	Nitrariaceae	
103	<i>Peganum harmala</i>	Herb
	Oleaceae	
104	<i>Fraxinus excelsior</i>	Tree
105	<i>Chrysojasminum humile</i>	Shrub

S. No.	Family / Botanical Name	Habit
	Oxalidaceae	
106	<i>Oxalis corniculata</i>	Herb
	Papaveraceae	
107	<i>Argemone mexicana</i>	Herb
108	<i>Corydalis crassifolia</i>	Herb
	Plantaginaceae	
109	<i>Digitalis purpurea</i>	Herb
110	<i>Lindenbergia grandiflora</i>	Herb
111	<i>Plantago lacustris</i>	Herb
112	<i>Plantago major</i>	Herb
	Platanaceae	
113	<i>Platanus orientalis</i>	Tree
	Poaceae	
114	<i>Agrostis pilosula</i>	Grass
115	<i>Apluda mutica</i>	Grass
116	<i>Aristida depressa</i>	Grass
117	<i>Arundo donax</i>	Grass
118	<i>Chrysopogon fulvus</i>	Grass
119	<i>Eragrostis pilosa</i>	Grass
120	<i>Festuca kashmiriana</i>	Grass
121	<i>Poa annua</i>	Grass
122	<i>Poa himalayana</i>	Grass
123	<i>Poa stapfiana</i>	Grass
	Polygonaceae	
124	<i>Polygonum molle</i>	Herb
125	<i>Fagopyrum acutatum</i>	Herb
126	<i>Oxyria digyna</i>	Herb
127	<i>Persicaria nepalensis</i>	Herb
128	<i>Rumex hastatus</i>	Herb
129	<i>Rumex nepalensis</i>	Herb
	Primulaceae	
130	<i>Myrsine africana</i>	Shrub
131	<i>Primula denticulata</i>	Herb
	Ranunculaceae	
132	<i>Caltha palustris</i>	Herb
133	<i>Delphinium denudatum</i>	Herb
134	<i>Ranunculus arvensis</i>	Herb
135	<i>Thalictrum elegans</i>	Herb
136	<i>Clematis montana</i>	Climber
	Rhamnaceae	
137	<i>Rhamnus virgatus</i>	Shrub
	Rosaceae	
138	<i>Malus baccata</i>	Tree
139	<i>Prunus armeniaca</i>	Tree
140	<i>Prunus padus</i>	Tree
141	<i>Pyrus pashia</i>	Tree
142	<i>Sorbus cuspidata</i>	Tree
143	<i>Cotoneaster microphyllus</i>	Shrub
144	<i>Crataegus oxyacantha</i>	Shrub

S. No.	Family / Botanical Name	Habit
145	<i>Prinsepia utilis</i>	Shrub
146	<i>Pyracantha crenulata</i>	Shrub
147	<i>Rosa macrophylla</i>	Shrub
148	<i>Rosa moschata</i>	Shrub
149	<i>Rosa webbiana</i>	Shrub
150	<i>Rubus foliosus</i>	Shrub
151	<i>Rubus macilentus</i>	Shrub
152	<i>Rubus niveus</i>	Shrub
153	<i>Sorbaria tomentosa</i>	Shrub
154	<i>Spiraea canescens</i>	Shrub
155	<i>Potentilla indica</i>	Herb
156	<i>Fragaria vesca</i>	Herb
157	<i>Rosa brunonii</i>	Climber
	Rubiaceae	
158	<i>Leptodermis lanceolata</i>	Shrub
159	<i>Rubia cordifolia</i>	Climber
	Rutaceae	
160	<i>Skimmia laureola</i>	Shrub
	Salicaceae	
161	<i>Populus ciliata</i>	Tree
162	<i>Salix alba</i>	Tree
163	<i>Salix tetrasperma</i>	Tree
	Saxifragaceae	
164	<i>Bergenia ciliata</i>	Herb
165	<i>Saxifraga saginoides</i>	Herb
	Scrophulariaceae	
166	<i>Buddleja asiatica</i>	Shrub
167	<i>Verbascum thapsus</i>	Herb
	Simaroubaceae	
168	<i>Ailanthus excelsa</i>	Tree
	Ulmaceae	
169	<i>Ulmus wallichiana</i>	Tree
	Urticaceae	
170	<i>Boehmeria macrophylla</i>	Shrub
171	<i>Girardinia diversifolia</i>	Shrub
172	<i>Pouzolzia zeylanica</i>	Herb
173	<i>Urtica dioica</i>	Herb
	Vitaceae	
174	<i>Parthenocissus semicordata</i>	Climber

ii. Gymnosperms

Gymnosperms in the area are represented by 8 species belonging to 3 families and 7 genera. A list of gymnosperms recorded from the study area is given in **Table 10.27**.

Table 10.27: List of Gymnosperms recorded from the study area

S. No.	Family	Scientific Name
1	Cupressaceae	<i>Cupressus sempervirens</i>
2	Cupressaceae	<i>Juniperus communis</i>
3	Ephedraceae	<i>Ephedra vulgaris</i>
4	Ephedraceae	<i>Ephedra gerardiana</i>
5	Pinaceae	<i>Abies pindrow</i>
6	Pinaceae	<i>Cedrus deodara</i>
7	Pinaceae	<i>Picea smithiana</i>
8	Pinaceae	<i>Pinus wallichiana</i>

iii. Lower Plants (Pteridophytes and Bryophytes)

In the study area presence of pteridophytes and bryophytes was observed along the streams and moist and wet places. The Pteridophyte group is represented by 3 species belonging to 3 genera and 2 families. *Athyrium foliolosum*, *Pteris cretica* and *Pteridium aquilinum* are dominant pteridophyte species in the area. Bryophytes in the study area are represented by 2 species belonging to 2 families. *Funaria hygrometrica* and *Marchantia paleacea* are commonly found bryophytes in the study area. The list of Pteridophytes and Bryophytes recorded from the study area are list below in **Table 10.28**.

Table 10.28: List of lower plants recorded from the study area

S. No.	Family	Name of Species
Pteridophytes		
1	Athyriaceae	<i>Athyrium foliolosum</i>
2	Pteridaceae	<i>Pteris cretica</i>
3	Pteridaceae	<i>Pteris aquilinum</i>
Bryophytes		
1	Funariaceae	<i>Funaria hygrometrica</i>
2	Marchantiaceae	<i>Marchantia paleacea</i>

iv. Lichens

During field survey four genus of Liches were recorded from the study area. List of Lichen recorded are given below in **Table 10.29**.

Table 10.29: List of lichens recorded from the study area

S. No.	Family	Scientific Name
1	Physciaceae	<i>Anaptychia sp.</i>
2	Cladoniaceae	<i>Cladonia sp.</i>
3	Parmeliaceae	<i>Flavoparmelia sp.</i>
4	Parmeliaceae	<i>Usnea sp.</i>
5	Teloschistaceae	<i>Xanthoria sp.</i>

v. Rare, Endangered, and Threatened Plant Species

The conservation status (Rare, Endangered, and Threatened) of all 192 species of plants reported from the study area was assessed by consulting Red Data Book of Indian Plants and IUCN Red List of Threatened Species Version 2022-2.

As per the Red Data Book of Indian Plants published by Botanical Survey of India, *Acer caesium*, *Dioscorea deltoidea* and *Inula racemosa* are listed as Vulnerable (VU) species, while *Saussurea costus* is listed as Endangered (EN) species.

Out of 192 plant species reported from the study area, only 66 species were evaluated by IUCN ver. 2022-2. As per the IUCN Red List of Threatened Species 2022-2, *Saussurea costus* was listed under Critically Endangered (CR), *Angelica glauca* under Endangered (EN), *Ephedra gerardiana*, *Marchantia paleacea* and *Ulmus wallichiana* under Vulnerable (VU), *Sonchus mauritanicus* and *Fraxinus excelsior* were listed under Near Threatened (NT) category. The rest of the species evaluated are either Least Concern (LC) or Data Deficient (DD) category.

10.4.2.3 Faunal Elements

The fauna of the study area has been compiled with the help of sighting during field surveys, supplemented with secondary sources and information provided by local people during a field survey in the study area. For the preparation of a checklist of fauna in the study area, the Forest Working Plan of Jhelum Valley Forest Division and ZSI Publication were consulted.

i. Mammals

a. Presence of Mammals based upon Field Surveys

During field surveys only Rhesus macaque (*Macaca mulatta*) and Small Indian Mongoose (*Herpestes auropunctatus*) are the species sighted in the study area. Besides these, no other wild animal was sighted during field investigation. A list of mammals commonly reported in the area is listed in **Table 10.30**.

b. Data on mammals based upon secondary Data

The data on mammals reported from the study area was compiled from the Forest Working Plan (implanting years 2020-21 to 2030-31) of the Jhelum Valley Forest Division after consultation with forest officials and villagers. Forest officials mention the presence of Common Leopard (*Panthera pardus*), Common Langur (*Semnopithecus entellus*), Himalayan Goral (*Naemoredus goral*) and Asiatic black bear (*Ursus thibetanus*) in the proposed study area lies under Jhelum Valley Forest Division and same was confirmed by villagers in the study area. However, no direct or indirect evidence could be recorded during the field survey about their presence in and around the project area.

Based on primary data collected during field survey and supplemented with secondary data, a list of 22 species of mammals with their conservation status reportedly found in the study area was compiled and the same is given in **Table 10.30**.

Table 10.30: List of Mammalian species reportedly found in the study area

S. No.	Family/Scientific name	Common name	Conservation status	
			IUCN 2022-2	WPA 1972
	ORDER: CETARTIODACTYLA			
	Family - Cervidae			
1	<i>Muntiacus muntjak</i>	Barking Deer	LC	III
2	<i>Naemorhedus goral</i>	Himalayan Goral	NT	III

S. No.	Family/Scientific name	Common name	Conservation status	
			IUCN 2022-2	WPA 1972
	Family - Moschidae			
3	<i>Moschus leucogaster</i>	Himalayan Musk Deer	EN	I
	Family - Suidae			
4	<i>Sus scrofa</i>	Wild Boar	LC	III
	ORDER: CARNIVORA			
	Family - Felidae			
5	<i>Panthera pardus</i>	Leopard	VU	I
6	<i>Prionailurus bengalensis</i>	Leopard Cat	LC	I
7	<i>Felis chaus</i>	Jungle Cat	LC	II
	Family - Herpestidae			
8	<i>Herpestes edwardsii</i>	Grey mongoose	LC	II
9	<i>Herpestes auropunctatus</i>	Small Indian mongoose	LC	II
	Family - Canidae			
10	<i>Canis aureus</i>	Golden Jackal	LC	II
11	<i>Vulpes vulpes</i>	Red Fox	LC	II
12	<i>Vulpes bengalensis</i>	Bengal Fox	LC	II
13	<i>Cuon alpinus</i>	Wild Dog	EN	II
	Family - Ursidae			
14	<i>Ursus thibetanus</i>	Asiatic Black Bear	VU	II
	Family - Mustelidae			
15	<i>Mustela sibirica</i>	Himalayan Weasel	LC	II
16	<i>Lutra lutra</i>	Common Otter	NT	II
	ORDER: PRIMATES			
	Family - Cercopithecidae			
17	<i>Macaca mulatta</i>	Rhesus Macaque	LC	II
18	<i>Semnopithecus entellus</i>	Common Langur	LC	II
	ORDER: RODENTIA			
	Family - Hystricidae			
19	<i>Hystrix indica</i>	Indian Crested Porcupine	LC	IV
	Family - Muridae			
20	<i>Mus booduga</i>	Little Indian Field Mouse	LC	V
	Family - Sciuridae			
21	<i>Funambulus pennantii</i>	Himalayan five-striped Palm Squirrel	LC	IV
22	<i>Petaurista petaurista</i>	Red Giant Flying Squirrel	LC	

IUCN- International Union for Conservation of Nature; VU – Vulnerable; EN: Endangered; NT- Near Threatened; LC - Least Concern; WPA – Wildlife (Protection) Act, 1972

ii. Avifauna

As time constraint and accessibility plays an important role in conducting the survey, birds were sampled on the same transect and trails marked for mammals. Sampling was carried out on a fixed width trails of 2 km wherever the terrain permits.

During the field survey, a total number of 25 bird species were sighted during the field survey. A large portion of avifauna species is comprised of resident birds in the project study area. Himalayan Bulbul, Red-vented Bulbul, Russet Sparrow, Black Drongo, Black Kite, Water Redstart, Slaty-headed Parakeet and Long-tailed Shrike were the most frequently

sighted bird species in the study area. Based on the sighted birds during the field survey, an inventory of avifauna was prepared which is enlisted in **Table 10.31**.

Table 10.31: List of avifauna recorded from the study area with their conservation status

S. No.	Family	Common Name	Scientific Name	Conservation Status		Residential Status
				IUCN 2022-2	WPA 1972	
	ORDER: BUCEROTIFORMES					
1	Upupidae	Common Hoopoe	<i>Upupa epops</i>	LC	IV	SV
	ORDER: ACCIPITRIFORMES					
2	Accipitridae	Black Kite	<i>Milvus migrans</i>	LC	IV	RR
3	Accipitridea	Crested-serpent eagle	<i>Spilornis cheela</i>	LC		RR
	ORDER: COLUMBIFORMES					
4	Columbidae	Spotted Dove	<i>Spilopelia chinensis</i>	LC	IV	RR
5	Columbidae	Rock Dove	<i>Columba livia</i>	LC	IV	RR
	ORDER: PASSERIFORMES					
6	Motacillidae	White Wagtail	<i>Motacilla alba</i>	LC	IV	WV
7	Motacillidae	Grey wagtail	<i>Motacilla cinerea</i>	LC	IV	SV
8	Leiotrichidae	Jungle Babbler	<i>Argya striata</i>	LC	IV	RR
9	Passeridae	Russet Sparrow	<i>Passer cinnamomeus</i>	LC	IV	RR
10	Passeridae	House Sparrow	<i>Passer domesticus</i>	LC	IV	SV
11	Laniidae	Long-tailed Shrike	<i>Lanius schach</i>	LC	IV	SV
12	Muscicapidae	White Capped water Redstart	<i>Phoenicurus leucocephalus</i>	LC	IV	SV
13	Muscicapidae	Plumbeous water Redstart	<i>Phoenicurus fuliginosus</i>	LC	IV	RR
14	Dicruridae	Black Drongo	<i>Dicrurus macrocercus</i>	LC	IV	RR
15	Pycnonotidae	Red-vented bulbul	<i>Pycnonotus cafer</i>	LC	IV	RR
16	Pycnonotidae	Himalayan Bulbul	<i>Pycnonotus leucogenys</i>	LC	IV	RR
17	Sturnidae	Common Myna	<i>Acridotheres tristis</i>	LC	IV	RR
18	Corvidae	Yellow-billed Blue Magpie	<i>Urocissa flavirostris</i>	LC	IV	RR
19	Monarchidae	Indian Paradise-flycatcher	<i>Terpsiphone paradisi</i>	LC	IV	SV
20	Muscicapidae	Grey Bushchat	<i>Saxicola ferreus</i>	LC	IV	RR
21	Muscicapidae	Blue Whistling-thrush	<i>Myophonus caeruleus</i>	LC	IV	RR
22	Corvidae	Eurasian Jackdaw	<i>Corvus monedula</i>	LC	IV	RR
23	Corvidae	Large-billed crow	<i>Corvus macrorhynchos</i>	LC	IV	RR
24	Corvidae	House Crow	<i>Corvus splendens</i>	LC	V	RR
	ORDER: PSITTACIFORMES					
25	Psittacidae	Slaty-headed Parakeet	<i>Himalayapsitta himalayana</i>	LC	IV	RR

IUCN- International Union for Conservation of Nature; LC - Least Concern; WPA – Wildlife (Protection) Act, 1972.; R: Resident; SV: Summer Visitor; PV: Passage Visitor

iii. Herpetofauna

The herpetofauna were sampled on the same transect marked for mammals. The sampling also carried along riverbanks and the sampling was repeated during evening time following the time constrained Visual Encounter Rates (VES) method. During the survey, Garden lizard (*Calotes versicolor*), Kashmir Rock Agamid (*Laudakia tuberculata*), and Skinks (*Asymblepharus ladacensis*) were commonly sighted species in the area. Common Rat Snake (*Ptyas mucosa*) and Himalayan Pit Viper (*Gloydius himalayanus*) are also reported in the Working Plan of Jhelum Valley Forest Division.

iv. **Butterflies**

Based on monsoon, winter and pre-monsoon season field survey, an inventory of butterflies was prepared which is enlisted in **Table 10.32**. The butterflies belong to families Lycaenidae, Nymphalidae and Pieridae family represents maximum species of butterfly in the proposed project area.

Table 10.32: Butterflies recorded from Study Area

S. No.	Family	Scientific name	Common name
1	Lycaenidae	Lycaena phlaeas	Small Copper
2	Nymphalidae	Aglaia cachmirensis	Indian Tortoiseshell
3	Nymphalidae	Vanessa cardui	Painted Lady
4	Pieridae	Pieris canidia indica	Indian Cabbage White
5	Pieridae	Colias fieldii	Clouded Yellow
6	Pieridae	Euchloe daphalis	Pearl white

IUCN Ver 2022-2; LC: Least Concern'; NA: Not Assessed

v. **Conservation Status of Fauna**

Himalayan Musk Deer (*Moschus leucogaster*) is the species listed under the Endangered (EN) category of the IUCN Red List of Threatened Species Version 2022-2. Common Leopard (*Panthera pardus*) and Asiatic Black Bear (*Ursus thibetanus*) are listed under Vulnerable (VU) category. Himalayan Goral (*Naemorhedus goral*) and Common Otter (*Lutra lutra*) are the species listed under the Near Threatened (NT) category of IUCN (**Table 10.30**). The remaining species are listed under Least Concerned (LC) category.

As per Wildlife Protection Amendment Act, 2022, Common Leopard (*Panthera pardus*), Himalayan Musk Deer (*Moschus leucogaster*), Himalayan Goral (*Naemorhedus goral*), Jungle Cat (*Felis chaus*), Leopard Cat (*Prionailurus bengalensis*), Grey mongoose (*Herpestes edwardsii*), Small Indian mongoose (*Herpestes auropunctatus*), Golden Jackal (*Canis aureus*), Red Fox (*Vulpes vulpes*), Bengal Fox (*Vulpes bengalensis*), *Cuon alpinus* (Wild Dog), Asiatic Black Bear (*Ursus thibetanus*), Himalayan Weasel (*Mustela sibirica*), Common Otter (*Lutra lutra*), Red Giant Flying Squirrel (*Petaurista petaurista*) and Indian Crested Porcupine (*Hystrix indica*) are the mammalian species listed as Schedule I species (**Table 10.30**). All other species are either listed under Schedule II or not included in any schedule of IWP Amendment Act, 2022.

All the avifaunal species sighted from the study area fall under Least Concern (LC) category as per IUCN 2022-2. As per Wildlife Protection Amendment Act, 2022, Crested-serpent eagle (*Spilornis cheela*) is under schedule-I. Rest of the avifaunal species recorded from the area are listed as Schedule II except House crow and Rock dove which are not listed under any schedule of Wildlife Protection Amendment Act, 2022.

10.4.3 Protected Areas

No project component falls in any notified protected area or notified ESZs of protected area. Nearest Protected Area to from Uri-I Stage-II HE Project are Kazinag National Park, Lachipora Wildlife Sanctuary and Limber Wildlife Sanctuary. The location of all protected areas with respect to project components are shown in **Figure 10.8**. Also, no area around the project has been designated as the wildlife corridor around the project area.

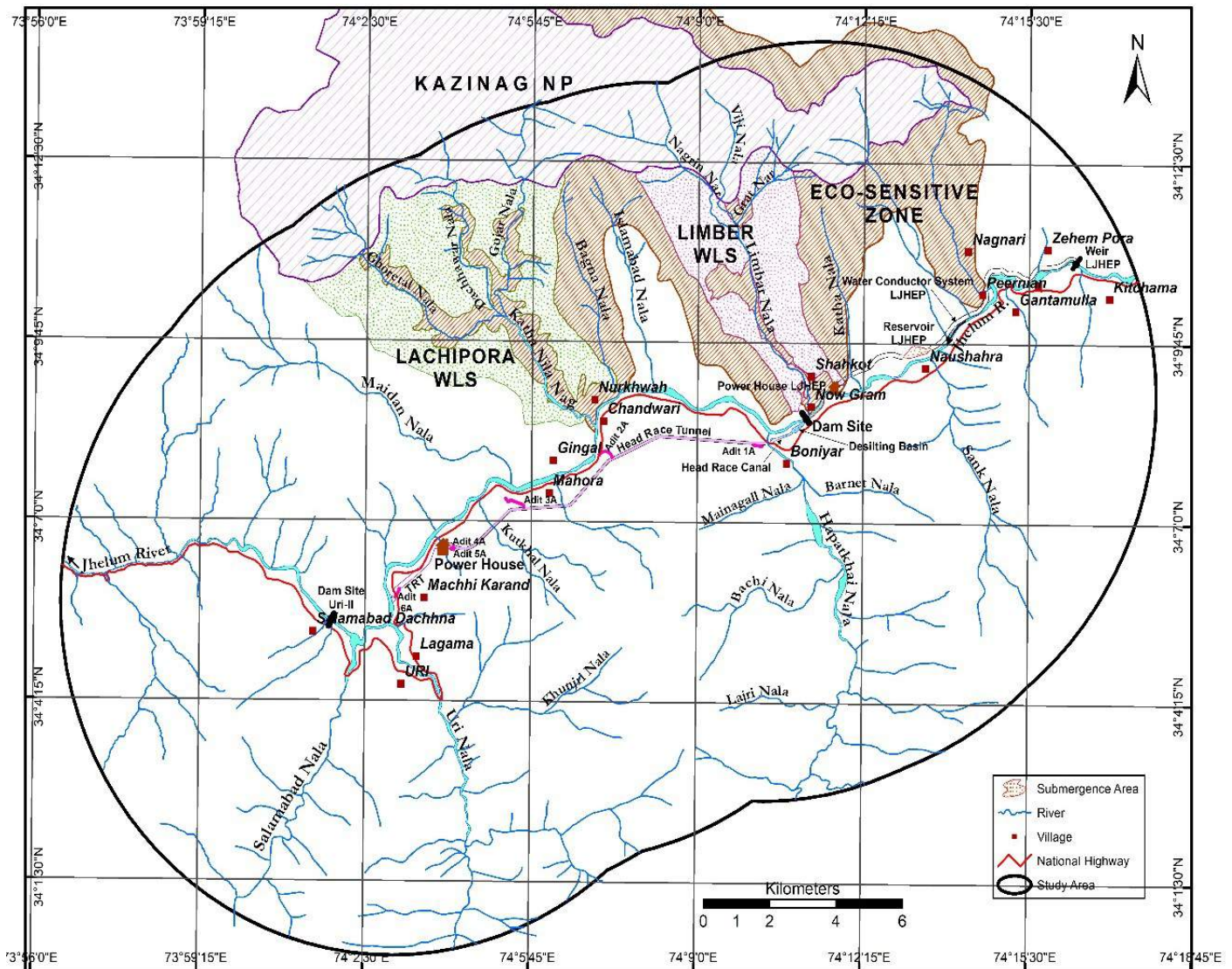


Figure 10.8: Map Showing distance of project components from Protected Area

10.4.4 Threats to Biodiversity & Wildlife

Habitat loss due to change of land use and use of heavy machinery for construction activities will affect biodiversity in the study area. Such activities might lead to increased disturbance to wildlife in the area, man-animal conflict, introduction of exotic weedy plant species into the adjacent forested area. Major threats to biodiversity and wildlife in the project area are as follows.

10.4.4.1 Threat Due to Project Activities

a) Project Construction Phase Impact

i) Impact of Flora

For the proposed scheme, no tree felling or clearing of vegetation cover will be undertaken. Only 17.0 ha underground forest land will be diverted for the underground construction work of the project components. Therefore, there is no impact on floral diversity and faunal diversity due to land acquisition.

The direct impact of construction activity will be limited in the vicinity of the construction

sites. As mentioned earlier, a large population of 500 including technical staff, workers, and other groups of people are likely to congregate in the area during the peak project construction phase. It can be assumed that the technical staff will be of higher economic status and will live in a more urbanized habitat, and will not use wood as fuel if adequate alternate sources of fuel are provided. However, workers and other population groups residing in the area may use fuelwood, if no alternate fuel is provided. Hence, to minimize such impacts, it is proposed to provide alternate fuel for cooking e.g. LPG/ kerosene to the construction workers. The other alternative is to provide community kitchens on a cooperative basis by the contractor. The details of the same have been covered in Environmental Management Plan.

Other major impacts on the flora in and around the project area due increased level of human interference i.e. the workers may also cut trees to meet their requirements for the construction of houses, furniture, and space heating. Normally in such situations, a lot of indiscriminate use or wastage of wood is also observed, especially in remote or inaccessible areas. Thus, it is necessary to provide alternative fuel, training and awareness; and implement adequate surveillance to mitigate the adverse impacts on terrestrial flora during the project construction phase.

ii) Disturbance to Wildlife

During the construction period, a large number of machinery and construction workers shall be mobilized, which may create disturbance to the wildlife population in the vicinity of the project area. During the EIA studies no major wildlife species has been reported from the project area. The operation of various equipment will generate significant noise; noise and vibration will also increase during blasting which will affect the fauna of the area. The noise may scare the fauna and force them to migrate to other areas, however, it will be temporary and last during the construction phase. Likewise, siting of construction plants, workshops, stores, labour camps, etc. could also lead to adverse impacts on the fauna of the area. During the construction phase, accessibility to the area will lead to an influx of workers and the people associated with the allied activities from outside will also increase. An increase in human interference will have an impact on the terrestrial ecosystem.

The impact of blasting needs to be mitigated by adopting controlled blasting and a strict surveillance regime and the same is proposed to be used in the project. This will reduce the noise level and vibrations due to blasting to a great extent.

Forest cover in the vicinity of the proposed project work sites and their immediate vicinity is comprised of coniferous forest associated with broad-leaved forest. 22 species of mammals and 25 species of avifauna have been compiled from the study area, as discussed in the Environmental Baseline chapter. Therefore, adequate measures will be required during the construction phase not to cause any adverse impact on the terrestrial and avifaunal population.

Thus, it is necessary to formulate a conservation and management plan to mitigate the adverse impacts on terrestrial flora during the project construction phase.

b) Operation Phase Impacts

On completion of the construction of the project, the land used for construction activities will be restored. Construction workers who have resided in that area will move to another project site. By ensuring all the mitigation and management measures, as planned for this project, are implemented to minimize the impact of the construction phase, a large part of the area will return to more or less its original form. Operation phase impacts on flora and fauna will be positive due to muck disposal area, green belt development, implementation of Biodiversity Management and Wildlife Conservation Plan, etc. The increase of greenery and increased moisture due to the creation of the reservoir will have a positive impact on avifauna diversity.

10.4.4.2 Human Wildlife Conflict:

Deforestation, growing human settlements, expansion of agricultural land and fragmentation of natural habitat and grazing ground of species like Wild Boar are the causes behind rising of human wildlife conflict. In the study area human-wildlife conflict in terms of crop damage is perhaps more common and causes huge loss to the farmers.

10.4.4.3 Hunting and Poaching

Damage of crops by species like Monkey, Langur, Wild Boar, etc. and loss of livestock Common Leopard and Black Bear results as hunting and killing of these wild animals by means of setting up of trap, poisoning or with the help of hunters.

10.4.4.4 Illegal cutting of trees

The area well known for conifer forest. There is huge demand of conifer wood for furniture. The excessive felling for domestic as well as for commercial purpose of conifer trees is illegal. Also, the stakeholders from the study area depends upon forest for their day to day need of fodder, fuelwood, and other non-Timber Forest products (NTFP) as well as timber wood needs. This results in tremendous pressure on the forests.

10.4.4.5 Grazing Pressure

The grassland and scrub land in the area is under heavy grazing pressure by the livestock and is susceptible to damage by livestock. Also, the altitude grassland in the area provide habitat and feeding ground to ungulates and antelopes like Musk Deer, Himalayan Goral, Barking Deer, etc. The over grazing and encroachment in the area and change in land use cause degradation of wildlife habitat.

10.4.5 Biodiversity Conservation And Wildlife Management Plan

10.4.5.1 Objectives of Management

Keeping in view of the anticipated impacts as per the foregoing chapters, the management objectives can be described as:

- i. Maintenance of ecological balance through preservation and restoration, wherever it has been disturbed due to project developmental activities,
- ii. Conservation and preservation of natural habitats in project surrounding
- iii. Mitigation and control of project induced biotic and/or abiotic pressures/ influences that may affect the natural habitats,

- iv. Habitat enhancement in project area by taking up afforestation and soil conservation measures,
- v. Creating all round awareness regarding conservation and ensuring people's participation in the conservation efforts and minimizing human wildlife conflict.

10.4.5.2 Mitigation Measures

The following management strategies including shall be implemented by forest department in the impact area of proposed project.

- i. Habitat Improvement of Schedule-I species through conservation and preservation of natural habitats in project surrounding
- ii. Infra-structure development
- iii. Anti-Poaching measures
- iv. Training Programme for Techniques of faunal species Rescue
- v. Prevention of Forest Fire
- vi. Creating all round awareness regarding conservation and ensuring people's participation in the conservation efforts and minimizing human wildlife conflict.

10.4.5.3 Conservation and Management Measures

Wildlife conservation is the preservation and protection of animals, plants, and their habitats. The most effective way of biodiversity management and wildlife conservation in the area are habitat management through habitat enhancement, preservation and improvement, conducting conservation programmes and creation of environmental awareness involving local people, and strict enforcement of wildlife protection laws.

A. Wildlife Habitat Preservation & Improvement

i. Afforestation and Enrichment plantation

Afforestation and enrichment plantation will be carried out in the area. Area under forest and tree cover will be expanded through systematic planning and implementation of afforestation and rehabilitation programme on available community lands. Afforestation programme in the degraded Forest Compartments is also proposed to be carried out in the surrounding to the project area. The sites and species to be planted will be finalized by the State Forest Department as the program will be implemented by them.

Plantation site will be trench fenced and brushwood fence, for the protected from cattle grazing. With the improvement in habitat of wildlife the incidences of human wildlife conflict will accordingly reduce. The estimate cost for plantation over about 25 ha degraded forest land in the surrounding of Project area has been worked @ Rs. 80,000 per ha for Enrichment plantation. The enrichment plantation will be carried in the adjoining forest area along the periphery of reservoir and intermediate area between barrage and powerhouse. As such, no additional forest land will be diverted for this purpose.

ii. Farm Forestry

The villagers for fuel and fodder to adjacent forest area. The project area harbours number of economically important plants like *Aesculus indica*, *Bauhinia variegata*, *Juglans regia* and *Pyrus pashia*, etc. These valuable resources will be directly useful to the people of the area.

With a view to reduce dependence on the natural forests for biomass and other non-timber forest products (NTFPs) or minor forest produce (MFP) alternate resources need to be building up. NTFPs/MFP plantations will be carried out on the community land, degraded land, fallow lands which help in sustainable land management and also a tool for reclamation.

Under this scheme Seedlings will be distributed every year to villagers on a nominal rate. Villages in the surrounding of project area has been given preference. The distribution will be facilitated through Forest Range office in the area. Forest department may take up prior survey with the help of local administrative bodies/panchayats to assess the requirement plants.

A budgetary estimate of **Rs. 5.00 lakh** has been made for development of farm forestry in the project area.

B. Development of Pastureland

As there are degraded patches of pasture in the area, this measure will be adopted to encourage development of new and healthy pastures for use of cattle of the area. Barren land with greater slopes has been recommended to be treated by developing pastures over them. Under this treatment, suitable species of grasses and leguminous plant species be planted in the land area earmarked for the purpose. A provision of Rs. 12,00,000/- (@ Rs. 60,000/ha) for development of pastureland over 20 ha degraded scrubland and grassland has been kept under this plan.

C. Awareness Programme

The success of any conservation plan of this magnitude is entirely hinged on the active support and wholehearted co-operation of all stakeholders with the members of public playing a major role. For this purpose, meetings and workshops will be organized from village to village on regular basis. Functions like Van Mahotsav, Wildlife Week, World Forestry Day, and World Environment Day will be organized in a befitting manner to which village heads, members of public representatives' system at Gram Panchayat level, local leaders and members of NGO will be involved. The topics should include deterioration of biodiversity, habitat loss, control of Blue Bull and Wild Boar damages and other human wildlife conflicts, fire damage control and how best the vegetation can be revamped etc. Members of public will be encouraged to speak. Student community should also be sensitized on various conservation issues.

Considering that the wildlife populations will be impacted by project construction activities and also due to influx of migrant labour force, mitigation measures should also be taken for the larger area. The following measures are proposed:

- Control on poaching.
- Awareness campaigns aimed at creating awareness towards respecting the habitat protection in general and the protection of wildlife species in particular.

Under this programme, various activities viz. training, publishing of pamphlets, brochures, hoardings, etc. shall be carried out during the construction phase of the project. The following activities are planned under this programme:

Observance of Wildlife Week: The wildlife week will be celebrated every year in the month of March to assess all the tasks set aside for wildlife management. Under this programme, seminars, art competitions and awareness campaigns will be held.

Nature Club: Nature clubs will be introduced at Higher secondary and High school level in the project area. They will be imparted education by means of audio-visual aids so as to sensitize them about importance of wildlife conservation.

Involvement of Village Panchayats and NGOs: The Panchayats of affected villages and active NGOs in the project area would be involved to disseminate the knowledge about the benefits of the proposed project and ensuring greater participation in the conservation efforts and safeguard the environment of the area.

For implementation of awareness programme an amount of **Rs. 1.00 lakh/year** for four year has been budgeted.

d. Strengthening of Infrastructural Facilities of Forest Department

Under this plan Project authority would assist the State Forest Department in strengthening the infrastructure facilities, which are poorly developed in the area. Various activities which are necessary for the forest protection plan are described in the following paragraphs.

- i) For improvement of vigilance and measures to check poaching, check posts and watch towers will be needed. In order to strengthen the working capacity, the workforce of the State Forest/Wildlife Department they must be provided with necessary equipment such as a camera, wireless, binoculars GPS, search lights, health kits, etc. that would increase their capability and efficiency of monitoring.
- ii) The construction of inspection paths and watch towers for more effective and meaningful patrolling by the department.
- iv) Creation of veterinary facilities and rescue camps for healthcare of wild animals and for disease control. For this purpose, it is essential to maintain a stock of medicines in addition to setting up of a *mobile-rescue-cum-rehabilitation-van*.

Project authorities would provide funds to State Forest Department. Total financial outlay under this head would be **Rs. 25.00 lakh**.

e. Budget

Total budget for the Biodiversity Management & Wildlife Conservation Plan would be **Rs. 66.00 lakh**. The breakup of the budget is given at **Table 10.33** below.

Table 10.33: Budget for Biodiversity Management & Wildlife Conservation Plan

S. No.	Particulars	Total Amount (Rs. in lakh)
1	Afforestation and Enrichment along the adjoining forest area (@ Rs. 80,000/ha for 25 ha)	20.00
2	Farm forestry for fuelwood and timber	5.00
3	Development of Pastureland	12.00
5	Awareness Programme @ Rs. 1 lakh/year for 4 years	4.00
6	Strengthening of Infrastructural Facilities of Forest Department	25.00
	Total	66.00

10.4.6 Conservation And Management Of Schedule-I Species

The development activities often present a threat to biodiversity in the area like habitat destruction, degradation, fragmentation through overexploitation, poaching, hunting, pollution, etc. Therefore, developmental projects are required to maintain ecological integrity to ensure biodiversity conservation and sustainable development together. The impacts need be mitigated or minimized substantially through well drafted conservation management plan. The Indian Wildlife (Protection) Act, 1972 mandates protection of plants and animal species by way of listing them under different schedules to provide them varying degrees of protection. Schedule I and part II of Schedule II provide absolute protection and offences under these are prescribed the highest penalties. Key strategies required for any biodiversity management plan are *in situ* strategy, *ex situ* strategy, reduction of anthropogenic pressure and rehabilitation of endangered species.

10.4.6.1 Schedule-I Species reported From Study Area

The faunal species reported from the study area have been discussed in section 10.4.2. According to it Common Leopard (*Panthera pardus*), Himalayan Musk Deer (*Moschus leucogaster*), and Mainland Leopard Cat (*Prionailurus bengalensis*) are the Schedule-I species as per Indian Wildlife (Protection) Act, 1972 reported from the study area.

10.4.6.2 Conversation Measures for Schedule-I Species

A. Leopard (*Panthera pardus*)

Apart from Asiatic lion, Bengal tiger, Snow leopard and Clouded leopard, the Indian Leopard (*Panthera pardus*) is one of the big cats found in India. The Indian Leopard (*Panthera pardus*) is widely distributed in the Indian subcontinent. They inhabit tropical rain forests, dry deciduous forests, temperate forests, and northern coniferous forests.

The leopard is classified as Vulnerable (VU) on the IUCN Red List of Threatened Species Ver. 2022-2 (<https://www.iucnredlist.org/species/15954/163991139>). *Panthera pardus* is listed in CITES Appendix I.

Threats

- a. **Habitat Threats:** Loss of natural habitat is a major threat to leopard. Habitat fragmentation reduced prey base and conflict with livestock have reduced Leopard populations throughout most of their range (<https://www.iucnredlist.org/species/15954/163991139>). Habitat degradation outside the protected area, caused by overgrazing, overharvest of forest products, expansion of agricultural areas, and mining of minerals also possess threats to the habitat of species.
- b. **Human - Leopard Conflicts:** Many wildlife biologists have studied the human leopard conflict in India like Athreya et. al. (2007), Chellam (2010), Aggarwal et. al. (2011), Mathur (2014), Chauksey et. al. (2017), Kshetry et. al. (2017), Naha et. al. (2018), and Athreya et. al. (2020). These studies have listed number of factors responsible these conflicts. Some of them are the expansion of agriculturally used land, encroachment of humans and their livestock into protected areas are main factors contributing to habitat loss and decrease of wild prey. As a result, Leopard's approach human settlements,

where they are tempted to prey on domestic livestock like cattle, dogs, and goats, which constitutes an important part of their diet, if they live on the periphery of human habitations. Human-leopard conflict situations ensue and have increased in recent years. In retaliation for attacks on livestock, leopards are shot, poisoned, and trapped in brutal snares. Leopard-human conflict is a serious problem in India and the subcontinent and is another cause of significant mortality of Leopards. India's Forest Department is entitled to set up traps only in cases of a leopard having attacked humans. According to Chellam (2010) several cases of leopard attack have been reported in Maharashtra and Madhya Pradesh and human leopard conflict is a well-known problem in and around protected as well as unprotected areas in India (Chauksey *et al.*, 2017).

- c. **Poaching:** A significant immediate threat to wild leopard populations is the illegal trade in poached skins and body parts. Illegal trade in Leopard body parts (skin, bones, and claws) continues to threaten the survival of the species in the wild.

B. Mainland Leopard Cat (*Prionailurus bengalensis*)

The Mainland Leopard Cat (*Prionailurus bengalensis*) is amongst the smallest of Southeast Asia's wild cats. This species is highly adaptable, occurring in a wide range of habitats including various types of primary forest, secondary habitats including cultivated areas, and plantations. Its diet is highly varied and includes large insects, and small vertebrates such as lizards and reportedly amphibians.

The Mainland Leopard Cat is classified as Least Concern (LC) by IUCN Red List of Threatened Species Ver. 2022-2 (<https://www.iucnredlist.org/species/223138747/223178117>) and listed under Appendix II of CITES.

Threats

Deforestation is potentially an important driver of habitat deterioration and may be a localised threat to Mainland Leopard Cat survival in certain areas. Other potential threats to Mainland Leopard Cat vary across its geographic range are hunting and snaring occur in most parts of Mainland Leopard Cat's range and is particularly intense in South-east Asia (Gray et al. 2018, Harrison et al. 2016, Willcox et al. 2014).

Misidentifications (as, for example mistaking the species as Leopard *Panthera pardus* or Fishing Cat leading to lethal anthropogenic responses are common in countries like India, Bangladesh and Nepal. These perspectives instil fear, resulting in stern retaliatory anthropogenic responses. Road kills in and around forests is another visible potential issue for the Mainland Leopard Cat in some areas.

C. Himalayan Musk Deer (*Moschus leucogaster*)

The Himalayan Musk Deer (*Moschus leucogaster*) distribution includes a large portion of northern India (including Sikkim), Bhutan, Nepal, Pakistan, Afghanistan, and China (southwest Xizang). This species inhabits high alpine environments, observed at lowest altitude of 2,500 m by Groves et al. (1995). It is found on barren plateaus at high altitudes, where it occupies meadows, fell-fields, shrublands or fir forests. It feeds mainly on grasses, shrubs, leaves, moss, lichens, shoots, and twigs (Green 1987). It is generally solitary and crepuscular (Harris and Cai 1993).

Himalayan musk deer mate between November and January. The gestation period is 185 to 195 days. One to two young are typically born between May and June and nurse from their mother for about 2 months.

Threats

Population growth has forced the people of Himalayan region to exploit forest resource to fulfill their forest basic needs such as fuel wood, timber, fodder. An unsustainable harvesting practices in Himalaya region lead to the subalpine and alpine vegetation in degradable condition (Echolm, 1975). These activities have urged the degradation of wildlife habitat which ultimately contribute in the reduction of musk deer population. In addition, owing to socio-economic and political conditions, musk deer population aren't being afforded safe sanctuary even in remote areas because of poaching and hunting for their live hood subsistence (Jackson, 1979).

Habitat destruction, due to increasing human and livestock populations limited the distribution of musk deer to smaller and fragmented area. As result, the population of musk deer has reduced considerably. The habitats of musk deer in the subalpine region of the Himalayas are increasingly used for harvesting firewood and as pasture land. Besides, this causes the loss of the understorey of vegetation which is of particular importance to musk deer for food and shelter against predators. In addition, fire and other anthropogenic activities also altered the potential musk deer habitat into vulnerable condition.

Musk deer is killed for the collection of natural musk which is found in the musk gland of mature males near the umbilicus. During illegal killing for every mature male, 4 – 5 females and juveniles are killed which have no musk or very small amount of musk. This activity results in the rapid decline of population of musk deer.

10.4.7 Conservation Measures

a. Panthera pardus (Leopard) & Prionailurus bengalensis (The Mainland Leopard Cat)

Habitat improvement: Leopards live in a variety of dry and wet forests, and in some grasslands, where boulders and scattered shrubs and trees provide shelter. The Leopard has the widest habitat tolerance than any big cat in India. Habitat of the species will be improved by planting suitable species in surrounding areas. The prey species preferred by leopard will be conserved to ensure sufficient prey availability, which will also reduce the conflict with humans. The prey species preferred by leopard will be conserved to ensure sufficient prey availability which will also reduce the conflicts with humans.

In addition to conservation of Sloth Bear habitat, restoration of habitat through community-based forestry activities needs to be implemented. Community-based forestry programs could significantly expand habitat for sloth bears. The benefits of this community-based approach to maintaining ecosystem integrity thus extends well beyond sloth Bear.

Biological Fences: Conflicts generally arises when leopard or Sloth Bear enters in human settlements, which indirectly reflect the condition of adjacent forested areas, i.e. its ability to support Leopard and Sloth Bear habitat. Protective Fencing to Protect Livestock:

Biological fences will be used to protect the livestock from the leopard attack.

Strict Protection Measures: The Wildlife (Protection) Act of 1972 provides us with the statutory framework for wildlife conservation, and Poaching is a crime against wildlife. During interview and discussion with local people it was noted that study area is not prone to poaching or any other wildlife violence related to leopard. But precaution will be always taken while dealing with wildlife. The contact information of concern wildlife and forest department will be provided to every worker or at the field office. If any kind of poaching or other offense is noticed; it will be immediately clued-up to the concern Forest and Wildlife Officials. More importantly, worker will make aware of wildlife crime and subsequent penalties and punishment.

b. Himalayan Musk Deer (*Moschus leucogaster*)

- I. Habitat Conservation by initiation of landscape conservation
- II. Controlled and restrict the grazing on area identified as Muck Deer feeding ground.
- III. Strengthening of patrolling to restrict hunting and poaching
- IV. Control excessive exploitation of forest resource collection.
- V. Awareness among the society about the ecological importance of Himalayan Muck Deer.

c. Public Awareness Programme

Involvement of local people in conservation activities will be ensured by organizing meetings and seminars from village to village on regular basis to carry the people along with implementation. The support of village heads and other members of gram panchayat, local leaders and members of regional NGO would be solicited to execute the proposed awareness and habitat improvement programmes. Functions like wildlife week, world forestry day, *Van Mahotsav* and world environment day will be organized. The discussion may evolve around habitat loss, human- wildlife conflicts and how best the vegetation can be revamped etc.

Moreover, a training workshop for all workers will be conducted in starting of any project. It will include the formal training on the importance of biodiversity and to make available the information of the flora and fauna of high conservation value present in the area. Information on Wildlife policies and Government regulation and penalties will be provided to workers. Similar kinds of activities will be done from time to time to enhance the interest of villagers and workers in the conservation.

10.4.8 Management Measures

In view of the above, various Management and Conservation measures like Habitat improvement, development of Biological Fences using suitable plant species, enforcement of Strict Protection Measures, Public Awareness Programme involving villagers and forest officials for protection and conservation of various species, Anti-Poaching measures, Construction and filling of water holes and check dams/Ponds, tube wells etc, Support/Provision of veterinary care, cages, rescue centers, etc., Infra-structure development (Surveillance Equipment's like Cameras, Wireless Sets, GPS etc), Training Programme for Rescue Techniques of faunal species, Prevention of Forest Fire activities like Training and Infrastructure facilities etc., have been proposed.

10.4.8.1 Veterinary care

Following provision has been made for ensure the veterinary care of wildlife in the protected area.

- i. Strengthen of veterinary facilities and rescue centres for healthcare of wild animals and for disease control.
- ii. Provision of 02 mobile-rescue-cum-rehabilitation-van with financial provision of **Rs. 20.00 lakh**.
- iii. For Maintenance of mobile-rescue-cum-rehabilitation-van and medical supplies provision of **Rs. 4.00 lakh/ year** for 4 years has been proposed under this plan.
- iv. Training programme shall be organised for upgradation of knowledge and techniques of faunal species rescue and veterinary care. A total budget of **Rs. 5.00** has been proposed for training programme.

10.4.8.2 Prevention of Forest Fire

The deciduous vegetation and pastureland in the area are prone to fire. Forest fire is caused both naturally as well as by the human beings. Anthropogenic causes will be minimized through forming a fire line around the forest area. The following measures are therefore proposed to be taken to prevent forest fire:

- i. **Fire Fighting Equipments:** These Fire watchers will also be equipped with certain Fire Fighting Equipments such as Fire resistance dress, Water bottle, Axe, Shoes etc. to attend to emergencies. Therefore, financial provision has been made for fire-fighting equipments.
- ii. **Clearing of Fire Line:** Fireline will be cleared over a vulnerable area.
- iii. **Training & Awareness:** Financial provision to organise firefighting training for forest officials and villagers residing around project area has been made under this Plan.

10.4.8.3 Maintenance of Drinking Water Sources in Wildlife Habitat

To avoid interference with human habitation it is necessary to maintain the drinking water sources of wildlife in their habitat. For easy accessibility of drinking water for wildlife within the forest area provision of maintenance of natural drinking water sources has been made. Fund has been allocated for maintenance of existing springs, waterholes/ ponds in the forest area. A total of **Rs. 10.00 lakh** has been allocated under this scheme.

10.4.8.4 Training to Volunteers/ Local Youth

In addition to activities like management and conservation of habitat and provision of veterinary care for faunal species in the area, training programme has been organized regarding the rescue techniques of faunal species for interested volunteers/ local youth, Government officials other than forest department by State Forest Department with the help of recognized organizations, wildlife professionals and NGO's. A lump sum budget of **Rs. 5.00 lakh** has been kept for Wildlife rescue training to volunteers.

10.4.8.5 Safeguards during construction phase

During the construction phase, various adverse impacts on the forest and wildlife are anticipated in the surrounding areas of the proposed project in terms of increased noise

levels, release of air and water pollutants, etc. To avoid and minimize the negative impacts of these activities, project authorities are advised to prepare strict guidelines as suggested below:

- (i) Minimum levels of noise during construction activities will be maintained and ambient noise should be monitored periodically at different locations as outlined in Environment Monitoring Program.
- (ii) Strict restrictions shall be imposed on the workers at project sites to ensure that they do not harvest any species/produce from the forests and cause any danger or harm to the animals and birds in the wild.
- (iii) The provision made for community kitchen and ensure the supply of the kitchen fuel from the nearest depots to avoid forest degradation and destruction of forest and wildlife habitats.
- (iv) The interference of human population would be kept to a minimum in the adjacent forested areas and it would be ensured that the contractors do not set up labour colonies in the vicinity of forests and wilderness areas.

10.4.8.6 Budgetary Provisions

The total budget allocated focusing on Conservation plan for Schedule -I species is **Rs 74.00 lakh**, under Biodiversity Conservation and Wildlife Management Plan of Uri-I Stage-II HEP. The Break-up of the budget is given in **Table 10.34**.

Table 10.34: Break-up for Wildlife Management and Conservation Plan for Schedule I Species

S. No.	Activity	Fund Allocated (Rs in Lakh)
1	Habitat Improvement by development of vegetation cover by plantation with suitable species.	0.0*
2	Biological fence (<i>Berberis</i> species, <i>Rosa macrophylla</i> , Bamboo species, <i>Salix</i> sp., <i>Agave americana</i> , etc.) around the habitation and around the agriculture fields adjoining to forest area to control human wildlife conflict	15.00
3	Support/Provision of veterinary care, cages, recuse centers, etc.	29.00
4	Prevention of Forest Fire: Training and Infrastructure facilities	10.00
5	Protection and maintenance of natural drinking water sources in wildlife habitat.	10.00
6	Training Programme for Techniques of faunal species rescue	5.00
7	Anti-Poaching measures and preventing illegal tree felling	5.00
8	Infra-structure development (Surveillance Equipment's like Cameras, Wireless Sets, GPS, etc.).	0.0*
	Total	74.00

*Covered under Biodiversity Management & Wildlife Conservation Plan (refer table 7)

10.4.9 Monitoring and Evaluation

The monitoring and evaluation of Biodiversity Conservation and Wildlife Management Plan of **Uri-I Stage-II HEP** will be carried out by a Biodiversity Management Committee (BMC). The committee will follow the guidelines of National Biodiversity Authority, State Biodiversity Conservation Strategy Action Plans (SBCSAP) and State Forest Department to implement, monitor and evaluate the Biodiversity Conservation and Wildlife Management

Plan of the proposed Project. The activities of BMC shall be under the direct administrative control of the Chief Wildlife Warden/Principal Chief Conservator of Forests, Jammu and Kashmir State Forest Department. The BMC will comprise of the following members:

Chief Wildlife Warden/Principal Chief Conservator of Forests, Jammu & Kashmir	Chairman
Manager (Environment), NHPC. Ltd.	Member Secretary
Divisional Forest Officer of the concerned Division	Member
Experts form State University and Active NGO's	Member
Local Body's Representatives from the villages	Member

The Chairman of the committee will have the right to assign various activities to various members for proper functioning and result-oriented tasks. The committee will monitor the progress of the proposed plan. Total financial outlay for the BMC would be **Rs. 4.00 lakh** only.

10.4.10 Locations of Proposed Intervention

Proposed intervention shall be implemented by State Forest department. Hence the selection of site for implementation of proposed measures will be finalized by state forest department.

10.4.11 Financial Provision

The total budget allocated focusing on Biodiversity and Wildlife Conservation and Management Plan including conservation and management measures for Schedule-I species is **Rs 144.00 lakh**. The Break-up of the budget is given in **Table 10.35**.

State Forest Department shall be the executing agency for implementation of the proposed mitigation measure under Biodiversity Conservation and Wildlife Management Plan in the surrounding of proposed project site, therefore, a total amount of **Rs. 144.00 lakh** will be deposited with the J&K Forest Department for taking up proposed activities within the area.

Table 10.35: Total Cost of Biodiversity Management and Wildlife Conservation Plan

S. No.	Activity	Fund Allocated (Rs in Lakh)
1	Biodiversity Conservation and Wildlife Management Plan	66.00
2	Conservation & Management of Schedule-I Species	74.00
3	Monitoring And Evaluation	4.00
	Total	144.00

Section 10.5

FISHERIES DEVELOPMENT PLAN

10.5 FISHERIES MANAGEMENT PLAN

Uri-I Stage-II HEP is a run-of-river hydroelectric project on River Jhelum located between Boniyar and Uri in Baramulla District of UT of J&K. Uri-I Stage-II Hydro Electric Project is extension of Uri-I Power Station (Uri-I Stage-I/ Uri-I Project), proposed to be developed on Jhelum River to harness the surplus water of Uri-I Power Station. The Uri-I Project was allotted to M/s NHPC Ltd. The existing structures like barrage, the surface water conveyance system consisting of Head regulator upto HRT intake of Uri-I Project shall be utilized for Uri-I Stage-II HEP. The construction of underground structures like 10.472 km long HRT, surge shaft, pressure shaft, an underground powerhouse complex and 2.28 km long TRT are proposed for Uri-I Stage -II Project.

The development plan will have to consider the impact of operation of hydropower projects on Jhelum River and its fisheries which have already been affected by the presence of the other projects. For these inputs from the Department of Fisheries, Government of Jammu & Kashmir, local licenced fishermen and private fish farm owners have provided valuable information on Jhelum fish and fisheries in general and on the experiences from artificial hatching and stocking of Snow trout in particular.

10.5.1 Fisheries of Jhelum River

River Jhelum important rivers of Indus River system, constitutes the major drainage system of Kashmir valley. Jhelum river originates from the spring Verinag located in the foot of the Panjal Mountains in the district Anantnag. The river runs a course of 203 kms through the valley. The river flows across the main valley of Kashmir in Northwest direction up to Boniyar in Bandipora district where it joins the Wullar lake. It then reemerges from the lake near Sopore in Baramulla district taking southwestern direction leaving the valley near Gantamulla. From there it assumes torrential nature and flows through the Uri town before entering over to Pakistan administered Kashmir.

During the field surveys experimental licenced fisherman was undertaken to know the type of fishes available in Jhelum River. Local people were interviewed about the type of fish found in Jhelum River. Based on primary data collection and data gathered from literature fishes found are Snow trouts like *Schizothorax esocinus*, *S. plagiostomus*, and *S. labiatus* are dominant in the area and *Glyptosternon reticulatum*, *Glyptothorax pectinopterus*, *Glyptothorax kashmirensis*, *Cyprinus carpio communis*, *Cyprinus carpio specularis*, *Triplophysa kashmirensis* and *Pethia conchoniis* are the common fish species in the study area. In addition, *Oncorhynchus mykiss* (Rainbow trout) and *Salmo trutta* (Brown trout), are also reported from the river. The list of fish species reported from the study area are tabulated below:

S. No.	Family	Name of Species
	ORDER: CYPRINIFORMES	
1	Botiidae	<i>Botia birdi</i>
2	Cyprinidae	<i>Bangana diplostoma</i>
3	Cyprinidae	<i>Carassius carassius</i>

S. No.	Family	Name of Species
4	Cyprinidae	<i>Crossocheilus diplocheilus</i>
5	Cyprinidae	<i>Cyprinus carpio communis</i>
6	Cyprinidae	<i>Cyprinus carpio specularis</i>
7	Cyprinidae	<i>Oncorhynchus mykiss</i>
8	Cyprinidae	<i>Puntius conchonus</i>
9	Cyprinidae	<i>Salmo trutta fario</i>
10	Cyprinidae	<i>Schizothorax curvifrons</i>
11	Cyprinidae	<i>Schizothorax esocinus</i>
12	Cyprinidae	<i>Schizothorax labiatus</i>
13	Cyprinidae	<i>Schizothorax niger</i>
14	Cyprinidae	<i>Schizothorax plagiostomus</i>
15	Nemacheilidae	<i>Schistura punjabensis</i>
16	Nemacheilidae	<i>Triplophysa kashmirensis</i>
17	Nemacheilidae	<i>Triplophysa marmorata</i>
ORDER: CYPRINODONTIFORMES		
18	Poeciliidae	<i>Gambusia holbrooki</i>
ORDER: SILURIFORMES		
19	Sisoridae	<i>Glyptosternon reticulatum</i>
20	Sisoridae	<i>Glyptothorax kashmirensis</i>
21	Sisoridae	<i>Glyptothorax pectinopterus</i>

Fish fauna in the Jhelum River and its streams is determined by the water temperature, the flow velocity and type of substrate. The species found here are either endowed with strong locomotion like Snow trout. No swamping ground were recognised between Diversion site of Lower Jhelum HEP and Uri-I barrage site. Boniyar Nala a left bank tributary of Jhelum River join Jhelum in the downstream of Uri-I Power Station barrage site provide suitable habitat for migratory fishes and identified as spawning ground for *Schizothorax* species.

With the help of local fishermen Experimental fishing was carried out in Jhelum River and Boniyar Nala with Cast nets. The exercise was undertaken for at least 4 hours every day for 4 days during each survey period. 6 individuals of trout fish (*Schizothorax plagiostomus*) captured in the downstream of barrage site of Uri-I Power Station of size varying from 25cm to 35cm and weighing about 200 to 500g.

10.5.2 Threats to Fisheries Resources

In general, the construction of barrage also creates some changes on aquatic environment of downstream and upstream reaches. In upstream, water level will be high, whereas, in the downstream water level will be drastically reduced during the lean months. This would have a huge impact on upstream migration of all the fish species. Thus, the spawning migration for hill stream fish species like Snow trout would become difficult.

Many aquatic communities are unable to adapt to the altered environment. The diatoms, blue-green and green algae have their habitats beneath boulders, stones, fallen logs along the river, where depth is such that light penetration can take place. But with the damming of the river, these organisms may be affected but they will find alternative habitat in the reservoir rim areas.

The present status of River Jhelum and its tributaries in the proposed project area provides a healthy environment for fisheries. The water quality parameters are obliging for the growth of fishes. The tributaries draining into the river provides a good breeding ground for fishes like Snow trout. In case of Uri-I Stage II HEP, the proposed project utilizes

operational structure like barrage and reservoir of existing Uri-I Stage-I (Uri-I Power Station) project without drawing additional water from the natural course of river Jhelum.

Keeping in view the present fisheries management strategy under Uri-I Power station and management measures adopted by J&K fisheries department, a fishery management strategy has been proposed for the strengthening the fish conservation and management measures in the project area.

10.5.3 Objective of Fisheries Management

Proposed Fisheries Development Plan has been prepared with the following objectives:

- Conservation, Management and Enrichment by Stocking of riverine fish fauna
- Strengthen of fishing techniques and skills of fishermen/ women societies
- Upgradation of existing Govt. Fish farms.
- Enrichment of Riverine Fish Fauna of Jhelum River and its tributaries in the intermediate stretch between Uri-I and Uri-II Power Station and Upstream stretch of Uri-I Power Station and Lower Jhelum HEP.

10.5.4 Management Measures

The barrage of Uri-I Power Station is run of the river project with very small pondage area of 900m long covering an area of 23.71 Ham. The barrage of Uri-I Power Station is designed and construct with provision of fish ladder for easy upward migration of fish species from barrage site. To ensure the adequate downstream discharge to sustain the aquatic life in the downstream stretch has been made by maintaining mandatory E-flow from the barrage site. Since, the Uri-I Power Station is under operation from 1997, it is assumed that the aquatic life in the area is adapted and sustained in the changed environment due to change in natural flow of the Jhelum River for a such a long period.

10.5.4.1 Fish Ladder at Uri-I Power Station

Based on the study on fish community undertaken by Institute of Freshwater Research, Sweden; University of Kashmir, Srinagar and NHPC during 1990-1997 and further study by SWECO from Sweden on different alternatives for a fishway and optimal design, a concrete (pools and orifice type) fish ladder has been constructed in Uri-I diversion structure. The ladder has been designed with one inlet at El. 1489.00 M and one outlet at El. 1475.50 M to facilitate the movement of different fish spp. viz *Schizothorax curvifrons*, *Schizothorax esocinus*, *Schizothorax labiatus*, *Schizothorax plagiostomus*, *Glyptosternon reticulatum*, *Glyptothorax pectinopterus*, and *Triplophysa Spp.* Considering the prescribed design by SWECO, a fish ladder (pools and orifice type, concrete baffles, 150 m length and 1.5 m width) has been provided through the barrage structure between bay no. 06 and bay no. 07. Total 47 numbers of steps are provided to negotiate the head of 14.5m and to maintain the water velocity of approx. 1-2 m/s. A slope of 1:10 has been provided inside fish ladder. A vertical type of sluice gate has been provided at the inlet of fish ladder to facilitate the seasonal migration of fish and to control the required amount of water flow i.e, 2.5 Cumecs inside the fish ladder.

Operation Rule: The fish ladder gate is kept open during fish migrating periods. The discharge is about 2.5 Cumecs in the fish ladder. The flow may be reduced, if found

favourable for the migration of fishes. It is pertinent to mention that MoEF, GoI has not prescribed any condition regarding release of e-flow across Uri-I barrage.

	
Upstream view of Fish ladder	Downstream view of Fish ladder
	
Arrangement of Fish Ladder	Fish ladder along Buniyar Nalla, Left Bank tributary of river Jhelum D/s of Uri-I Barrage

Assessment of efficacy of Fish Ladder: The efficacy of fish ladder was ascertained through Fish Tagging experiments during the study, *“Effect of Uri and Lower Jhelum Barrages on the spawning migration of fish Schizothorax Heckel”* by the University of Kashmir for three consecutive years 1997-1999. The study concluded that the single most negative factor affecting fish stock abundance as substantial quantity of water is diverted into the PS during dry seasons a year. Quantitatively, the drop is roughly related to the decrease in width of the stream i.e. from normal season flow pattern to a trickle for almost half of the year which may hamper fish movement in the river and reduced accessibility to tributaries by migrating fishes. Further, as suggested a fishway has also been provided along the Buniyar nalla, a downstream tributary of river Jhelum.

10.5.4.2 Environment Flow (E-Flow)

Based on the study carried out by Institute of Fresh Water Research, Sweden in association with Department of Zoology, University of Kashmir, Srinagar, Environmental flow of provision of 2.5 cumec as downstream discharge through fish ladder of barrage of Uri-I Power Station. However, to comply with NGT's order for e-flow release, updated flow release worked out as 14.2 cumec based on more recent flow data available and being 15% of average lean season (four months i.e., Oct – Jan) flow of Jhelum River at Uri Barrage as per average 10 daily flow series has been adopted as e-flow release.

Hence, 14.2 cumec release is adopted as e flow release for the project based upon present habitat based hydrodynamic simulation study. The barrage is equipped with a Fish Pass

between bay No. 6 and bay No. 7 to release discharge of 2.5 cumec continuously. Balance e-flow discharge of 11.7 cumec is provisioned to pass through the Silt excluder gate on a continuous basis. The project utilizes water coming from Lower Jhelum HE Project for power generation after releasing mandated e-flow and remaining water spills over the barrage as there is no live capacity in the reservoir. Hence, this project development has no significant effect on hydrological regime of the river.

10.5.4.3 *Enrichment of Riverine Fish Fauna*

The morpho-ecological changes occur in the original lotic water body due to river valley development projects and other development activities along the natural drain system and rivers adversely affect the migratory as well as non-migratory fish species. The result of these activities also includes conversion of natural flow system into regulated maneuvered discharge, impoundment of waterbodies and water pollution, that have significant impact on aquatic fauna and food chain system of the water bodies.

Considerable change in the aquatic ecosystem and dependency of local people on fish resources in the area require habitat conservation and rehabilitation of aquatic fauna in natural water bodies and reservoirs.

Although there is an ongoing riverine enrichment programme implemented by State Fisheries Department by introducing fingerlings at different stretch of Jhelum River. Considering the ecological and commercial importance of fisheries resources in the area and strengthening ongoing efforts of fisheries department a budgetary provision of **Rs. 10.00 lakh (Rs. 2.50 lakh/year)** has been made to enrich fisheries resources in the riverine ecosystem of the river Jhelum under the head of Fisheries Management Plan.

10.5.4.4 *Stocking of Reservoirs*

Reservoirs form an important source of fish production in India. The best management practices evolved over the years for different categories of reservoirs entail 'stocking-cum-capture practices. Stocking will be the mainstay of reservoir fisheries development and will facilitate fish production on a sustainable basis. In the study area of proposed project there are three operational Run of the River projects on Jhelum River viz. Lower Jhelum HEP, Uri-I Power Station and Uri-II Power Station. While Lower Jhelum HEP and Uri-I Power Station are Run-of-the-River project with very small pondage and stocking of fisheries is not possible in the storage of both the reservoir and fisheries management in the stretch between Lower Jhelum and Uri-I Power Station will be manage through enrichment of riverine fauna. In case of Uri-II Power Station, located in the downstream of Uri-I Power station have reservoir with live storage capacity of 6.34 MCM will be considered for stocking.

Under stocking programme Snow trout species like *Schizothorax esocinus*, *S. richardsonii*, *S. plagiostomus*, and *S. labiatus* and *Glyptosternon reticulatum*, *Glyptothorax sp.*, *Cyprinus carpio communis*, *Cyprinus carpio specularis*, *Triplophysa kashmirensis* and *Pethia conchoni* were introduce in the reservoir. In addition, exotic species *Oncorhynchus mykiss* (Rainbow trout) and *Salmo trutta* (Brown trout) having aesthetic and economical importance will also be considered during stocking. Stocking of additional species of ecological as well as commercial importance may also be considered after consultation

with the beneficiary.

In addition to stocking, supplementary stocking is required until a critical mass of breeding population is established in the water body to ensure replenishment of the stocks that are harvested annually.

Considering all the facts and potential of reservoir on Jhelum River, financial assistance for development of reservoir fisheries, financial provision of Rs. **12.0 lakh (@ Rs. 3 lakh/ year for four years)** has been kept under this plan.

10.5.4.5 Upgradation of existing Govt. Fish farms

As per information available in State fisheries department (http://jkfisheries.in/Trout_Rearing_Units.htm), there are 4 Trout Rearing Units (TRU) viz, Tanamarg TRU, Kalantra TRU, Kangroosa TRU and Bela TRU and one Seed Farm (National Fish Seed Farm Manasbal) are working under administration of District Fisheries Department in Baramulla district.

The proper functioning of Trout Rearing Units and Seed Farms are essential to ensure the supply of required stocking material for enrichment of riverine fisheries and stocking of reservoir. Stocking of these reservoirs and tanks, enrichment of riverine fish fauna and sustainability of fish farms is only possible if the seed sources viz. Fish Seed Farms and Fish Seed Rearing centres are properly functional. To ensure the supply of fingerlings for stocking the reservoirs for enrichment of riverine fish fauna, provisions has been proposed to strengthen the Government Fish Seed Farms in Baramulla District. To promote pond culture, fingerlings have been provided to owners of private fish farms on subsidize rate by Department of fisheries from these government run fish farms.

For strengthening the infrastructure of these Government fish farms, one-time financial assistance of **Rs. 17.0 lakh** (Rs. 3.0 lakh each for 4 TRU and Rs. 5.0 lakh for Fish Seed Farm) has been kept for upgradation and maintenance of existing fish farms under the Fisheries Development Plan of proposed project.

10.5.4.6 Development of Local Fish Farms/ Fresh water Aquaculture

The increasing pressure of population demands future requirements for development and employment generation on one side and production of food and livestock on the other side. In India large population depend on fisheries for food and employment. Other than riverine and marine fisheries, fish farming is also a substantial source of fish production that helps in employment generation and secure the need of food. The farming aspect of aqua farming implies aspects of intervention in the natural growing process to enhance production. Fish farming is mainly raising fish commercially in tanks and ponds for the purpose of producing food. Commercial trout fish farming also reduces the pressure on natural resources and helps in preserving natural ecosystems.

The Department of Fisheries, Union Territory of Jammu & Kashmir has successfully undertaken the propagation of Fish culture in Private Sector to create employment avenues for educated un-employed youth of the State especially in rural areas under Hon'ble Prime Minister's package introduced in 2004-05. The scheme has given

encouraging results and there is a great response from the public, especially the youth for taking up fish culture as a reliable source of income. Against the target of 410, the Department established 481 ponds and the fish farmers were provided seed, feed, equipments and training. This has also given a boost to the Fisheries in private sector.

Therefore, considering the potential of freshwater aquaculture in the district and potential of fish farming, financial provision of **Rs. 10.00 (Rs. 2.00 lakh/ year for 05 years)** has been made for skill development, training & extension, and awareness programme for promotion of freshwater aquaculture and management of freshwater aquaculture/ fish farming to the registered fish farm owners in Baramulla District. In addition to training and skill development to promote freshwater aquaculture/ fish farms, the subsidize seeds/ fingerlings shall be made available for from the Government fish farms.

10.5.5 Locations of Proposed Intervention

Proposed intervention shall be implemented by State Fisheries department. Hence the selection of site and selection of species for implementation of proposed Fisheries Management Plan will be finalized by state forest department.

10.5.6 Financial Provision

The total budget allocated focusing on Fisheries Development Plan is **Rs 49.00 lakh**. The Break-up of the budget is given in **Table 10.36**.

The State Fisheries Department shall be the executing agency for implementation of the proposed Plan in the surrounding of proposed project site, therefore, a total amount of **Rs. 49.00 lakh** will be deposited with the Department of Fisheries UT of Jammu & Kashmir for taking up different activities within the area.

Table 10.36: Total Fisheries Development Plan

S. No.	Activity	Fund Allocated (Rs in Lakh)
1	Enrichment of Riverine Fish Fauna	10.00
2	Stocking of existing Reservoir	12.00
3	Upgradation of Existing Govt. Fish farms	17.00
4	Development of Fish Farms/ Fresh water Aquaculture	10.00
	Total	49.00

Total Cost with Capital & Recurring Cost for Implementing Fisheries Conservation & Management Plan

Capital Cost (Rs. In)	Recurring Cost (Rs. In Lakhs)				Total Cost (Rs. In)
	Year 1	Year 2	Year 3	Year 4	
17.00	8.00	8.00	8.00	8.00	49.00

Section 10.6

MUCK MANAGEMENT PLAN

10.6 MUCK MANAGEMENT PLAN

The proposed Uri-I Stage-II HE Project (240 MW) is the extension of Uri-I HEP (480 MW). Uri-I HEP is a run-of-river Hydro Electric Project, which was commissioned in 1997 by NHPC Ltd. and has been operating successfully since then. Uri-I Stage-II HEP is planned as per the provision kept in the Detailed Project Report (DPR) of Uri-I HEP. A parallel separate HRT is proposed to be constructed for Uri-I Stage-II HEP along with surge shaft, pressure shafts and a separate underground powerhouse (near the existing underground powerhouse of Uri-I Power Station) and TRT.

Muck generated from excavation of any project component is required to be disposed in a planned manner so that it takes the least possible space and is not hazardous to the environment. An account of the same has been given in the following paragraphs.

10.6.1 Quantity Of Muck To Be Generated

The total quantity of muck expected to be generated has been estimated to be of the order of about **11,58,300 cum** of soil and rock excavation (**Table 10.37**). Total quantity of excavated muck (soil and rock) would have to be disposed in designated muck disposal area.

Table 10.37: Detail of Muck Generated

S. No.	Location	Quantity (Cum)
A	Quantity of Muck excavated	
1	HRT & Adits	655800
2	TRT, Surge Galleries & Adits	217500
3	MAT and other Adits	49500
4	Surge shaft and construction Adits	48500
5	Pressure Shaft	24400
6	Powerhouse Carvens	162600
	Total	11,58,300
B	Quantity to be utilized	2,80,000
C	Quantity of Muck to be Disposed off	8,78,300

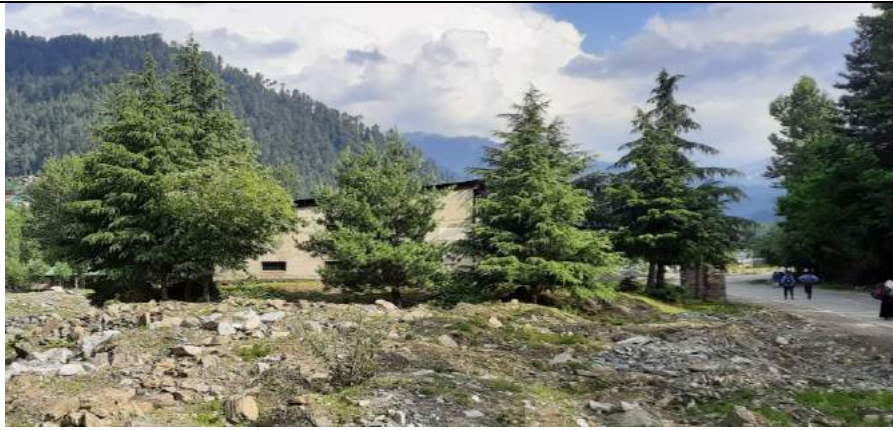
Source: NHPC Ltd.

10.6.2 Dumping Sites

The identification of muck disposal areas is done in line with the topographic and site-specific conditions. Muck is to be dumped in 4 pre-identified sites (**Refer Figure 10.38**). The total area of these sites is **16.90 ha**.

Table 10.38: Detail of Muck disposal sites

S. No.	Dumping Yard	Location	Area (Ha)	Capacity (Cum)
1	D1	Lari Dumping Site	0.85	67984
2	D2	Hiller Peernia Dumping Site	2.37	118370
3	D4	Mohura Dumping Site	4.24	508992
4	D5	Param Pillan Dumping Site	9.44	1416630
		Total Area	16.90	2111976

PROPOSED MUCK DUMPING SITES FOR URI-I STAGE-II HEP**D1: Lari Dumping Site****D2: Hiller Peernia Dumping Site****D4: Mohura Dumping Site****D5: Param Pillan Dumping Site**

10.6.2.1 Criteria for Selection of Dumping Sites

Based on the geological nature of the rocks and engineering properties of the soil, a part of the muck can be used as construction material. However, the balance requires being suitably disposed. In the proposed project only **1158300 cum** of muck generated from soil and rock excavation.

Out of 1158300 cum, a total quantity of **878300 cum** is to be disposed at muck disposal sites in a total area of **16.90 ha**. Rest 280000 cum will utilize as construction material.

The following points were considered and followed as guidelines for finalization of the areas to be used as dumping sites:

- i) The dumping sites have been selected as close as possible to the project area to avoid long distance transport of muck.
- ii) The sites are free from active landslides or creep and care has been taken that the sites do not have a possibility of toe erosion and slope instability.
- iii) The dumping sites are either at higher level than the flood level or are away from the river course so that the possibility of muck falling into the river is avoided.
- iv) There is no active channel or stream flowing through the dumping sites.
- v) The sites are far away from human settlement areas.

The selection of muck disposal sites was done based upon site inspections and available best conditions of the land availability, land stability, accessibility from the portals, sloping pattern, minimum vegetative and tree cover, away from any ecological sensitive area, riverbed conditions and away from high flood levels of the Jhelum River and its tributaries. After surveys five suitable sites were identified (shown in **Figure 10.9**). The proposed locations are spread over a land area of **16.90 ha**. The total capacity of muck disposal areas is **21,11,976 cum**, more than the total quantity of unused muck to be disposed. The unused excavated material expected to be comprised of fragmented rock mixed with soil would be piled at an angle of repose around 30° at the proposed dumping sites. This will be done to provide stability to the slopes and also to provide ample space for planting trees, which would further help in holding and consolidation of the material stacked at the proposed dumping sites.

In order to maintain an angle of repose less than 30° at the proposed dumping sites, the slopes at dumping sites would be broken up by creating benches across the slope. This will be done to provide stability to the slopes and to provide ample space for planting trees, which would further help in holding and consolidating the material stacked at different sites. The description regarding the stabilization of the stacked material along the proposed roads has been discussed in the following paragraphs.

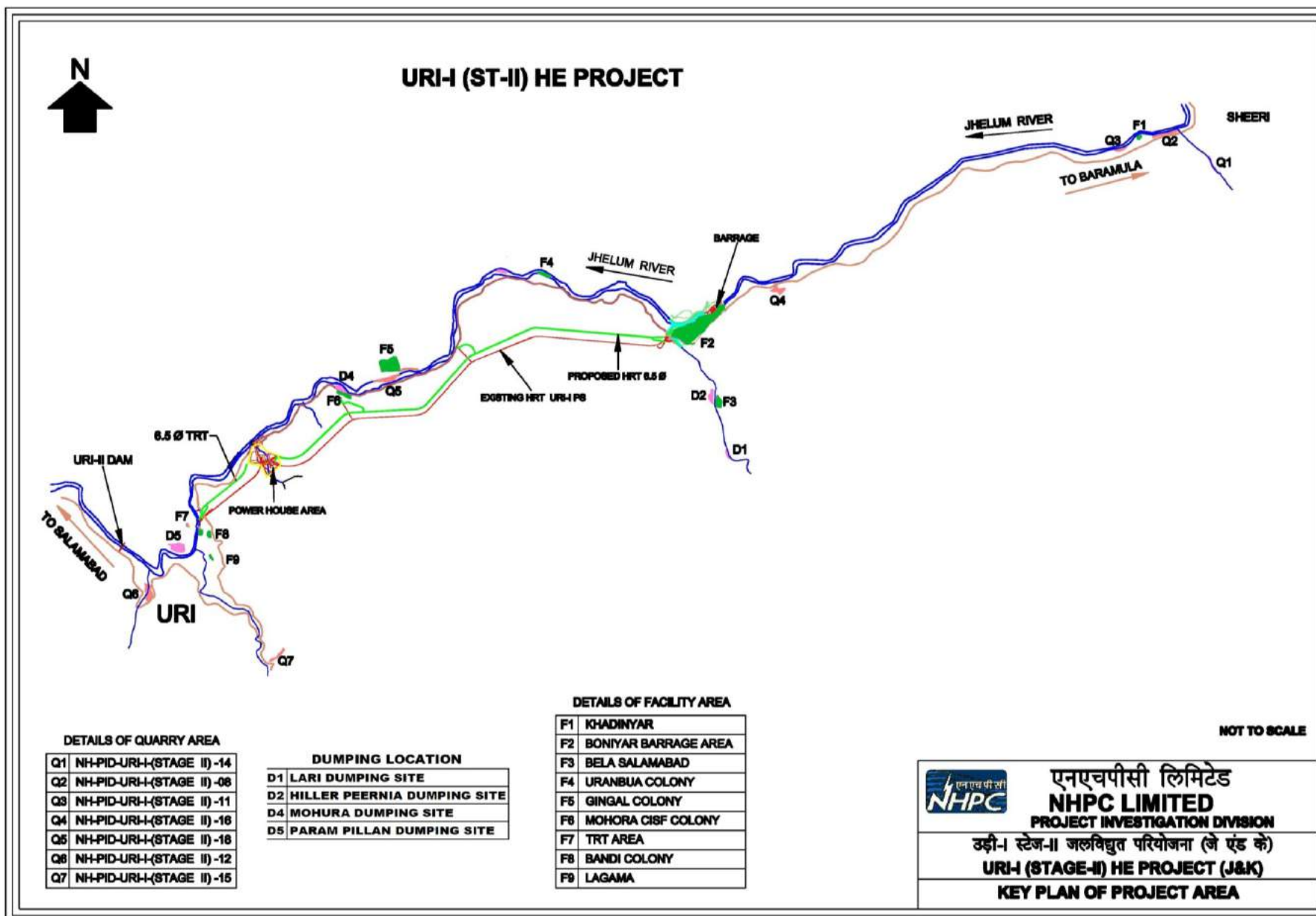


Figure 10.9: Map Showing location Map of Proposed Muck Dumping Sites

The options like dumping muck in stages and allowing it to consolidate/settle through the monsoon, compacting the dumped muck, zoning the dump judiciously to ensure the stability of 30° slope under all superimposed conditions will be utilized. The contour plan of proposed muck dumping sites are given at **Figure 10.10**.

The sites identified for dumping is under possession of NHPC and were utilized earlier for disposal of muck generated during construction of Uri-I Stage-I and Uri-II Projects. All the sites are planned on the banks of the nearest drainage and away from river HFL. The identified area is mostly gradually sloping near the riverbank. The drainage side bank of the area will be properly protected and stabilized with Retaining Walls of suitably designed sections (refer to **Figure 10.11A & 10.11B**).

10.6.3 Methodology Of Dumping

The main objectives of process of muck dumping and restoration of these muck disposal sites are:

- to protect and control soil erosion;
- fencing around the designated muck dumping site;
- to create greenery in the muck disposal areas;
- to improve and develop the sites into recreational sites;
- to ensure maximum utilization of muck for the construction purposes;
- to develop the muck disposal sites/ dumping yards to blend with the surrounding landscape; and
- to minimize damages due to the spoilage of muck in the project area.

In Uri-I Stage-I HEP during identification of the dumping sites above mentioned aspects were kept in mind. All possible alternate sites were inspected and examined before rejecting or selecting any site. All the dumping sites:

- i) have minimum possible vegetation cover,
- ii) the settlement areas are far away from the identified dumping sites so as to have least impact on human life,
- iii) the proposed dumping sites are located at a minimum distance of 30m away from the HFL at these sites as all the dumping sites are at a higher level than the flood level from the river course to provide protection from high flood, and
- iv) the identified muck sites are close to the sites from where muck is to be generated to avoid hazards related to transport of muck to long distances.

10.6.3.1 Dumping Process

The generated muck will be carried in dumper trucks covered with heavy duty tarpaulin properly tied to the vehicle in accordance with best international practices. All precautionary measures will be followed during the dumping of muck. All dumpers will be well maintained to avoid any chances of loose soil from being falling during transportation. All routes will be periodically wetted with the help of sprinklers prior to the movement of dumper trucks. Dumping would be avoided during the high-speed wind, so that suspended particulate matters (SPM) level could be maintained. Further, dumping will be avoided during heavy traffic. After the dumping the surface of dumps will be sprayed with water with the help of sprinklers and then compacted.

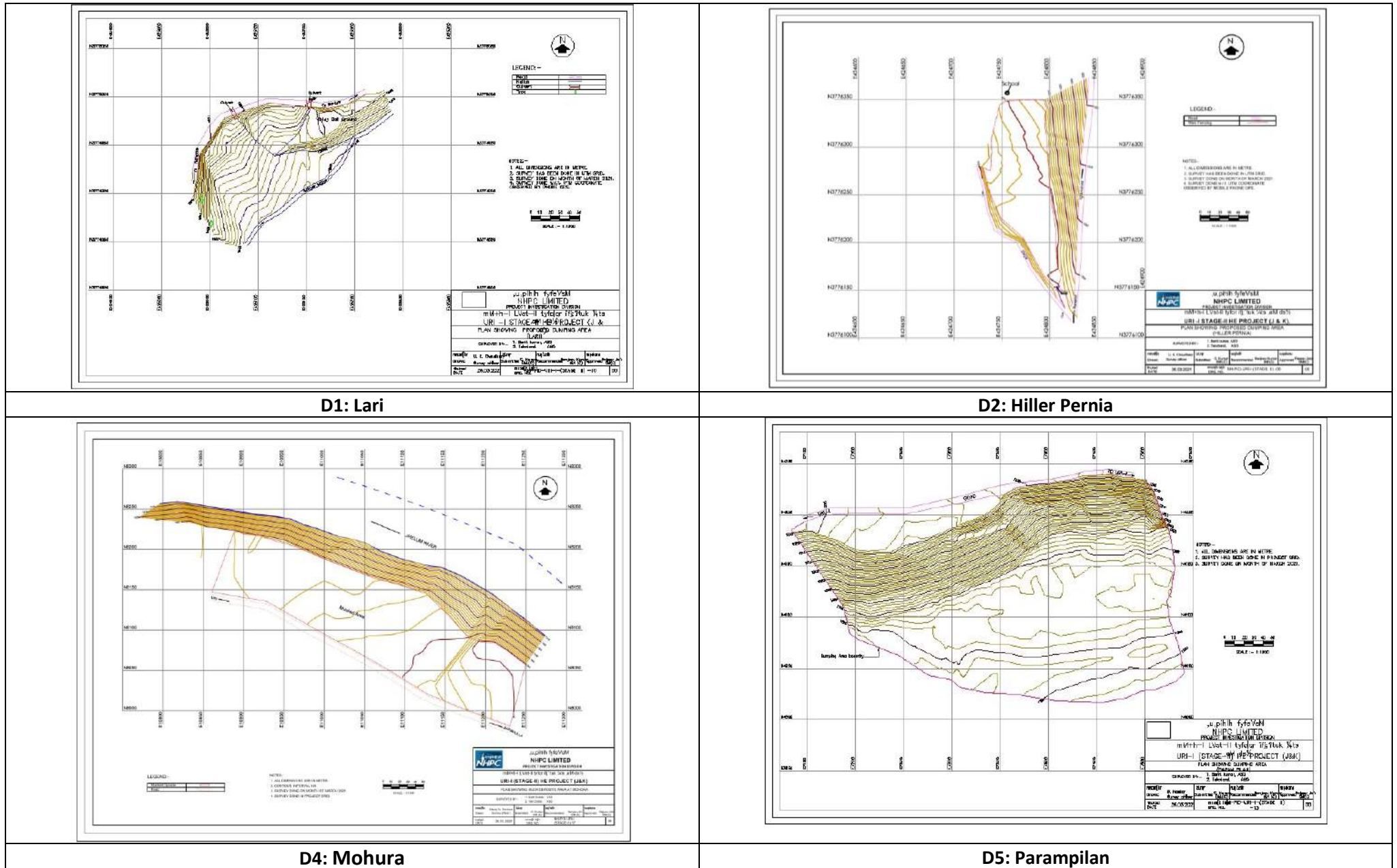


Figure 10.10: Layout of Muck dumping sites

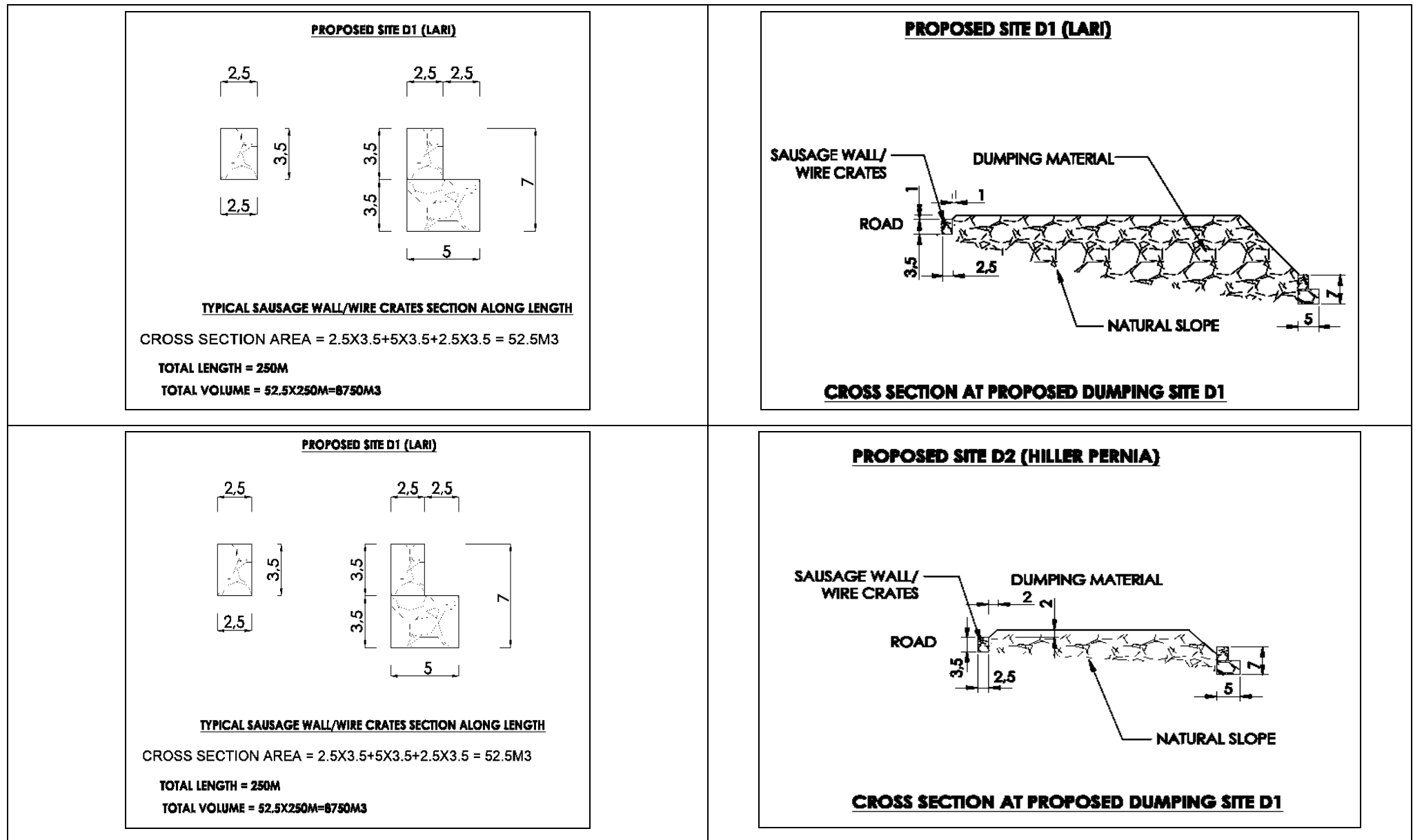


Figure 10.11A: Sections of muck disposal area (D1 & D2)

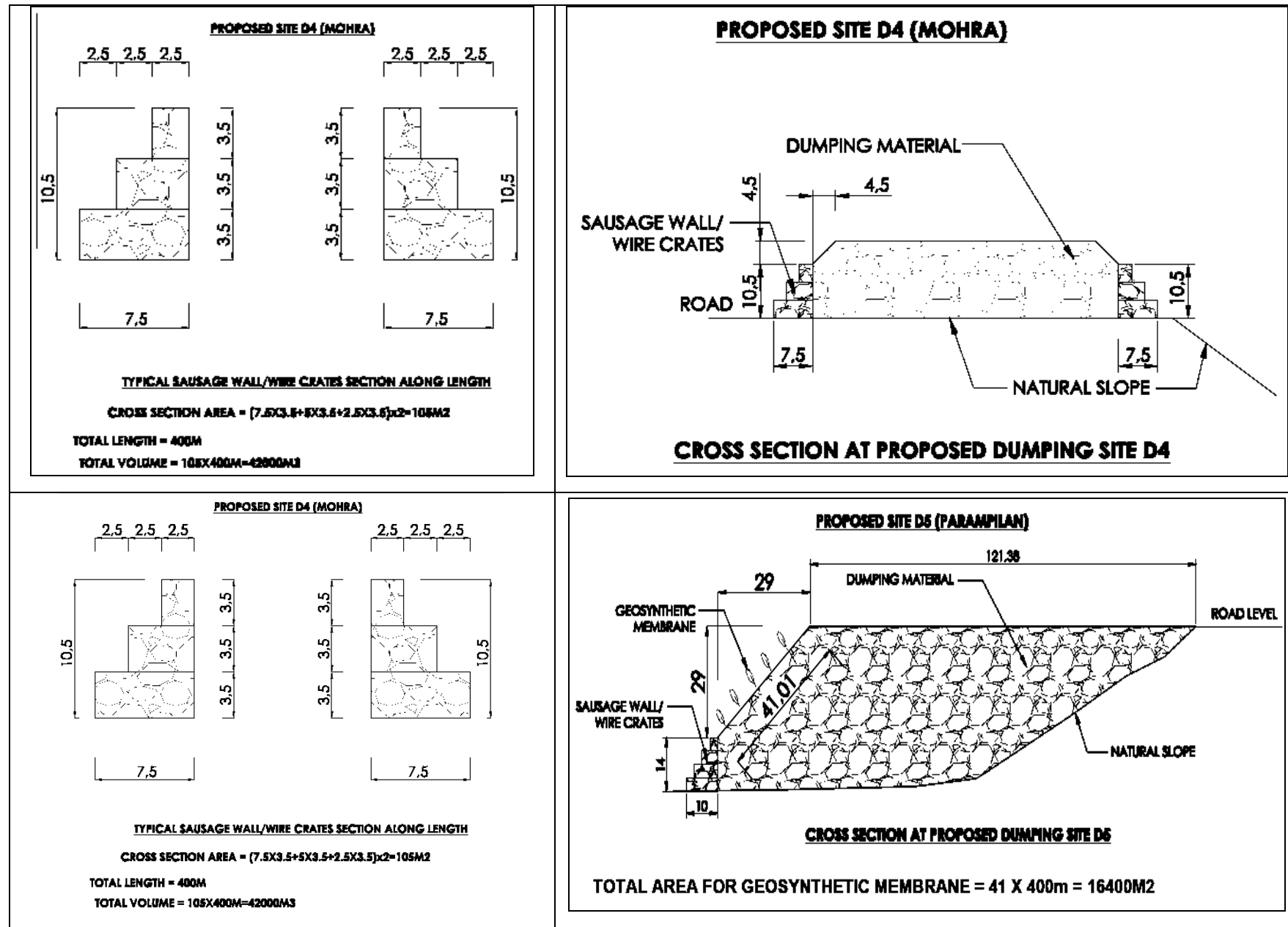


Figure 10.11B: Sections of muck disposal area (D4 & D5)

A retaining wall has been proposed to hold the muck on the lower part of the dumping site and shall be constructed prior to dumping of muck. Loose muck would be compacted layer-wise (**Figure 10.10a & 10.10b**). The height of Gabion Wall is proposed to be 6m on average. The muck brought by dumpers will be spread in layers behind the wire crate walls and then compacted by rollers till the top level is achieved. The retaining wall shall be laid with proper berm and the muck dumped behind it in layers and compacted by rollers. The process shall be repeated up to 50 cm level below the desired height which shall be laid with good soil for providing grass cover. At a regular vertical interval of 1.5 m and 3.0 m c/c masonry drains (catch water drains) shall be provided to drain off the rainwater. Proper fencing of the entire area will be done.

The muck disposal area will ultimately be covered with fertile soil and suitable plants will be planted adopting suitable bio-technological measures. The project authorities would ensure that the dumping yards blend with the natural landscape by developing the site with gentle slope, patches of greenery in and around them. These sites can also be developed later as recreational parks and tourist spots with sufficient greenery by planting trees.

The Rehabilitation plan of muck dumping sites includes engineering and biological measures. Most of the total unused excavated muck would be placed at an angle of repose to avoid any slippage of the muck at the proposed dumping sites. Slopes would be broken up by creating benches across the slope. This will be done to provide stability to the slopes and also to provide ample space for planting trees which would further help in holding and consolidating the material stacked at different sites. As stated earlier, efforts will be made to dispose of the muck within short distances from sites of its generation.

The capacity/volume of the muck dumping sites is more than the volume of the muck to be disposed. All measures would be adopted to ensure that the dumping of muck does not cause injury or inconvenience to the people or the property around the area. The spillage of muck into the river at any site would be prevented by making concrete retaining walls to retain the muck pile. It shall be ensured that dumping is carried out at a minimum distance of 30 m away from the active river bank. The top surface would be leveled and graded after the capacity of any dumping site is exhausted. The top surface will be covered with soil and grass seeding will be ensured to promote vegetation cover.

10.6.3.2 *Rehabilitation Of Dumping Sites*

The project authorities would ensure that the dumping yards blend with the natural landscape to develop the sites with gentle slopes, bunds, terraces, and patches of greenery in and around them. These sites can also be developed later as recreational parks and tourist spots with sufficient greenery by planting ornamental plants. The re-vegetation of dumping yards through 'Integrated Biotechnological Approach' would be undertaken. It may be necessary to inoculate the spoil dumps for the development of landscape as the soils would be poor in nutrients. This can be developed through culture of microorganism or vermiculture practices at the nurseries developed for this purpose.

All the spoiled areas will be developed as per the latest technology of dumping. In addition, sprinkling of water may also be resorted to, if required to avoid or minimize dust pollution. A proper drainage system will be provided to ensure unobstructed flow of runoff. Planting suitable species of trees, shrubs and other biomass will also be initiated.

The following engineering and biological measures have been proposed for the development of spoiled areas.

A. Engineering Measures

For stacking of dumped material retaining wall is proposed to be built before dumping of any material on to the sites (refer **Figure 10.11a & b**). In all total length of about 1300 running meters (rmt) of retaining walls (Sausage wall/ wire crates) would be required to be built wall (for details see table below).

S. No.	Dumping Sites	Length of Retaining Wall (in Running meters)	Total Volume of Retaining Wall (Cumec)
1	Dumping Site D1	250.0	8750
2	Dumping Site D2	250.0	8750
3	Dumping Site D4	400.0	42000
4	Dumping Site D5	400.0	35000

In addition, leveling would also be done after dumping the material on every cycle and simultaneously improving the drainage of the disposal site. All the approach roads to various project structures will be constructed by employing the methodology recommended by National Highway with minimal environmental damage. The methodology consists in developing the formation width is half cutting and half filling, so that the materials obtained from cutting are utilized in filling. The excavation on hill side will be done to get a stable slope for the materials encountered. At places breast wall, gabion walls shall be done in natural slope to retain filled material, particularly where there is problem of retaining the hill slope.

To minimize the environmental damage, construction material like stones, sand, etc., required for the construction of road will be obtained mostly from the excavated material. In the streams, box culverts will be provided to prevent the erosion of nala bed. In addition, stone/concrete work on the downstream area will also be provided at vulnerable places to minimize erosion.

i) Retaining Walls

Total area for the dumping of muck is **16.90 ha** which can accommodate more than **21.0 lakh cum** whereas the estimated muck to be disposed is about **8.9 lakh cum**. The total length of retaining walls proposed to be constructed along the river at different muck dumping site would be about 2500 m. Total financial outlay for the retaining walls is **Rs. 2100.74 lakh** and details are given in **Table 10.29**.

ii) Compaction & Levelling

Compaction is an engineering measure, which would reduce bulk density of the muck thereby optimising the use of muck disposal area and would make it suitable for the plantation and other biological measures. Top surface would be levelled and graded to make the alternative use. The muck will be spread in 50 cm thick layers. Top surface would be levelled and graded to make the alternative use. On top a layer of soil would be spread to make the land suitable for plantation. The total cost for the process of compaction is **Rs. 25.00 lakh**.

iii) Fencing

Fencing is a bio-engineering measure. After rehabilitation of muck the dumping areas need protection for some time from disturbing by human and domestic animals. For this reason, fencing over the muck deposits is required. Barbed wire strands with two diagonal strands, clamped to wooden/ concrete posts placed at 3m distance are proposed around the dumping piles. Project authorities will establish temporary wind barriers around 3 sides of dumps in close of settlement area.

The muck is proposed to be filled in layers properly compacted. The cost of the same has been given in **Table 10.39**. In addition, catch water drains are also proposed to be built and levelling of soil would also be done after dumping the material on every cycle and simultaneously improving the drainage of the disposal site. The estimated cost of engineering measures would be **Rs. 2130.74 lakh**.

Table 10.39: Cost of Engineering Measures

S. No.	Description	Qty (Cum)	Unit	Rate (Rs)	Amount (Rs in lakh)
I.	Construction of Retaining Wall				
	Protection Wall (Sausage Wall/ Wire Crates)	94500	cum	2208.0	2086.56
	Geosynthetic membrane at site D5 (Param Pillan)	14350	cum	50.0	7.18
	Contingencies and Fencing, etc. @ 0.5% of cost of works				7.00
	Sub-total - I				2100.74
II.	Site Clearance for dumping area and compaction for different layers and levelling – Lump sum				25.00
III.	Construction of drainages along periphery of muck disposal sites				5.00
	Grand Total (I+II+III)				2130.74

B. Biological Measures

Top surfaces and slopes of all dumping areas would be left and will be treated for the purpose of plantation. Vegetation cover controls the hydrological and mechanical effects on soils and slopes. Therefore, biological measures to stabilize the loose slope are essential. In order to implement the biological measures in dumping areas the following activities would be taken into account. The biological measures include the following:

i) Soil treatment

Muck dumped at various sites is not considered to be nutrient rich as it is excavated from tunnels and other structures. In order to make it suitable for the plantation it will be provided

bio treatment. The work plan will be formulated for re-vegetation of the dumping sites through Integrated Biotechnological Approach.

ii) Plantation

After the completion of muck dumping process and compaction the area will be available for the plantation. In order to stabilize the stacked dumped material, vegetation cover would be provided to hold dumped material over a period of time. Following steps are envisaged:

- Plantation of suitable tree species and soil binding using bio-fertilizer technology.
- Turfing of the exposed area and improvement of environment with fast growing and ornamental species.
- Protection with mechanical support.
- Biological fencing.

After consultation with officials of forest department, suitable plant species will be planted to restore the dumping sites. The selected species will be planted after their nurseries have been developed. The dumping areas are very small; therefore, separate nursery would not be required. The temporary nursery developed for the implementation of Greenbelt Development Plan can be used for the rehabilitation of dumping areas. The provision of temporary nursery with financial estimates has been kept under Greenbelt Development Plan (refer section 10.9.7). Nearly 1-2 years old saplings would be used for the plantation. The plantation of suitable plant species of high ecological and aesthetic values which can adapt to local habitat will be undertaken with 800 plants per hectare depending upon the canopy cover required. The plantation can be carried out in lines across the area and slopes along the dumping sites. Grass and herb species would be used in the inter space of tree species. They will help in providing the continuous chain of support in retaining debris, reinforcing soil and increasing the infiltration capacity of the area.

The proposed measures would be carried out on an area of about 15.0 ha. The estimated cost of these measures would be **Rs. 57.42 lakhs**. This cost includes the cost of turfing of slopes, preparation of ground, spreading of manure, etc., providing 5cm of soil cover and transportation and carriage. It also includes the cost of fencing, irrigation, watch and ward, etc. (see Table 10.40).

Table 10.40: Total financial outlay for the biological measures at dumping sites

S. No.	Particulars	Quantity	Rate (in Rs.)	Amount (Rs. in lakh)
1	Rolling of Muck	Lump sum		20.00
2	Pitting (size: 0.45 m x 0.45 m x 0.45 m)	14,400 pits	50.00/pit	7.20
3	Manure and soil filling in pits	14,400 pits	5.00/pit	0.72
4	Transportation of plant material from nursery	Lumpsum		12.00
5	Turfing with grasses	5000 sq. m	50.00/sqm	2.50
5	Fencing, maintenance, watering, transport, etc.	Lumpsum		15.00
Total				57.42

10.6.4 Monitoring & Compliances

Muck shall be dumped from bottom in layers of 50-70 cm depending on size of boulders.

- i) Each layer shall be rolled compacted.
- ii) A layer of soil shall be spread on top of it to make it suitable for plantation.
- iii) Water testing facilities shall be set up for checking quality parameter of water.
- iv) Soil samples shall be regularly collected and tested for checking the level of contamination.
- v) Prescribed norms and approvals will be sought from APSPCB wherever necessary.
- vi) All norms of related to muck disposal shall be complied with.
- vii) Design consultant shall be engaged for designing of retaining structures.
- viii) Plantation will carry out with consultation of forest department and shall be done on the reclaimed.
- ix) Native species of ecological importance shall be planted.

10.6.5 FINANCIAL REQUIREMENT

The estimated cost of the relocation and rehabilitation of excavated material is given in **Table 10.41**. The total cost of these measures will be **Rs. 2188.16 lakh**.

Table 10.41: Financial requirements for implementation of Muck Disposal Plan

S. No.	Item	Amount (Rs.in lakh)
1	Engineering measures	2130.74
2	Biological measures	57.42
	Total	2188.16

Total Cost with Capital & Recurring Cost for Implementing Fisheries Conservation & Management Plan

Capital Cost (Rs. In	Recurring Cost (Rs. In Lakhs)				Total Cost (Rs. In
	Year 1	Year 2	Year 3	Year 4	
17.00	8.00	8.00	8.00	8.00	49.00

Section 10.7

LANDSCAPING AND RESTORATION PLAN

10.7 LANDSCAPING AND RESTORATION PLAN

The proposed Uri-I Stage-II HEP on Jhelum River utilize existing barrage and reservoir. However, the proposed project would entail construction of various project underground structures like Headrace Tunnel, Underground Powerhouse, Tail Race Tunnel, which would require a large quantity of construction material, storage facilities, and labour colonies. During the construction phase of the project several temporary construction sites, storage, and working areas will be set up in the available project area. For construction, material excavation will also be carried out. All these activities will require restoration and rehabilitation after the construction is over.

10.7.1 Restoration of Quarries/Borrow Areas

The construction of a head race tunnel, underground powerhouse complex, and other project structures require a large amount of construction material, and the estimated requirement is given in **Table 10.42**.

Table 10.42: Estimated requirements of aggregates for construction

Construction Material	Unit	Quantity	Source
Aggregates			
Coarse Aggregate	(Lakh Cum)	3.60	Shoal deposit/ Rock quarry and muck excavated from HRT & TRT
Fine Aggregate	(Lakh Cum)	1.80	
Steel	MT	0.13 lakh (approx.)	Open Market
Cement	MT	1.51 lakh (approx.)	Open Market

The total requirement of coarse and fine aggregate for the construction of the project has been estimated to be around 3.60 lakh Cum and 1.80 lakh Cum, respectively. To cater the requirement of construction material seven different sites were identified as construction material sources (**Figure 10.12**).

Among the seven identified sources 3 are river shoal or terrace deposits sits, 2 nos. of Rock quarry sites i.e. Sheeri shoal, terrace deposit opposite Mohra power house and Salamabad shoal along with two numbers rock quarries at Naushera, Hajipeer nala and Excavated material from HRT & Power House were identified and investigated as the potential sources of material for the construction of Uri-I Stage-II HE Project. The identified sites with the available quantity is given in **Table 10.43**.



Table 10.43: River Shoal Deposit & Rock Quarries Identified for Construction material

S. No.	Name of Deposit	Index No.	Distance from site		Total Available Quantity (Lakh cum)
			HRT	PH	
1	Sheeri Shoal Deposit	UR-I St-II G-1	15	35	1.80
2	Salamabad nalla shoal deposit	UR-I St-II G-2	21	10	1.6
2	Naushera Rock Quarry	UR-I St-II R-1	8	24	7.0
4	Hajipeer Rock Quarry	UR-I St-II R-2	25	10	5.0
5	Excavated Muck Material of HRT	UR-I St-II R-3	10	5	6.0
6	Excavated Muck Material of Powerhouse cavern	UR-I St-II R-4	10	0	3.5
7	Mohra P/H Terrace Deposit	UR-I St-II G-3	10	8	1.25

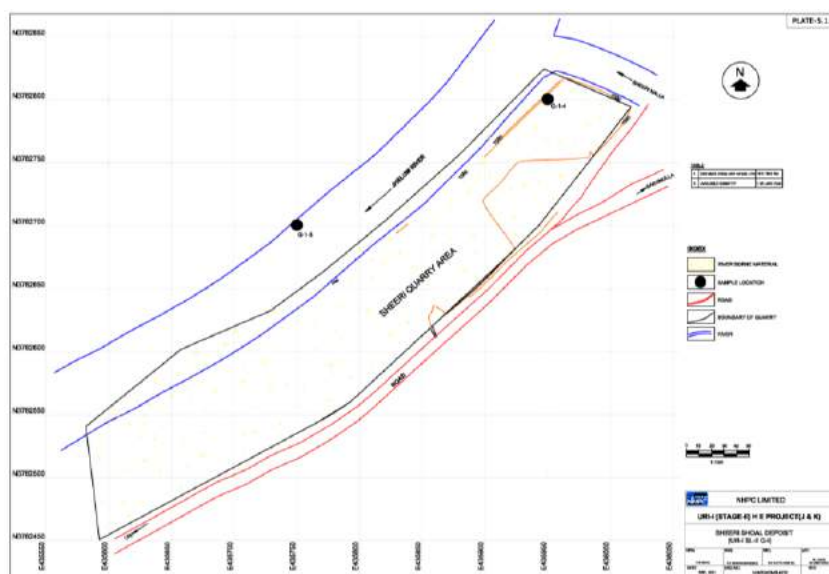
Source: DPR of Uri I Stage-II HEP

i. Sheeri village shoal deposit (UR-I St-II G-1)

This deposit is situated about 15 km upstream of Intake site on left bank of Jhelum River along with tributary Mundari nala and is connected with road network. This deposit comprises fragments of angular to sub-rounded boulders, cobbles, pebbles, gravel and sand.



View of Sheeri Village shoal Deposit)



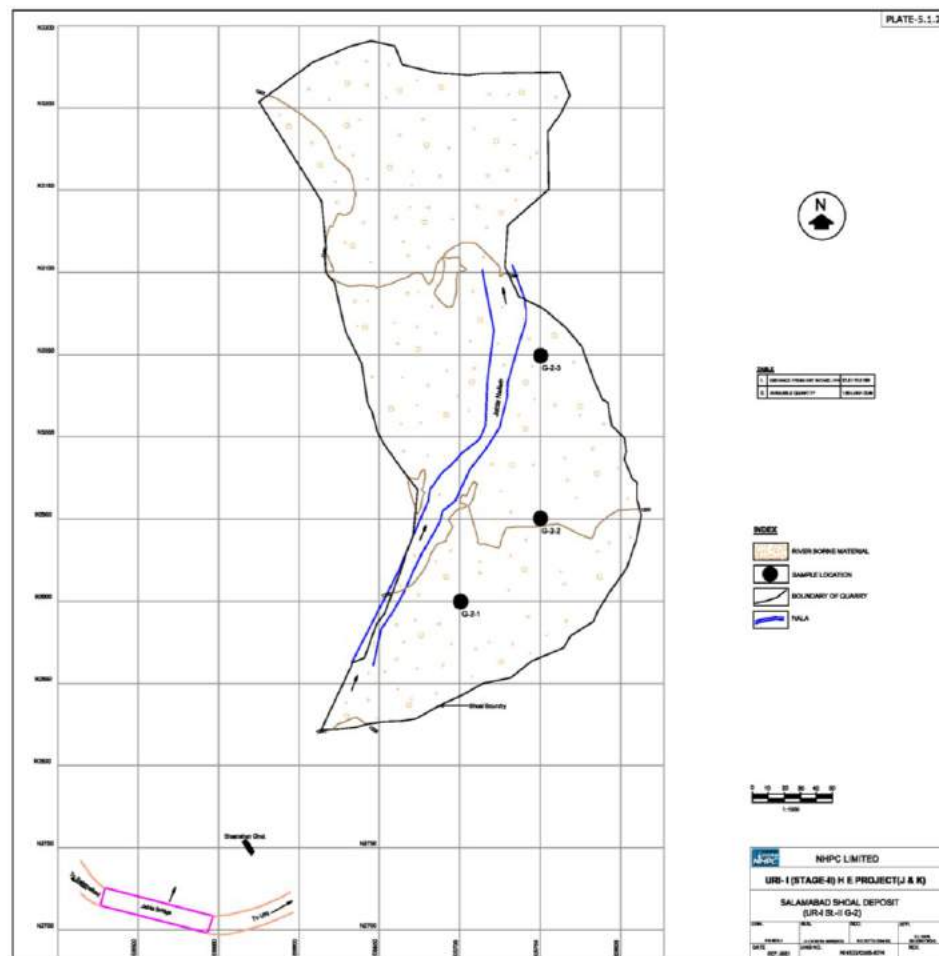
Section of Sheeri Village shoal Deposit

ii. Salamabad Nala Shoal Deposit (UR-I St-II G-2)

This deposit is situated about 10 km downstream of PH site on left bank of Jhelum River at confluence of Salamabad nala and is connected with road network. This deposit comprises mainly fragments of angular to sub-rounded boulders, cobbles, pebbles, gravel and sand.



View of Salamabad Nala Shoal Deposit



Section of Salamabad Nala Shoal Deposit

iii. Mohra Powerhouse Terrace Deposit (UR-I St-II G-3)

This deposit is situated about 10 km downstream of Intake on right bank of Jhelum River and is not connected with road network. This deposit comprises fragments of angular to sub-rounded boulders, cobbles, pebbles, gravel and sand.



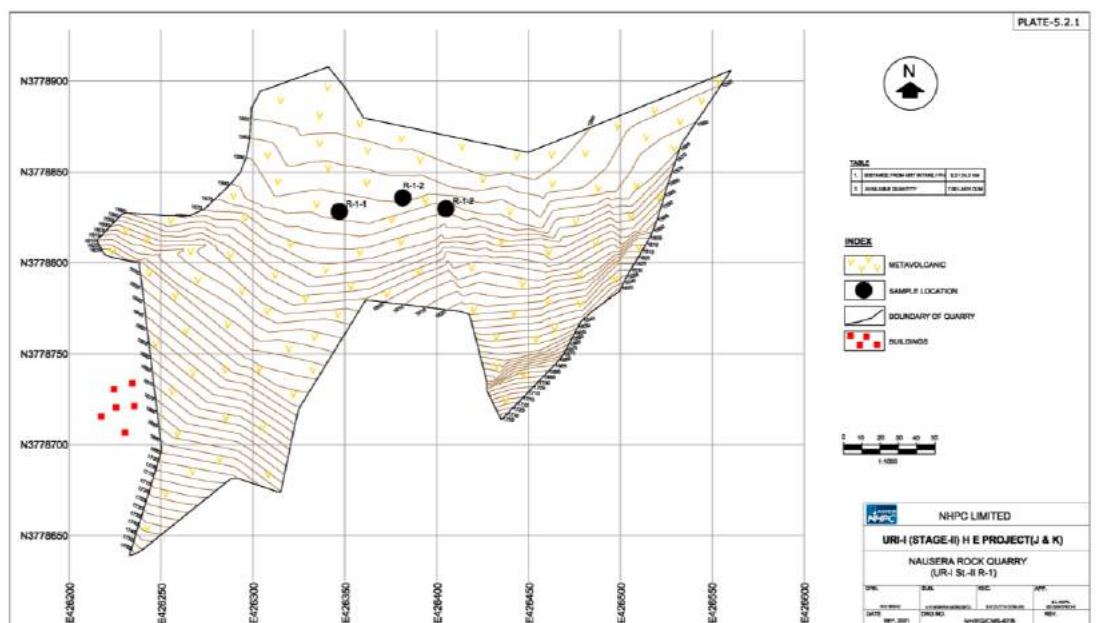
View of Mohra P/H Terrace Deposit

iv. Naushera Rock Quarry (UR-I St-II R-1)

This quarry is situated at the left side of Jhelum River above the National Highway & presently no approach road is available for this rock quarry. This rock quarry contains Meta-volcanic. It is estimated that material available from the quarry shall be 7.0 lakh cum.



View of Naushera Rock Quarry



Section of Naushera Rock Quarry

v. Hajipeer Rock Quarry (UR-I St.-II R-2)

This rock quarry is situated on the right bank of Hazipeer nala and presently well connected with road network. This rock quarry contains compacted silt stone/sand stone. It is estimated that 5.0 lakh cum of material shall be available from quarry. As material required for the construction of the project is available in nearby source, therefore this source is kept reserved.



View of Hazipeer Rock Quarry

vi. Excavated Material from HRT (UR-I St-II R-3)

The excavated material from HRT will be utilized as concrete aggregate. This rock quarry contains Quartzitic schist. It is estimated about 6.00 lakh cum total excavated muck will be generated, out of which around 1.80 lakh cum of usable quantity shall be available.



View of Excavated Material from HRT

vii. Excavated Material of Powerhouse Cavern (UR-I St-II R-4)

Suitable excavated material from powerhouse cavern will be utilized as concrete aggregate. Powerhouse is located on the left side of Jhelum River and presently well connected with road network. Excavated material of powerhouse contains Meta volcanics rocks. It is estimated about 2.80 lakh cum excavated muck will be generated, out of which around 1.00 lakh cum of usable quantity.



View of excavated rock material from Power House

1. Landscaping & Restoration Plan for Quarry and Borrow areas

The environmental impacts of excavation of construction material depend on the excavation process, local hydrological conditions, rock types, size and type of methodology adopted, and topography. Opening of rock quarries will cause visual impact because of the removal of a significant part of the hill face. Other impacts that are likely to be generated are the noise generated during aggregate acquisition through explosive and crushing (which could affect wildlife in the area), dust produced during the crushing operation to get the aggregates to the appropriate size and transport of the aggregates, and transport of materials to the nearby drainage channels. The quarrying for rock material in the proposed project would lead to the removal of vegetation cover, topsoil and leave the area barren. After the completion of mining activity, these areas will be restored to their normal habitat conditions.

Similarly, excavation and transportation of fine aggregates from the riverbed will cause visual impact because of the removal of a significant part of the riverbed. The extraction of construction material from riverbeds may also affect the river water quality due to an increase in the turbidity levels. This is mainly because the dredged material gets released during one or all the operations mentioned below:

- Excavation of material from the riverbed
- Loss of material during transport to the surface
- Overflow from the dredger while loading
- Loss of material from the dredger during transportation

The cumulative impact of all the above operations will lead to an increase in turbidity levels. Good dredging practices can, however, minimize turbidity. It has also been observed that slope collapse is the major factor responsible for the increase in turbidity levels. If the depth of cut is too high, there is the possibility of slope collapse, which releases a sediment cloud. This will further move outside the suction radius of the dredged head.

2. Mitigation and Restoration Measures for Quarries and Borrow Areas

Quarrying for construction materials will require **22.93 ha** (see Table below). Standard mitigation measures against erosion and sedimentation, noise and air pollution will be taken, especially for the use of explosives. At the end of the excavation, quarries will be rehabilitated. This will include re-establishment of vegetation, restoration of natural water courses, avoidance of flooding of the excavated areas, achievement of stable slopes, and avoidance of features, which would otherwise constitute a risk to health and safety or a source of environmental pollution. Rehabilitation and restoration of quarry sites shall be undertaken by engineering as well as biological measures.

S. No.	Facility	Area (ha)
1	Quarry area	7.34
2	Borrow Areas	15.59
	Total	22.93

A. Biological & Engineering Measures

The general plan to minimize the degradation of area due to mining for construction material would be as follows:

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

However, the details of measures proposed to be adopted for landscaping of the quarry site are described below:

i) Measures to be adopted before quarrying

The top 6-12" of soil will be removed before starting the quarrying activity or any other surface disturbance. This topsoil will be kept separate and stock piled so that it can be reused after quarrying is over for rehabilitation of sites. This soil contains all microbes (including earthworms) and important nutrients and organic matters which will be required at the time of restoration of the quarry sites.

ii) Measures to be adopted after quarrying

Filling of depressions: Removal of rocks from quarry sites for different construction works will result in the formation of depression and/or craters. The depressions are to be filled by the dumping materials consisting of boulders, rock, gravel, and soil from nearby plant/working

sites, followed by compaction to prevent subsidence, porosity, and permeability, and to increase the capacity of fill on site. Compacted inert waste material helps retarding percolation to the quarry base and the adjacent watercourse.

Diversion of run off: Effective drainage system will be provided to avoid the infiltration of run-off and surface waters into the ground of quarry sites.

Construction of breast wall/ retaining walls: Breast walls are generally constructed at the base of filled-up depressions of quarry sites to provide the necessary support, particularly where there are moderately steep slopes. At the top of the fill, cast concrete strip foundation and erect a random dry-stone rubble wall along the established and/or designed location of field boundaries; place the subsoil simultaneously on the lower sides of the terraces. Retaining walls will be constructed at the filled-up depressions of quarry site to provide necessary support particularly where there are moderately steep slopes.

Laying of the top soil: The depressions/craters filled up with rock aggregates will be covered with topsoil. The topsoil then will be covered with geo-textiles like coir, jute or by other locally available bio-degradable material. In addition, the fungal spores naturally present in topsoil will aid plant growth and natural plant succession. These activities will protect the topsoil from erosion. The topsoil will be further enriched by organic manure and Vesicular-Arbuscular Mycorrhizal (VAM) fungi. This will help in the process of soil reclamation and the early establishment of juvenile seedlings.

Revegetation: The work plan formulated for revegetation of the quarry site through 'Integrated Biological and Biotechnological Approach' would be based upon the following parameters:

- i. Evaluation of rock material for their physical and chemical properties to assess the nutrient status to support vegetation.
- ii. Formulation of appropriate blends of organic waste and soil to enhance the nutrient status of rhizosphere.
- iii. Isolation and screening of specialized strains of mycorrhizal fungi, rhizobium, azotobacter and phosphate solubilizers (bio-fertilizers inoculums) suitable for the mined-out sites.
- iv. Mass culture of plant specific biofertilizer and mycorrhizal fungi to be procured from different institutions/ organizations which are engaged in the phyto-remediation activity of degraded areas.
- v. Plantation at quarry site using identified blend and biofertilizer inoculums.

Though the above described are broadly recommended for rehabilitation of quarries after the mining operation of over at the site, however, it is recommended that the project proponent undertake detailed site surveys and formulate appropriate engineering measured after ascertaining the steepness of the slope and extent of depression formed after the excavation.

Generally, rehabilitation includes re-establishment of vegetation, restoration of natural watercourses, avoidance of flooding of the excavated areas, achievement of stable slopes, and avoidance of features, which would otherwise constitute a risk to health and safety or a source of environmental pollution. However, revegetation of bare slopes does not seem feasible in these quarries owing to steep slope face and almost complete absence of any soil cover which is a prerequisite for the establishment of any vegetation cover.

As the tentative cost of landscaping and restoration of quarry sites covering a total area of 22.83 ha cannot be estimated till a detailed engineering plan to stabilize the disturbed area of quarries is formulated by the project proponent to be prepared during pre-construction activities a lumpsum amount of **Rs. 50.00 lakh** have been earmarked for the same.

10.7.2 Construction Areas & Project Colonies

No permanent establishment is to be constructed for permanent residential or non-residential staff of project proponent. Staff quarters, field hostels/ bachelor's accommodations are available for executives, non-executives and workers in Gingal township complex of Uri-I Power Station.

However temporary buildings would be constructed for site offices and contractor staff and labour colony. The land required for temporary structures are already in possession of NHPC. These structures would be constructed in such a way that these buildings complete their life with the completion of the construction period. These activities will result either in the modification or destruction of the existing landscape of the area. It is therefore imperative that after the project work and related activities are over restoration work should be carried out in these areas to bring them back to their similar or near-similar pre-construction conditions and land use.

During construction period land will be required for establishment of workshops and Aggregate Processing Plant, Batching Plants, etc.

10.7.3 Aggregate Processing and Batching & Mixing (BM) Plant

To meet the total requirement of aggregate to produce the concrete for the project 1 no. of Aggregate Processing Plants (APP) of capacity 240 TPH for crushing, screening, and washing of coarse and fine aggregate have been proposed. Considering the total quantum of concrete including shotcrete two batching & mixing plants of 90 cum/h capacity are proposed to be used for catering the concrete production requirement of the project.

10.7.4 Workshops

For Hydro-Electrical-Mechanical work, Uri-I Power station has one operational, a fully equipped self-sufficient heavy equipment workshop servicing and repairing facilities in Boniyar Barrage Complex for maintenance of heavy construction equipment so that availability of equipment is maintained, and the work does not suffer for repairs and maintenance of equipment.

An electrical infrastructure wing is operational at Gingal Township complex which looks after every requirement of all complex at Uri-I Power Station. These may be provided to

contractors during the construction period. Besides this, maintenance facility may be availed from Baramulla district town.

Maintenance facility for Light Vehicle Workshop may be availed from Baramulla district town as well as various other workshops operational along NH-1.

Therefore, no additional facilities need to be developed for the construction phase of Uri-I Stage-II HEP. For development of Ferrule Fabrication Workshop sufficient land is available near Powerhouse area.

10.7.5 Mitigation and Restoration Measures

Although the land required for construction facility area and colony for development of Uri-I Stage-II HEP is already in possession of NHPC preciously utilized during construction of Uri-I Stage-I Project (Uri-I Power Station). All these sites were restored after completion of Uri-I Stage-I construction. No additional infrastructure is required to execute the proposed project. The existing offices, residential colony, field hostels, transit camps of Uri-I Power Station facilities shall be utilized. However temporary colony and construction facility shall be established near the construction sites and it is necessary to restored these area after completion of construction work. The following measures will be undertaken for the rehabilitation/ restoration and landscaping of the construction sites:

- Herbaceous plants and tree seedlings will be sown in alternating rows along the colony area. The growth of tree shrubs and herbaceous species will provide adequate erosion control, add vegetation variety for aesthetic values and provide the habitat for wildlife.
- The choice of the tree species for plantation will depend upon the topography of the area required to be regenerated after the constructional activities.
- The species which fix nitrogen like *Robinia pseudoacacia* (leguminous) will help in increasing nitrogen levels of soil, sufficient to maintain growth of non-nitrogen fixing species.
- Retaining walls will be built to avoid the landslides and slips. Proper channels would be provided inside the colony to drain out the rain/ domestic water.

After the project activity is over construction sites and other temporary settlements would be splattered with the top soil (separated out before construction). These leftovers can support the growth of mosses and lichens which will act as ecological pioneers and would initiate the process of succession and colonization. This will provide necessary cushion and support for the growth of seeds of other plants to germinate.

The creation of Green Belt around project areas is being planned and discussed later in the chapter.

10.7.6 Project Roads

10.7.6.1 Roads to the Project Components

The Uri-I Stage-II HEP utilizes the existing infrastructure of Uri-I Stage-I HEP (Uri-I Power Station) located along the left bank of Jhelum River and are well connected to NH-1.

Similarly, the adits of Uri-I Stage-I HE Project are planned as such to utilize during construction of HRT of Uri-I Stage-II and these are also well connected to road network. The proposed powerhouse and TRT outlet are located alongside of Uri-I Power Station powerhouse and TRT outlet which also approachable through existing project road well connected to NH-1. Therefore, no additional road construction is envisaged for the development of Uri-I Stage-II HEP.

10.7.7 Plan Implementation

The landscaping and restoration plan will be implemented with help of landscaping experts and in consultation with Jammu Kashmir Horticulture Department and concerned forest division and funding will be provided by the project proponent for successful implementation of this plan.

10.7.8 Cost Estimates

The estimated cost for the restoration works, landscaping of quarry areas, roadside plantations, and creation of green belt around reservoir and colonies and working sites would be **Rs. 130.00 lakh**.

Table 10.44: Summary of Cost estimates

S. No.	Item	Amount (Rs. in lakhs)
1	Reclamation of quarry areas	50.0
2	Restoration of construction areas, colonies, and residential areas	80.0
	Total	130.00

Total Cost with Capital & Recurring Cost for Implementing Landscaping, Restoration of Quarry & Construction Sites

Capital Cost (Rs. In lakh)	Recurring Cost (Rs. In lakh)							Total Cost (Rs. In Lakh)
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	
25.00	0.00	25.00	30.00	20.00	15.00	15.00	0.00	130.00

**Section
10.8****RESERVOIR RIM TREATMENT PLAN****10.8 RESERVOIR RIM TREATMENT**

The Uri-I Stage-II HEP utilize the existing reservoir, barrage, water conveyance system consisting of Head regulator upto HRT intake of Uri-I Power Station located on the left bank of Jhelum River.

Uri-I Power Station is a run-off the river project with 21.5 m high barrage having reservoir extending about 950.0m length at FSL along river Jhelum. The reservoir capacity is 23.71 ha at FRL 1491M. The reservoir is under operation since 1997 and no changes are envisaged due to construction of stage-II project. In the reservoir area, river Jhelum flows generally in NE-SW direction. The immediate slopes on both banks of the reservoir are gentle to moderate and occupied by thick pile of riverine / fluvioglacial material and slope wash material. However, the upper slopes are steep with rock cliffs. Bedrock of quartzitic schist, schistose quartzite are exposed in the vicinity of reservoir periphery.

10.8.1 Geology of Reservoir Area

The barrage and reservoir area are completely located in the Tanawal Schist and Jhelum fill material. These structures are already existed, and no diversion structure is proposed Uri-I Stage-II HE Project.

10.8.2 Landslides

In general, the reservoir rim appears to be stable. There are no landslides in the reservoir area and has no implication of any kind whatsoever on the competency of the already operating reservoir.

10.8.3 Treatment Measures

As discussed earlier that the reservoir of Uri-I Power Station is under operation since 1997 and no changes are envisaged due to construction of stage-II project. Similarly, though no major active landslide or slope instability is present in the reservoir area.

In general, the reservoir rim appears to be stable. There are no landslides in the reservoir area and has no implication of any kind whatsoever on the competency of the already operating reservoir. The higher slopes are stabilized by contour drains /step drains suitably connected channelized to the river/reservoir. Both banks of the reservoir rim has also been stabilized by rip rap boulder pitching and other protection measures and are well maintained. In addition to ongoing treatment measures taken by Uri-I Power Station, treatment measures for degraded areas with financial provision has been made Catchment Area Treatment Plan. Also, enrichment plantation will be carried out on suitable areas along the banks of Uri-I Power Station reservoir (Jhelum River) under Green Belt Development Plan (refer section 10.9). Therefore, no additional budget has been allocated for the Reservoir Rim Treatment Plan.

Plate 5.1

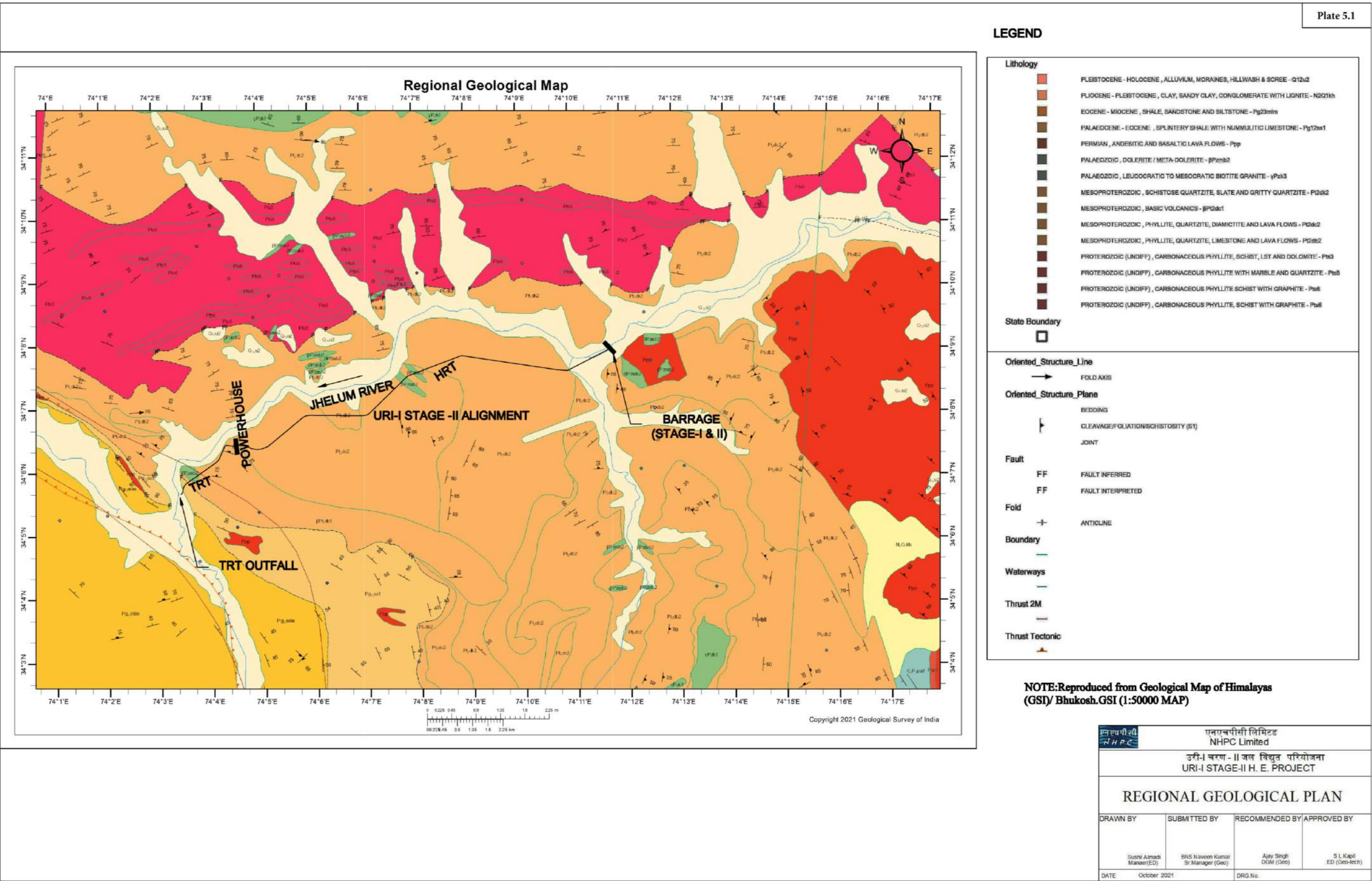


Figure 10.13: Geological map of Uri-I Power Station Project Area (Source: DPR)

Section 10.9

GREEN BELT DEVELOPMENT PLAN

10.9 GREEN BELT DEVELOPMENT

Green Belt Development Plan will comprise plantations at various places like alongside roads, around the periphery of reservoir rim, construction areas, and at different project offices and colonies.

10.9.1 Roadside/Avenue Plantation

No new roads are required to approach the construction sites and for construction activities. The existing road of Uri-I Stage-I (Uri-I Power Station) shall be utilized during construction of Stage-II project components. All the roads in the project area are well maintained. Greenbelt development and plantation activities were carried out during rehabilitation of sites after completion of Uri-I Stage-I construction work.

There is very little feasibility to undertake roadside plantation along the roads. However, assuming the availability of the area around the project road financial provision for tree plantation has been proposed.

10.9.2 Green Belt Development along the Reservoir Rim

The proposed Uri-I Stage-II HE Project utilizes the existing reservoir of Uri-I Power Station. The reservoir is under operation since from last 25 years. The annual maintenance was carried out at vulnerable locations by project authorities with close association with concerned forest division of J&K Forest Department. A viewpoint is already constructed upstream of the barrage on the left bank and is well maintained. The dumping site on the downstream of barrage has been developed as green belt zone, parks and gardens. Further adjacent to the approach highway, the cut and cover section of head regulator and intake area is well developed as recreation park and is open for public and well maintained by NHPC.

The afforestation and enrichment plantation along the rim of existing reservoir over the land under jurisdiction of forest department is proposed with financial provision has been made under Catchment Area Treatment Plan (CAT Plan) (**refer section 10.2**). In addition to plantation under CAT Plan, avenue plantation the suitable location along the reservoir rim over on land under NHPC possession has been proposed under Green Belt Development Plan to increase the greenery and beautification of the area. Financial provision of **Rs. 5.00 lakh** has been kept for Greenbelt Development along reservoir rim of Uri-I power station.

10.9.3 Green Belt at Barrage Site and Powerhouse site

As stated earlier proposed Uri-I Stage-II HEP utilize existing barrage of Uri-I Stage-I (Uri-I Power Station). Similarly, Powerhouse of both Stage-I and Stage-II are at same location. The restoration and planation activities were successfully completed after commissioning of Uri-I Stage-I.

For enrichment plantation, avenue plantation and beautification of the area around barrage and powerhouse site plantation of species of recreational value, horticultural importance shall be planted within the complex. The following measures will be undertaken for the development of greenbelt after rehabilitation/ restoration and landscaping of the construction sites:

- Herbaceous plants and tree seedlings, grown in nurseries will be sown in alternating rows. The growth of tree shrubs and herbaceous species will provide adequate erosion control, add vegetation variety for aesthetic values and provide the habitat for wildlife.
- The rows of herbaceous plants will be later used for the cultivation of medicinally important plant species.
- The choice of the tree species for plantation will depend upon the topography of the area required to be regenerated after the construction activities.
- The species which fix nitrogen like *Robinia pseudoacacia* (leguminous) will help in increasing nitrogen levels of soil, enough to maintain the growth of non-nitrogen fixing species.

10.9.4 Green belt around Crusher and Batching & Mixing Plants

The land utilized for establishment of Crusher and Batching & Plants are already under possession of NHPC. The area shall be restored after completion of work. During construction phase for mitigating the impact of dust and noise, which will rise from the crusher plant, plantation must be done around the crusher plant area.

10.9.5 Green Belt around Colony area and Office Complex

No additional infrastructure is required to execute the proposed project. The existing offices, residential colony, field hostels, transit camps of Uri-I Power Station facilities shall be utilized. The colony area has been well established along with avenue plantation and beautification. However, the financial provision of **Rs. 5.00 lakh** has been kept under Greenbelt Development Plan for plantation activities in the colony area.

Besides this, it is also proposed to develop a green belt around the working areas for trapping the dust and noise. Plantation of avenue, ornamental, and fruit trees are proposed in these areas along with the area around the office complex. The ornamental and fruit plants will be procured from the horticulture department and local market while plants for avenue plantation will be procured from the forest department nursery. For the protection of trees from cattle, iron tree guards shall be required.

10.9.6 Choice of Species

The plantations have been suggested for restoration and reclamation of quarry areas, working sites, and plantations in and around the residential colonies, green belt local native species of trees, shrubs, and herbs have been suggested and a list of these species is given in **Table 10.45**.

Table 10.45: Plant species suggested for landscaping and restoration work

S. No.	Family	Scientific Name
Trees		
1	Fabaceae	<i>Robinia pseudo-acacia</i>
2	Juglandaceae	<i>Juglans regia</i>
3	Oleaceae	<i>Fraxinus xanthoxyloides</i>
4	Pinaceae	<i>Cedrus deodara</i>
5	Pinaceae	<i>Pinus wallichiana</i>
6	Rosaceae	<i>Prunus armeniaca</i>
7	Rosaceae	<i>Malus domestica</i>
8	Salicaceae	<i>Salix denticulata</i>
9	Salicaceae	<i>Salix alba</i>
10	Salicaceae	<i>Salix fragilis</i>
11	Salicaceae	<i>Populus ciliata</i>
Shrubs		
1	Berberidaceae	<i>Berberis aristata</i>
2	Berberidaceae	<i>Berberis lycium</i>
3	Cupressaceae	<i>Juniperus communis</i>
4	Ephedraceae	<i>Ephedra gerardiana</i>
5	Grossulariaceae	<i>Ribes orientale</i>
6	Rosaceae	<i>Rosa moschata</i>
7	Rosaceae	<i>Rosa webbiana</i>
8	Rosaceae	<i>Prunus armeniaca</i>
9	Rosaceae	<i>Prunus padus</i>

10.9.7 Development of Nursery

In order to cater to the needs of biological treatment measures, proposed under Mucking Management Plan, Greenbelt Development Plan and landscaping and restoration of Construction Site Plan of Uri-I Stage-II HEP, one new temporary nursery of 1 ha is proposed to be developed. The cost for the formation of nursery is **Rs. 4,13,305.36/- (Say 4.13 lakh)** and the cost of raising of plant material and maintain ace including engagement of Labours as Watch and Ward for the period of five year is **Rs. 31.46 lakh**. The cost for the formation of new nursery has been taken as per the norms provided by the office of Chief Conservator of Forests, Kashmir vide Letter No. 421/CCF(K)/Plg/2023-24/871-72 dated 19/07/2023, refer (**Annexure IV**). The total financial provision kept under development and maintenance of nursery is **Rs. 35.59 lakh**.

The suitable land under possession of NHPC shall be used for development of temporary nursery. State forest department has been engaged for the development and running of nursery. NHPC will provide financial assistance for development and operation of nursery till the management period of plantation carried out under Environmental Management plan of Uri-I Stage-II HEP.

10.9.8 Cost Estimates

The estimated cost for the creation of green belt around reservoir, roadside and colonies and working sites would be **Rs.75.59 lakh**. A summary of the same is given at **Table 10.46**.

Table 10.46: Cost estimates for biological & engineering measures

S. No.	Item of work	Quantity	Rate/ Unit (Rs. In lakh)	Amount (Rs. in lakh)
1	Roadside/ Avenue Plantation	5.0 ha	1.00	5.00
2	Greenbelt development along the reservoir area*	0.00	0.00	5.00
3	Greenbelt Development at Barrage site and Powerhouse site	--	Lum sump	15.00
4	Greenbelt Development around Crusher plants	--	Lum sump	5.00
5	Greenbelt Development around colony area and offices	5.0 ha	0.50	10.00
6	Development of Temporary Nursery**	1 ha	4.13	4.13
7	Maintenance of Nursery **	5 years	--	31.46
	Grand Total			75.59

Total Cost with Capital and Recurring Cost for Implementing Green Belt Development Plan

Capital Cost (Rs. In Lakhs)	Recurring Cost (Rs. In Lakhs)							Total Cost (Rs. In Lakhs)
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	
0.00	4.13	4.12	11.01	14.48	19.93	11.18	10.74	75.59

**Section
10.10****SANITATION AND SOLID WASTE
MANAGEMENT PLAN****10.10 SANITATION AND SOLID WASTE MANAGEMENT**

The solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management to dispose of as warranted under the Solid Wastes Management Rules (SWM), 2016. For that, an efficient waste management system will be required to put in place to keep the environment of the region clean and healthy. These colonies and temporary settlements will also require an adequate water supply for drinking and cleaning. The project authorities will ensure sewage generated from labour colonies and site office is treated and disposed of as per the SPCB guidelines. It is proposed to provide adequate septic tanks with soak pits for treatment and disposal of sewage from labour and project colonies.

The waste generation rate in Indian cities ranges between 200-870 grams/capita/day, depending upon the region's lifestyle and the size of the city. The per capita waste generation is increasing by about 1.3% per year in India (Annepu, 2012). State-wise data show that Jammu & Kashmir average is about 540 gm/capita/day, however, the project area being small-town/rural is expected to generate lower than that of the state average. It is assumed for the estimation of quantum of waste generation, for preparation of solid waste management plan, that migrant labour population will follow the local pattern. Therefore, when the project goes for construction, about 300 grams/capita/day is expected to be generated.

Further, the peak worker population is estimated to be 500 persons (350 labours + 150 technical staff). It is also expected that locals in the proximity will also use solid waste management facilities; keeping this in view, the plan is prepared for about 500 persons.

For 500 persons an estimated amount of about 150 Kg/day (0.30 kg x 500 individuals) of solid waste will be generated. This waste will be collected, segregated, and disposed of in line with the provisions laid down in Solid Waste Management Rules, 2016.

10.10.1 Management of Solid Waste

The project authority shall, within the territorial area of the project complex/ colony, be responsible for the implementation of the provision of Solid Wastes Management. Adequate facilities for the collection, transportation, and disposal of solid waste will be developed. Any solid waste generated in the project complex/ project colony/ labour colony, shall be managed and handled appropriately. Various aspects of solid waste management include:

- Reuse/Recycling
- Storage/Segregation
- Collection and Transportation
- Disposal

10.10.1.1 Reuse/Recycling

The project proponent/contractor will explore the opportunity to recycle the waste generated at the project site, project will identify authorized vendors for recycling or disposal of used batteries, used oil, and used oil filters, etc. Bio-degradable waste will be treated in Organic Waste Composter (OWC) and the manure generated will be use in project developed gardens, green belts and distributed to local villagers.

10.10.1.2 Storage and Segregation

In the project & labour colony, project office and worksites provisions shall be made to separately store the degradable and non-degradable solid waste. Two different coloured bins will be provided to each family, who will segregate the waste generated in their household. Green and Biodegradable waste will to be deposited in one container and non-biodegradable waste in another container. In the case of canteens and community kitchens also, two different coloured dust bins will be used for separately storing the biodegradable and non-biodegradable waste generated and such bins will all installed at appropriate places in the labour and project colony, offices, project market area, etc. A sustained awareness programme will be conducted to educate workers about the segregation of degradable and non-degradable wastes.

10.10.1.3 Collection and Transportation

The project authorities shall prohibit littering of solid wastes in the area under their control by resorting to the following collection practices:

- Organizing house-to-house collection of solid waste on regular pre-informed timing will be done by using mini trucks.
- Collected waste from residential areas shall be transferred to community collection area by suitable vehicle.
- Collection of wastes from office complexes and commercial areas.
- Construction/demolition wastes, or debris shall be separately collected and disposed of.
- Wastes from community kitchens from labour colony shall be separately collected.

Solid waste collected shall be disposed of at a common storage point. Three mini-trucks will be commissioned to collect the solid waste and dispose of the same at sites designated for the disposal of solid waste.

10.10.1.4 Disposal

The solid waste will be transported for disposal at the designated landfill sites. The landfill shall have impervious clay at the bottom-most layers. The second layer shall be impervious liner (Geomembrane), the third layer will be of sand, after that well-compacted solid waste is to be put over the sand, then again, a layer of clay, finally a layer of soil. Vegetation shall be grown on the topmost layers. It will give a good aesthetic view of the landfill.

i) Degradable component

The bio-degradable portion of the solid waste would be disposed of by composting. The degradable portion is expected to be about 50% i.e., about 75 kg/day of the degradable portion of solid waste will be generated.

For treatment of bio-degradable solid waste, provision of Solid Waste Treatment Plant has been proposed established in the project area. The capacity of treatment plant is about 5 ton/day. Proposed Solid Waste Treatment Plant not only manage the solid waste generated inside the project area, but also cater the management of Solid Waste of Killar town and surrounding villages. The composting process takes around 45-60 days to mature. The screened compost would be used as good manure especially for the cultivation of vegetables and for fruit orchards in the area. The treated waste is further utilized as manure at plantation sites, gardens, and herbal park.

ii) Non-Degradable component

The non-degradable portion (about 28 ton/annum) shall be segregated and transported to disposed at designated sites to be finalized with local authorities. No land fill site will be developed on the hill slopes. A transfer station at a suitable location shall be set up to collect residual and inert waste. A suitable landfill site shall be identified in consultation within proximity of project colony area (land under possession of NHPC) under for setting up sanitary landfill. In case on non-availability of land, in consultation with local authority, waste can be disposed off at regional landfill site. The details of land fill site are given as below:

Waste Generation:	75 kg/day
Design Life:	4 years (construction phase)
Total Waste Generation in 4 Years:	109.50 tons
Volume of waste:	129 m ³ (assumed density =0.85 tonnes/m ³)
Provision of daily cover, liner, etc.:	26 m ³ (20% approx.)
Total Volume:	155 m ³
Pits of Size (LxWxD):	12m x 8m x 3m (effective depth 2.7 m)

A provision of additional 25% of the total area, for accommodating infrastructure facilities will be included while working out requirement of space. The liner system will comprise of the following layers below the waste:

0.30m thick drainage layer comprising of coarse sand or gravel

0.2m thick protective layer of sandy silt

1.50mm thick HDPE geo-membrane

1m thick clay layer/amended soil layer, comprising of local soil.

iii) Bio-medical Wastes

Biomedical waste is generated during the diagnosis, treatment or immunization of human beings. It may include wastes like scrap, anatomical wastes, culture media, discarded medicines, chemical waste, syringes, swabs, bandages, body fluids, human excreta, etc. These wastes are highly infectious and can be serious threat to human health if not managed in a scientific and discriminate manner. In Uri-I Stage-II HEP, biomedical waste will be generated

from first aid posts and other medical establishments in the area. As the quantity of biomedical waste generated is not expected to be very significant requiring separate incineration at project site, it is proposed to have a tie up with Govt. hospital at Baramulla to treat/ dispose-off biomedical waste generated from project activities in their facility.

At present handling of biomedical waste generated from such facilities will also be included as part of upgrading component as the existing facilities are not in place. Provision of financial aid under Public Health Delivery System for strengthening existing medical facilities at Project Hospital is allocated for this plan.

iv) Sewage Treatment

For disposal and treatment of sewage generated from the project area (labour colony and staff quarters), provision of Sewage Treatment and Disposal Plant of capacity is about 15 kiloliters/day has been proposed. The sewage from the community toilet will be treated in a septic tank.

10.10.2 Financial Requirement

The total budget to manage the solid waste generated from this population has been proposed as **Rs. 206.56 lakh (Table 10.47)**.

Table 10.47: Cost Estimate for Solid Waste Management Plan*

S. No.	Item	Cost (Rs. lakh)
1	Solid Waste Treatment Plant (including organic waste composter at NHPC Uri-Power Station Colony)	20.0
2	Operation and maintenance of Solid Waste Treatment Plant during construction (@ Rs. 1.0 Lakh/year for 4 years)	4.0
3	Construction at composting site	25.0
4	Reclamation and stabilization of land fill and composting site	10.0
5	Sewage Treatment Plant at NHPC Uri-Power Station Colony (1 No.)	50.0
6	Septic Tanks at Labour colony**	0.0
7	Two covered mini trucks for the conveyance of solid waste to landfill site @ Rs. 15.00 lakh per truck	30.0
8	Running, operation and maintenance of trucks including driver's salaries @ Rs. 25000 per vehicle per month for 2 vehicles for 4 years	24.0
9	Manpower cost for 6 persons @ Rs. 12000 per person per month for 4 years	34.56
10	Awareness Programme/ Periodical Training for control and management of waste generation (Rs. 1 Lakh/ year)	4.0
11	Tools & implements	5.0
Total Cost (Rs. lakh)		206.56

* Cost of land is taken in DPR;

** Cost for construction of septic tank is taken in DPR under construction cost of colonies

Total Cost with Capital & Recurring Cost for Implementing Sanitation & Solid Waste Management Plan

Capital Cost (Rs. In Lakhs)	Recurring Cost (Rs. In Lakhs)				Total Cost (Rs. In Lakhs)
	Year 1	Year 2	Year 3	Year 4	
111.00	31.64	25.64	21.64	16.64	206.56

Section 10.11

PUBLIC HEALTH DELIVERY SYSTEM

10.11 PUBLIC HEALTH DELIVERY SYSTEM

10.11.1 Existing Medical Facilities

Medical services at secondary level play a vital and complimentary role to the tertiary and primary health care systems and together form a comprehensive district-based health care system.

Requisite medical facilities are available at Gingal township complex. A well-equipped Hospital along with adequate residential Doctors is operational in the Gingal premises. This will be further strengthened during construction. In order to cater for the medical care and emergency needs of the project workers, first aid and take care of any construction related injuries, common sickness and medical emergencies along with medical ward, under the charge of 2 qualified medical officer supported by sufficient support staff. 2 nos. of well-equipped ambulances shall also be provided at the clinic under the control of a medical officer. Public health system is also available in District Town Baramulla. These are frequently supported by Uri power station. Adequate medical equipment, stretchers, medical oxygen cylinders etc. shall always be kept in ready to service position. Sufficient stock of medicines shall be kept at the clinic to meet the requirements at the Project Site.

10.11.2 Objective of Public Health Delivery System

- Provide medical facilities at the construction sites during construction Phase.
- To improve efficiency in the allocation and use of health resources in the project area.
- To improve the performance of the health care system in the project area through improvements in the quality, effectiveness and coverage of health services at the first referral level and selective coverage at the primary level, to improve the health infrastructure.

10.11.3 Threats to Public Health

Project construction and operation will bring about several changes in the socio-economic environment of the area including increased threats to the health of the community. Possible threats to public health are briefly discussed below along with the management measures.

- New Diseases due to Migratory Population:** During the project construction period, there will be increase in the population of this region, particularly around the project area. Migrant workers and their family members may be the potential carriers of new diseases hitherto unknown/unreported from the project area. Diseases like VDs, gastroenteritis, etc. are some of the potential risks to human inhabitants of this area. The present available health services in the area would be insufficient to cater to such a influx of outside population in this area. Therefore, the project authorities and their contractors will have to register all the labourers

including their family members, quarantine and vaccinate them against common diseases like malaria, etc. The project authorities will hold screening camps for the labourers, where rapid blood tests will be conducted for diseases like, TB, etc. and health card will be issued. Only after valid certification a labour or his family members will be registered with the contractor. The project authorities would ensure that the contractors follow this strict quarantine procedure, and this clause would be included in the award of the contract/works. Adequate medical facilities will be provided by the project authorities for this purpose in addition to providing medical facilities to workers.

- ii. **Chances of increase in water borne diseases are high** if there is a stagnant water body in the vicinity. Stagnation of water and multiplication of mosquitoes and other vectors is not anticipated as long as adequate hygiene and sanitation standards are maintained, however, monitoring and preventive measures are recommended to prevent outbreak of water-borne diseases.
- iii. **Chances of increase in respiratory troubles due to increase in suspended particles during the construction phase.** Mainly a cause of concern for construction workers who are likely to be exposed to dust for long hours. PPEs, such as dust masks, are recommended to mitigate such impacts.
- iv. **Chances of occurrence of gastroenteritis, cholera and typhoid in the labour camps.** The project should make proper arrangements for maintaining high hygienic conditions in the colonies and labour camps, by providing good sanitation and drinking water facilities. Medicines would be distributed to the labour during the construction period as and when required.

10.11.4 Medical Facilities

A migratory population of labour force of about 500 persons is expected to be present during construction phase. One part of impact is on local population due to migrant population and second part is medical needs of migrant population putting stress on existing limited medical resources in the area. Another dimension which needs to be kept in mind while planning medical services from project side is the risk of accidents during project construction and emergency medical services to respond to such incidents. Working at heights, underground operations, blasting using explosives, use of heavy machinery and equipment with moving parts, movement of large number of vehicles carrying men and material, etc. increase the risk of accidents at workplace. Despite training and use of safety gears, possibilities of accidents at workplace cannot be ruled out and require preparedness.

It is recommended that the developer provide the following medical facilities, directly or through contractor, to ensure safe and healthy operations during the entire construction phase. This also helps in minimizing the dependence of labour population on the existing medical facility.

- Two fully equipped ambulances need to be procured to provide pre-hospital care. The ambulances should always be stationed near major construction sites or sites where risky operations are taking place. Typically, the ambulance should have equipment such as Forno-flex Chair/COT, Ventilator, Vacuum Splint Kit (Adult), Scoops Stretcher, Oxygen Cylinder with accessories, Resuscitation Bag (Adult), Suction Pump, Spine Board, siren/beacon, Emergency Light with public address system, Wireless equipment, additional battery, First Aid bag, BP instrument, stethoscope, etc. and with trained manpower.
- Two first-aid posts will be established - near proposed construction sites and colony areas to take care of basic medical needs of the workers at major construction site. The first aid posts will have essential medicines including dressing materials, stretcher, wheelchair, ORS packets, etc. The first aid post can be housed in a temporarily erected structure and should be managed by one Health Assistant and assisted by one dresser/first aid attendant. Visiting doctors can attend First Aid post regularly every day at a fixed time. Project will also provide a dispensary with at least one doctor and assisting staff for day-to-day medical needs of Project employees and locals.
- As the existing medical facilities in the area are not adequate, budget provisions have been made for strengthening existing facilities in the project area.

10.11.5 Health Extension Activities

The health extension activities will have to be carried out in the villages situated within the study area. It is important to inculcate hygienic sanitary habits especially with respect to water pollution by domestic wastes.

A health worker from NHPC Hospital at Uri-I Power Station, Ginal and district hospital Baramulla to be engaged to make regular visits to these villages and organize health promotional activities with the active participation of the local village leaders, NGOs and available local health functionaries. The health functionaries would undertake the following tasks as a part of health promotional activities:

- Awareness programs and medical camps will be organised to make people aware about the common diseases in the region. This should include poster campaign, awareness camps, medical camps for health check-ups and vaccination/ treatment, etc.
- Collect water samples to ascertain the potability of water from different sources so as to Regular monitoring of water quality of drinking water sources.
- Maintain close liaison with the community leaders and health departments, so that they can be mobilized in case of an emergency.
- Close interaction to be maintained with health department functionaries of the state government.

10.11.6 Cost Estimates

Budgetary estimates for the public health delivery system have been worked out as **Rs. 166.00 lakh**, as per the breakup given at **Table 10.48**.

Table 10.48: Budgetary estimates for developing health care facilities

S. No.	Particulars	Amount (Rs. lakh)
1	Ambulance: 2 no. with all the basic Medicare facilities and small DG set, etc. in the project area	30.00
2	Budget for running the ambulances including driver salary, fuel and maintenance for 4 years @ 3 lakh per ambulance per annum for two ambulances	24.00
3	Two first aid posts including sheds, furniture and basic equipments	15.00
4	Budget for running two first aid posts @ Rs. 8 lakh per post per annum including cost of medico, para-medico/ Nurses and attendant, consumables, etc. for 4 years	64.00
5	Budget for strengthening existing medical facilities at Uri-I Power Station Project Hospital	25.00
6	Budget for Health Awareness/ Vaccination Camps @ Rs. 2.00 lakh per annum for 4 years	8.00
	Total (Rs. lakh)	166.00

Total Cost with Capital and Recurring Cost for Implementing Public Health Delivery System

Capital Cost (Rs. In Lakhs)	Recurring Cost (Rs. In Lakhs)				Total Cost (Rs. In Lakhs)
	Year 1	Year 2	Year 3	Year 4	
50.00	29.00	29.00	29.00	29.00	166.00

**Section
10.12****ENERGY CONSERVATION MEASURES****10.12 ENERGY CONSERVATION MEASURES**

As discussed previously, the proposed project would remain under construction for about 4 years, and it is estimated that migrant population during peak construction phase will be of the order of 500 workers (labour and staff). It is the general tendency of the migrant laborers to use forest wood for fuel and other domestic uses, especially when it is easily available. This would create serious biotic pressure on the nearby forest. To mitigate such impacts, various management measures need to be put in place and strictly implemented.

Energy Conservation Measure (ECM) are to be planned and implemented during construction phase either directly by developer or through contractor to reduce the pressure on natural resources in the project area and minimize impacts on this count. These measures can affect a variety of resources mainly forest, from negative impact of fuel wood collection by stakeholders as well as by labours during construction period. To mitigate such impacts, feasible measures will be adopted to help minimize pressure on forest. These are briefly discussed in the ensuing text.

10.12.1 Conservation Measures

Renewable natural resources like Forests should be protected/ cared to enhance quality of life and can also be used and replenished for future use. In study area, supply of cooking gas and kerosene is available in all villages, but fuel wood is the dominant source of energy due to its easy availability; therefore, there is need to reduce the pressure on natural forests for wood. With an estimated migrant population of 500 persons in the area, the existing facilities will become insufficient for supply of kitchen fuel for the migrant population during the construction of the project. Fuel for cooking is an essential requirement and in the absence of adequate fuel availability they will resort to tree cutting for use of fuel wood. The project authorities would need to make adequate arrangements for supply of fuel for domestic use. It shall be the responsibility of the Contractors to provide the subsidized LPG cylinders, free/ subsidized kerosene oil along with improved smokeless Chullahs and other alternative fuel arrangements to the Labour population to reduce impact on forests in project vicinity. LPG godown shall be established by the project in association with State Govt. near project area to cater to the need of LPG cylinders for use of labour and project staff. The kerosene oil depot may also be established by project/ contractor for providing the free kerosene oil to labour population.

10.12.2 Provisions for Kitchen Fuel

The demand for kitchen fuel will increase due to the population coming from outside for the construction and other related work of the project. Project authority through contractor/ working agencies should provide kitchen fuel and make arrangement for community kitchen, canteen and efficient cooking facilities, as briefly discussed below.

Community kitchen: The project developer through contractor/ working agencies would make sufficient arrangement for the establishment of at least two community kitchens. These will be established near the project colonies. The kitchen should provide food to the labour at subsidized rates. The facility should maintain proper hygiene while preparing and supplying food, with adequate arrangement for waste collection and disposal. In addition, canteens are also proposed for labour near major construction sites to provide tea/snacks at subsidized rates.

Kitchen fuel: During the construction period of the project, many families may prefer cooking on their own instead of using community kitchen. In absence of fuel for cooking, they would resort to tree cutting and using wood as fuel. To avoid such situations, the project authority through contractor/ working agencies should make LPG available to these migrant workers. The supply of LPG can be ensured on regular basis at subsidized rates.

It is estimated that about 50% of married labour families and all the technical and supervisory staff would prefer doing their own cooking. Additional connections would be needed for community kitchens, and married labour families. Based on this, it is estimated that a total of 600 LPG connections would be needed for locals, labour and community kitchen. Therefore, developer through contractor/ working agencies will coordinate with the LPG supplier to set up a storage depot in the area to ensure regular supply of LPG cylinders in the project area during construction period.

Efficient cooking facilities: Project authority should also take measures for reducing the fuel consumption. The authority should provide solar cookers and pressure cookers through contractor/ working agencies to migrant workers. Accordingly, budget has been allocated for the supply of cookers. This facility will also increase work efficiency of migrant workers and they will also get proper daily diet.

Solar Cookers and Lantern: Provision of solar lantern has also been made in the project budget and these will be distributed among the workers.

Awareness Programmes on Energy Conservation: Special awareness programmes against tree cutting should be held, which should concentrate on the awareness of labor families and villagers on environment conservation and sustainable development for the future generations. Thus, issues like saving trees, electricity and water should be covered in such programmes.

10.12.3 Cost Estimates

A total budget of **Rs. 152.00 lakh** have been proposed towards the provision of kitchen fuel, and other facilities including establishment of community kitchen or canteens for the migrant workers (**Table 10.49**).

Table 10.49: Financial Provision for Energy Conservation Measures

S. No.	Particulars	Amount (Rs. In lakh)
1	Connection cost of 200 connections @ Rs. 5000.00 per connection	10.00
2	Community Kitchen (2 No.) – capital cost (Rs. 5.00 lakh per kitchen)	10.00
3	Community Kitchen (2 No.) –running cost for 4 years @ Rs. 8 lakh per kitchen per annum	64.00
4	Canteen (2 No.) – capital cost (Rs. 3.00 lakh per canteen)	6.00
5	Canteen (2 No.) – running cost @ Rs. 5.0 lakh per canteen per annum for 4 years	40.00
6	Distribution of Solar Cooker and Pressure Solar Lantern to project staff and labours	20.00
7	Community Awareness Programme @ Rs. 0.50/ annum for 4 years	2.00
	Total (Rs. lakh)	152.00

Total Cost with Capital and Recurring Cost for Implementing Energy Conservation Measures

Capital Cost (Rs. In Lakhs)	Recurring Cost (Rs. In Lakhs)				Total Cost (Rs. In Lakhs)
	Year 1	Year 2	Year 3	Year 4	
26.00	31.50	31.50	31.50	31.50	152.00

Section 10.13

LABOUR MANAGEMENT PLAN

10.13 LABOUR MANAGEMENT PLAN FOR THEIR HEALTH AND SAFETY

About 500 labour and technical staff would be engaged temporarily during the peak construction period, which is planned to be completed in 44 months. Construction work has many associated risks and health impacts for the workers who are directly exposed to such health and safety risks. Direct exposure to heat, noise and dust can cause long term health impacts. On the other hand, risky operations if carried out by untrained workers can cause serious accidents at sites not only affecting to those working at site but also in surrounding areas. Natural accidents such as flooding, landslide, earthquake also pose risk to life of workers on the project site. Therefore, there is a need to prepare complete health and safety documents for workers either by project proponent or by contractor and project proponent shall ensure its implementation. The document should cover the following:

1. Identification of risks – fire and explosion, collapse of shed/structure, fall from working at height, collapse of lifting appliances, hit by fallen objects, landslides, failure during underground work, drowning, etc. All the potential risk and high hazard areas/activities need to be identified and listed. It should also cover high pollution area such as working in high noise or high dust areas.
2. Steps to Minimize Accident/Emergency – Documents should list all the Do's and Don'ts to avoid/minimize emergencies. It should also identify the activities and areas requiring use of specific PPEs. Prepare SOPs for risk operations.
3. Resource Planning – Document should identify the resources required to minimize accidents/emergency as well as those which would be required to manage emergency, if it happens and budge thereof.
4. Preparation of Site Emergency Plan – a site specific emergency plan needs to be prepared covering all the accident/emergency situations listing control and command structure and roles and responsibilities.
5. Training and Awareness – regular training and awareness of workers will be needed to ensure they understand and follow all the safety instructions and use appropriate PPEs.

A detailed plan will be prepared covering the above activities before start of construction work. A tentative budget for labour management is given in **Table 10.50**.

Table 10.50: Budget for Labour Management Plan

S. No.	Activity	Budget (Rs. In lakh)
1	Identification of risks, risky operations and areas and preparation of onsite emergency plan	10.00
2	Provision of PPEs @ Rs. 25.00 lakh as capital expenditure and Rs. 5 lakh every year for next 3 years for replenishment	40.00
3	Safety Training and Awareness Programs for Workers @ Rs.	6.00

S. No.	Activity	Budget (Rs. In lakh)
	1.50 lakh per annum for 4 years	
4	Regular Safety Audits @ Rs. 0.50 lakh/annum	4.00
	Total	60.00

Total Cost with Capital and Recurring Cost for Implementing Labour Management Plan

Capital Cost (Rs. In Lakhs)	Recurring Cost (Rs. In Lakhs)				Total Cost (Rs. In Lakhs)
	Year 1	Year 2	Year 3	Year 4	
35.00	4.00	7.00	7.00	7.00	60.00

Table 10.51 gives list of BIS Standards related to safety aspects during various stages of construction, installation, erection of different components and appurtenance of river valley projects, including inspection, observation and maintenance aspects from safety consideration. Relevant codes should be used to ensure safety of workers at sites.

Table 10.51: List of relevant BIS Standards

S. No.	IS No.	Title
1	IS 10386 (Part 1):1983	Safety code for construction, operation and maintenance of river valley projects: Part 1 General aspects
2	IS 10386 (Part 2):1982	Safety code for construction, operation and maintenance of river valley projects: Part 2 Amenities, protective clothing and equipment
3	IS 10386 (Part 3):1992	Safety code for construction, operation and maintenance of river valley projects Part 3 Plant & machinery
4	IS 10386 (Part 4):1992	Safety code for construction, operation and maintenance of river valley projects Part 4 Handling, transportation and storage of explosives
5	IS 10386 (Part 5):1992	Safety code for construction, operation and maintenance of river valley projects: Part 5 Electrical aspects
6	IS 10386 (Part 6):1983	Safety code for construction, operation and maintenance of river valley projects: Part 6 Construction
7	IS 10386 (Part 7):1993	Safety code for construction, operation and maintenance of river valley projects: Part 7 Fire safety aspects
8	IS 10386 (Part 8):1995	Safety code for construction, operation and maintenance of river valley projects Part 8 Excavation
9	IS 10386 (Part 9):1998	Safety code for construction, operation and maintenance of river valley projects Part 9 Canals and cross drainage works
10	IS 10386 (Part 10):1983	Safety code for construction, operation and maintenance of river valley projects: Part 10 Storage, handling, detection and safety measures for gases, chemicals and flammable liquids

Section 10.14

DISASTER MANAGEMENT PLAN

10.14 DISASTER MANAGEMENT PLAN

10.14.1 Safety and Stability of Uri-I Power Station Barrage

DAM Safety Review Panel (DSRP) for Uri-I barrage constituted for Review of Safety and Stability of Barrage had submitted its report in October 2020 with conclusion that “The Uri-I Barrage and its appurtenant structures are well maintained and in good condition. All safety norms as applicable to dam/barrage safety are adhered and applied to keep the dam/barrage and its appurtenant works in safe condition. The condition of the Uri-I barrage is satisfactory and over all safety category of dam falls under CATEGORY –III”.

Standard Operating Procedures for Early Warning System (EWS) in Vulnerable Hydro Projects issued by CEA/concern authorities may be followed & implemented. Establishment of Early Warning Systems (EWS) (i.e., 24x7 real time data collection with upstream Lower Jhelum Project, setting up central command and control station with satellite phone/ mobile phone/ discharge measurement devices) need to be ensured. Regular/hourly intimation regarding discharge from upstream Lower Jhelum Barrage to Master Control Room and close coordination with upstream Lower Jhelum Project & sharing of information to downstream Uri-II Power Station should be ensured.

10.14.2 Emergency Action Plan of Uri-I Power Station

Dam Safety Organization of Central Water Commission (CWC) issued guidelines for development and implementation of Emergency Action Plan (EAP) for dams in May 2006. These guidelines should be followed during development and implementation of EAP for dams. While preparing EAP for dam.

- (i) The EAP should include a section that is signed by all parties involved in the plan, where they indicate their approval of the plan and agree to their responsibility in its execution. Including the approval signatures is essential in an EAP, as it assures that all parties involved are aware of and understand the EAP and agree to do their assigned roles, as soon as an emergency takes place.
- (ii) The plan should designate a spokesperson to disseminate information. The news media, including radio, television and newspapers should be utilized to the extent available and appropriate.
- (iii) Prescribed formats for emergency event report, earthquake damage report, etc., to be used for recording various emergency situations and unusual occurrences.

The Emergency Action Plan of Uri Power Station has been prepared based on the "Guidelines for Development and implementation of Emergency Action Plan (EAP) for Dams" published by CWC in May, 2006. In order to have conformity regarding roles and responsibilities, etc.,

reference has been drawn from Disaster Management Plan (DMP) of URI Power Station prepared in year 2005. The purpose of EAP document is to help emergency officials, save lives, minimize damages to property, structures and inhabitations and also to minimize environmental impacts in the event of flooding caused by large releases from the dam, dam failure or in other such events. At present the EAP of Uri-I Power Station is functional and summary of same has been given in **Annexure-V**.

This EAP defines the functions and responsibilities of all concerned, managerial, operational & supporting services, fire services, medical services, CISF and other emergency management authorities, viz. Civil Administration, Armed forces, Paramilitary forces, Project Authorities and other Central/ State Agencies for effective management of the on-site-emergency situations. The Copy of the EAP has been distributed to various departments of Uri Power Station & as well as to district administration.

EAP describes the Owners responsibility, Responsibility for Evacuation, Rescue & Relief, Emergency identification, Evaluation and classification, Emergency levels or events or Situations, Preparedness and preventive mitigation measures to be taken at Dam. Standard operational procedures for critical process are also part of EAP. In Emergency identification, probable crisis and disaster which may occur is identified and their prevention and mitigation process, preparedness process is elaborated in EAP. Followings crisis and disasters are identified as a probable threat and included in EAP in case of Uri Power Station-

- a) Floods
- b) Earthquake
- c) Bomb threat/ sabotage/ Violent Agitation/ Terrorist Attack
- d) Land Slide
- e) Fire
- f) Power Failure

Whenever any crisis or disaster occurs then EAP comes in the picture. All emergency activities will be done as per EAP. As per the EAP of the Power Station, General Manager will be responsible for development, implementation and review of the EAP. General Manager will also act as the Incident Controller in case of any disastrous event, he will assess the situation any declare emergency (if required) and instruct site controller to take required actions. Incident controller-II will coordinate between all internal & external agencies.

The EAP of Uri Power Station contains 17 nos. of annexures, which includes the important information about Uri Power Station like Power Station Layout, Task Force detail, Critical equipment's list & important suppliers list etc., are mentioned in various annexures of the EAP. The various reporting formats for Emergency Event reports are attached at Annexure G, H & I of EAP. The copy of the EAP has been distributed to various departments of Uri Power Station as well as to district administration.

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**Chapter
11****SUMMARY AND CONCLUSION****11.1 PROJECT DESCRIPTION**

The proposed Uri-I Stage-II HEP is planned as per provision kept in the DPR of Uri-I Power Station. Thus, the already exist structure like barrage, the surface water conveyance system consisting of Head regulator upto intake of Uri-I Power Station shall be utilized for Uri-I stage-II HEP.

Uri-I Power Station was commissioned in the year 1997, by NHPC Ltd. consist of 21.5m high barrage (from deepest foundation level), desilting basin, open channel, 10.63 km long Head Race Tunnel (HRT), 2 nos. Pressure Shaft, an underground Powerhouse, & 02 km long Tail Race Tunnel (TRT) with outfall at the Bandi village.

The existing structures like barrage, the surface water conveyance system consisting of Head regulator upto HRT intake of Uri-I Power Station shall be utilized for Uri-I Stage-II HEP. The construction of underground structures like 10.472 km long HRT, surge shaft, pressure shaft, an underground powerhouse complex and 2.28 km long TRT are proposed for Uri-I Stage -II Project.

NHPC Ltd. has signed Memorandum of Understanding (MoU) with Government of Jammu Kashmir for execution of Uri-I Stage-II HE Project (240 MW) on Build, Own, Operate & Transfer (BOOT) basis for the period of 40 years.

11.2 DESCRIPTION OF THE ENVIRONMENT

Data on the existing environmental parameters in the study area delineated as per the approved Terms of Reference (TOR) for EIA studies by Ministry of Environment, Forests & Climate Chang (MoEF&CC), Government of India were collected to understand the present setting of the environment at the project site. The base line status is described briefly in the following sections:

11.2.1 Land Use/ Land Cover

For the preparation of land use/ land cover map of the study area, digital data on land use/land cover thematic maps prepared by National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO) of Dept. of Space, Govt. of India with Ecology, Environment & Remote Sensing, Govt. of J&K as partner under Natural Resource Census (NRC) project of National Natural Resource Repository (NRR) program was used.

The land use/ land cover of the study area is classified into 9 different classes. Evergreen/Semi-Evergreen Forest constitutes predominant land use in the study area (about 45.0%), followed by scrub forest which constitute about 21.0% of the total study area (see **EIA Chapter 3, Figure 3.8 & Table 3.10**). Scrub land covers around 19.0% of the study area. Waterbody covers around 1.17% and Snow/Glacier is comprised of 0.60%. of the study area.

11.2.2 Physiography

The study area of the proposed project lies between 1116 m and 3893 m elevation. About 34 % of the study area lies in 2000 to 2500 m elevation band (refer **Figure 3.5** and **Table 3.8** of Chapter 3) and about 29% of project components are restricted to 1500 to 2000m elevation band. Nearly 45% of the study area is characterised by steep slopes and about 36% area by moderately steep slopes (refer **Figure 3.6** and **Table 3.9** of Chapter 3).

11.2.3 Geology

Uri-I Stage-II Hydroelectric Project is an extension of Uri-I Power Station located on the eastern part of the Kashmir syntaxial bend of the northwest Himalaya where the arcuate ridges are aligned nearly along NESW. Geologically, the area exposes rocks of Salkhala Formation, Dogra Group, Pir Panjal Group, Kazinag Granite, Palaeozoic basics, Subathu Formation, Murree Group, Karewa Group and undifferentiated Quaternary deposit. Jhelum River flanked on either side by the rocks of Dogra ($\equiv$ Buniyar) Group with faulted contact in the north and thrust contact (Chhulan Thrust) in the south, which is concealed under Quaternary sediments.

11.2.4 Hydrology

Uri-I Hydroelectric Project, a runoff the river scheme, is situated on river Jhelum in Uri Tehsil of Baramulla district of UT Jammu and Kashmir. The Jhelum is the principal waterway of Kashmir. It has its source from a spring called Verinag.

The catchment area of the Jhelum River at the Uri-I Barrage is fan shaped and has an area of 12,750 km². About 20 percent of the catchment lies downstream of Wular Lake. The catchment area of Jhelum at Uri-I Power Station lies between Longitude 73°55' E to 75°35' E and Latitude 33°25' N to 34°40' N. The highest peaks in the Jhelum catchment reach above 5000 m, but most of the area is located between elevation 1400 and 4000 m.

11.2.5 Meteorology

The study area of the proposed project lies in Baramulla District of UT of Jammu & Kashmir. The average maximum temperature of 33.3°C was recorded in Uri tehsil during June. The average minimum temperature of 2.3°C was recorded during January. The area receives maximum rainfall during the southwest monsoon i.e., between June and September when about 49.5% of the annual average rainfall is received during monsoon months. The mean annual average rainfall of the Uri tehsil was recorded as 1645.48 mm. The Humidity is generally low throughout the year, except during monsoon months, humidity in the study area is close to 66% in the month of August. The average maximum wind speed of 4.18 m/s is observed during May.

11.2.6 Soil

As per soil maps collected from National Bureau of Soil Survey & Land Use Planning, Regional Centre, New Delhi, soils in the project area in general are predominantly Entisols and Inceptisols i.e. they have weakly developed soil profiles. Predominant soil type in the study area was represented by Soil Unit 37 cover 60.61 % of the study area lies under sub-group Lithic Udorthents associated with Typic Udorthents characterized by Shallow, somewhat excessively drained, mesic, loamy-skeletal soils on steep slopes with loamy surface, severe erosion and strong stoniness; associated with: Medium deep, somewhat

excessively drained, mesic, loamy-skeletal soils on moderately steep soils with loamy-surface, severe erosion and strong stoniness.

The soil fertility based upon Nutrient Index in terms of NPK shows that Nitrogen is in the 'Low' range Phosphorus fertility rating 'Medium' range during monsoon but in pre-pre-monsoon and winter season is in the 'Low' range whereas, Potassium fertility status of soil in the 'medium' range.

11.2.7 Ambient Air and Noise Quality

The Ambient Air Quality monitoring was carried out conforming to the National Ambient Air Quality Standards for Industrial, Residential, Rural & Other Areas and Ecologically Sensitive Areas. The concentrations of PM_{2.5}, PM₁₀, SO₂, and NO₂ at all the sites were well within the Residential & Rural area permissible limits prescribed by National Ambient Air Quality Standard 2009 notified by CPCB.

The results of monitoring show that PM_{2.5}, PM₁₀, SO₂, and NO₂ levels at all the sites are well within the Residential & Rural area permissible limits prescribed by National Ambient Air Quality Standard 2009 notified by CPCB. Air quality was also assessed using 24hr averages of PM_{2.5}, PM₁₀, SO₂, and NO₂ levels in the AQI calculator of CPCB. All the locations fall under the 'Satisfactory' category in the different seasons in the study area except AQ2/ Near Barrage Site Village, AQ4/ Near NHPC complex and AQ6/ Gurudwara near TRT during monsoon season fall under 'Good' category in the study area.

11.2.8 Water Quality

The data on water quality has been collected to evaluate surface and ground water quality in study area. The water quality in the study area, in general, is good. This is primarily due to the absence of any industrial establishment and low population density in the project area.

Surface water quality of Jhelum and its tributaries samples collected during winter, pre-monsoon, and monsoon seasons was compared with the Water Quality Criteria of Central Pollution Control Board (http://www.cpcb.nic.in/Water_Quality_Criteria.php) fall under Class 'A' with Drinking-Water Source without conventional treatment but after disinfection.

Analytical results of Groundwater samples were compared with drinking water standards IS-10500:2012 to assess the status of Groundwater taken from Spring water as this water is used for drinking purposes in villages. All the samples were found within permissible limits as per drinking water standards prescribed by CPCB.

11.2.9 Floristic Diversity

Forest is dominant land use pattern in the study area as more than 66% of the study area is under good forest cover. ii) According to 'A Revised Survey of the Forest Types of India' by Champion and Seth (1968). Forests in the study area are comprised of Group 12-Himalayan Moist Temperate Forest and Group 13-Dry Temperate Forest.

The most common tree species in the project area are *Cedrus deodara*, *Pinus wallichiana*. *Picea smithiana*, *Celtis australis*, *Fraxinus xanthoxyloides* and *Robinia pseudo-acacia* are

dominant in area. Shrub vegetation in the area was represented by *Sorbaria tomentosa*, *Cotoneaster microphyllus*, *Desmodium elegans*, *Spartium junceum*, *Artemisia nilagirica*, *Boehmeria platyphylla*, *Gerardiana heterophylla*, *Indigofera cassioides*, *Viburnum grandiflorum*, *Caryopteris odorata*, *Prinsepia utilis* and *Myrsine africana*, etc. are the grass species in the catchment, mostly grown on barren rocky steep slopes.

Overall, the study area harbors 192 plant species belonging to different plant groups like Angiosperms, Gymnosperms, Pteridophytes, Bryophytes and Lichens. Angiosperms were represented by 174 species, Gymnosperms by 8 species, 3 species of Pteridophytes, 2 species Bryophytes and 5 species of Lichens were recorded during the survey.

As per the IUCN Red List of Threatened Species Version. 2022-2, *Saussurea costus* was listed under Critically Endangered (CR), *Angelica glauca* under Endangered (EN), *Ephedra gerardiana*, *Marchantia paleacea* and *Ulmus wallichiana* under Vulnerable (VU), *Sonchus mauritanicus* and *Fraxinus excelsior* were listed under Near Threatened (NT) category. The rest of the species evaluated are either Least Concern (LC) or Data Deficient (DD) category.

As per the Red Data Book of Indian Plants published by Botanical Survey of India, *Acer caesium*, *Dioscorea deltoidea* and *Inula racemose* are listed as Vulnerable (VU) species, while *Saussurea costus* is listed as Endangered (EN) species.

11.2.10 Faunal Diversity

Mammals: During field surveys only Rhesus macaque (*Macaca mulatta*) and Small Indian Mongoose (*Herpestes auropunctatus*) are the species sighted in the study area. Besides these, no other wild animal was sighted during field investigation.

Presence of Common Leopard (*Panthera pardus*), Common Langur (*Semnopithecus entellus*), Himalayan Goral (*Naemorhedus goral*) and Asiatic black bear (*Ursus thibetanus*) were confirmed by forest officials and villagers in the project area.

Avifauna: A total of 25 species of bird species 5 Order and 17 families were recorded during the field survey from the study area. Most commonly found birds were Himalayan Bulbul, Red-vented Bulbul, Russet Sparrow, Black Drongo, Black Kite, Water Redstart, Slaty-headed Parakeet and Long-tailed Shrike were the most frequently sighted bird species in the study area. A large portion of avifauna species comprised of resident birds in the project study area.

Herpetofauna: During the survey, During the survey, Garden lizard (*Calotes versicolor*), Kashmir Rock Agamid (*Laudakia tuberculata*), and Skinks (*Asymblepharus ladacensis*) were commonly sighted species in the area. Common Rat Snake (*Ptyas mucosa*) and Himalayan Pit Viper (*Gloydius himalayanus*) are also reported in the Working Plan of Jhelum Valley Forest Division.

Butterflies: 6 species of butterflies were recorded during the field survey. Indian Tortoiseshell, Indian Cabbage White, and Pearl white were the frequently sighted species observed all along the water bodies.

Aquatic Ecology: Among the aquatic organisms, 33 species of phytobenthos and 17 species of phytoplankton were recorded from river Jhelum and its tributaries. During sampling 12 species of zooplankton and 10 genera of macro-invertebrates (MI) were recorded from various sampling site.

Fish fauna: During the experimental fishing Snow trout (*Schizothorax plagiostomus*) is the only species captured during experimental sampling. According to published literature, 21 fish species were reported from the area.

Conservation Status

As per Wildlife Protection Amendment Act, 2022, Common Leopard (*Panthera pardus*), Himalayan Musk Deer (*Moschus leucogaster*), Himalayan Goral (*Naemorhedus goral*), Jungle Cat (*Felis chaus*), Leopard Cat (*Prionailurus bengalensis*), Grey mongoose (*Herpestes edwardsii*), Small Indian mongoose (*Herpestes auropunctatus*), Golden Jackal (*Canis aureus*), Red Fox (*Vulpes vulpes*), Bengal Fox (*Vulpes bengalensis*), Wild Dog (*Cuon alpinus*), Asiatic Black Bear (*Ursus thibetanus*), Himalayan Weasel (*Mustela sibirica*), Common Otter (*Lutra lutra*), Red Giant Flying Squirrel (*Petaurista petaurista*) and Indian Crested Porcupine (*Hystrix indica*) are the mammalian species listed as Schedule I species (Table 3.46). All other species are either listed under Schedule II or not included in any schedule of IWP Amendment Act, 2022.

All the avifaunal species sighted from the study area fall under Least Concern (LC) category as per IUCN 2022-2. As per WPA (1972), Crested-serpent eagle (*Spilornis cheela*) is under schedule-I. Rest of the avifaunal species recorded from the area are listed as Schedule II except House crow and Rock dove which are not listed under any schedule of IWP Amendment Act, 2022.

11.2.11 Proximity to Protected Area

Kazinag National Park, Lachipora Wildlife Sanctuary and Limber Wildlife Sanctuary are the nearest protected areas from Uri-I Stage-II HE Project. All the project components area outside the notified ESZ of protected areas.

11.2.12 Social Environment

The proposed project falls in the Uri & Buniyar tehsil of Baramulla district of Union Territory of Jammu & Kashmir. According to the 2011 census, Baramulla district has a population of 1,008,039. Of the total population, 534,733 (53.05%) were males and 473,306 (46.95%) were females, the sex ratio being 885 females for every 1,000 males. The district has a population density of 305 inhabitants per square kilometre. Baramulla district has a literacy rate of 66.93% with male literacy 77.35% and female literacy 55.01%. Baramulla town is the largest town in the district and the fourth most populous town in the Union Territory of J&K with a population of 1, 67,986 as per 2011 census.

Baramulla is the largest producer of Horticulture products in the Jammu & Kashmir. Baramulla has a Rabbit Farm at Palhallan, Pattan, one of the only two rabbit farms in Northern India. Baramulla has a Silkworm breeding unit at Mir Gund, Pattan.

The entire study falls under Baramulla district. In the study area, 91 inhabited villages fall within a 10 km radius of proposed project. The population of the villages in the study area

is 139213 with 75260 (54.06%) males and 63953 (45.93%) females. The sex ratio was found at 849 females per 1000 males. The total Scheduled Tribes (ST) population is 14.78% of the total population. In the project study area, there are 66817 literates which constitute 47.99% of the total population of the study area. According to 2011 census total population of workers in the study area 37613 (27.01%). Main and marginal workers were 18269 (48.57%) and 19344 (51.42%) respectively.

The education facilities in the area are moderate up to middle school but for secondary and senior secondary education students travel up to 5 to 15 km. In the study area there are 3 colleges up to graduation available in the village namely Buniyar, and Nowshera. There is a one Pvt. Hospital at Buniyar.

There are 2 primary health sub and 5 primary health centres available in the surveyed area. There is no community health center in the survey villages. In addition to these NHPC Hospital at Gingal also provides basic medical facilities to the villagers. The District Hospital and Medical College at district headquarter Baramulla is the only government hospital serving as referral center for complicated cases in the district.

The livelihood of most of the people of the study area depends on job, agriculture and cattle rearing. Spring water and Piped water supply are the main source of drinking water in the study area. The most important road passes through the area are National Highway 1A (Baramulla to Uri). Transportation facilities are good in the area, all the village roads are well connected to highway through metaled roads. Most of the surveyed villages have postal and phone connectivity available.

11.3 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

11.3.1 Ambient Air Quality

Construction Phase Impacts: The air environment around project site is free from any significant pollution source at present. The construction activities including operation of crushers, concrete batch plants, construction work and movement of vehicles along unpaved road will generate dust & gaseous emission and impact air quality. The burning of waste will also affect air quality. In absence of proper fuel, construction workers at the project site may use wood for fuel burning and space heating. This will also impact air quality. Therefore, needs to be managed properly.

Operation Phase Impacts: In hydropower project, air pollution occurs mainly during project construction phase. During operation phase, no impacts are envisaged on air environment.

11.3.2 Noise Environment

Construction Phase Impacts: Noise in and around the construction site may affect the wildlife in the nearby areas. Due to construction activity in the area, noise levels will increase during the period of construction, however, they will remain limited to the work area. Sources of noise will be increased vehicular traffic due to project construction on approach roads and at construction sites. Other sources of noise and vibration will be the operation of various equipment and use of explosives for blasting purposes for construction activities.

The effect of high noise levels on the operating personnel may be harmful. Continuous exposures to high noise levels affect the hearing ability of the workers/operators. To prevent these effects, it has been recommended by Occupational Safety and Health Administration (OSHA) that the exposure period of affected persons be limited.

Operation Phase Impacts: No major impacts are envisaged on noise environment during project operation phase.

11.3.3 Water Environment

Construction Phase Impacts: Water is used in construction activities leading to wastewater generation with high suspended solids. Similarly, effluents due to washing from truck or equipment etc. would have high concentration of oil and grease. Assessment of quantum of wastewater from such activities is difficult, however, they can impact the nearby water bodies if surface run off with high suspended solid is discharged into them. Domestic wastewater will be generated from project and worker's colony to be set up during construction phase, which can find its way to river/ ground water without any treatment will cause significant impact on water environment therefore needs to be managed properly.

Operation Phase Impacts: Construction of dam to regulate water for power generation may lead to permanent change in flow regime of the river. Also, the major impact of such project is habitat disturbance of aquatic fauna. In case of proposed project, the operational barrage of Uri-I Power Station is utilized for Uri-I Stage-II HEP. The Uri-I Power Station barrage is under operation since 1997. The mitigation measures for habitat conservation like fish ladder and maintaining the downstream discharge (environmental flow) to sustain the aquatic life is already implemented during operation of Uri-I Stage-I project. Therefore, no additional impact of operation of Uri-I Stage-II has been anticipated.

11.3.4 Land Environment

Construction Phase: The following positive impacts are anticipated on Land environment during construction phase:

- **Impact due to Land Requirement and change in land-use:** For the development of the Uri-I Stage-II HEP, no surface area would be acquired for construction of project components, reservoir area creation, muck dumping, quarrying operations, construction camps, and colonies. The required 97.0335 ha non-forest land is already under possession of NHPC and the remaining 17.0 ha forest land is required for underground work.
- **Impact Due to Muck Generation:** Muck generation, transportation and disposal can significantly impact the land environment, if not managed properly.
- **Impact due to Waste Generation:** The main sources of waste generation can be categorized as:
 - i. Municipal waste (includes commercial and residential wastes, excluding industrial hazardous wastes and bio-medical wastes)
 - ii. Construction and demolition debris (C&D waste)
 - iii. Bio-medical waste
 - iv. Hazardous waste (generated from construction machinery and equipment)

- v. e-Waste (computer parts, Printer cartridges, electronic parts, etc.).
- **Impacts due to Quarrying:** Quarrying is normally done by cutting the face of the hill. The rock from the exposed face of the quarry due to erosion forces gets slowly weathered and they become a potential source of landslide, which needs to be managed.

11.3.5 Impacts on Forests and Forest Land

No surface forest land needs to be diverted for the construction of the project. Only 17.0 ha of underground forest land will be diverted for the underground construction work of the project components. Therefore, no tree felling or clearing of vegetation cover will be undertaken for the proposed project.

11.3.6 Flora and Fauna

Construction Phase

Impact on Terrestrial Flora: Increase in human interference could have an impact on terrestrial ecosystem. The workers may cut trees to meet their requirements for fuelwood, construction of houses, furniture etc. Thus, it is necessary to provide alternative fuel, training and awareness, community kitchens, fencing of critical areas, maintain cooking fuel supply and adequate surveillance to mitigate the adverse impacts on terrestrial flora during project construction phase.

Impact on Terrestrial Fauna: For proposed Uri-I Stage-II HEP, no deforestation will be required, only 17.0 ha underground forest land shall be acquired for HRT, TRT and Powerhouse. Hence there is no disturbance due to acquisition of land on wildlife habitat in the area. However, during the construction period, mobilization of large number of machineries, blasting activity and influx of construction workers may create disturbance to wildlife habitat in the vicinity of project area. However, these will be temporary and last during the construction period. Therefore, it is necessary to provide fencing in critical areas, controlled blasting and restrict movement of labours in forest areas and implement anti-poaching measures.

Operation Phase

Uri-I Stage-II HEP utilize operational barrage of Uri Stage-I Power Station. Operation phase impacts on flora and fauna will be positive due to restoration of construction areas, restoration of the muck disposal area, green belt development, implementation of Biodiversity Management and Wildlife Conservation Plan, etc. The increase of greenery and increased moisture due to the presence of the reservoir have a positive impact on avifauna.

The operation of hydroelectric project has impact on fisheries resources. *Schizothorax* species, a fish species migratory in nature was observed by the study team in the upstream and downstream of Uri Power Station barrage site. In addition to fish ladder/ fish pass in the Uri-I barrage, fish passage for easy upstream movement of fish species along the rapids and steep slopes on Buniyar nala has been also constructed and maintained regularly with the help of J&K Fisheries Department.

11.3.7 Socio-Economic Environment

a) Positive Impacts on Socio-Economic Environment

The following positive impacts are anticipated on the socio-economic environment of the villages in vicinity of project area during the project construction and operation phases:

- i) A number of marginal activities and jobs opportunities with employment with contractors, new market ventures, etc. would be available to the locals during construction phase.
- ii) Developer bringing large scale investment to the area will also invest in local area development and will benefit the locals. Education, medical, transportation, road network and other infrastructure will improve.
- iii) The availability of alternative resources provided by developer in the rural areas will reduce the dependence of the locals on natural resources such as forest.
- iv) Petty contracts and R&M works will be available to PAFs and locals as per NHPC policy.

b) Negative Impacts on Socio-Economic Environment

- i) Impact due to influx of outside population may lead to various social and cultural conflicts during the construction stage. Therefore, permits/ restrictions will be imposed on movement of labours.
- ii) Increased incidence of Diseases.

11.3.8 Mitigation Measures for Air, Water and Noise Pollution

Proposed project involves construction of underground structures like HRT, Powerhouse, TRT, and other associated infrastructure. Major construction activities have potential of pollution generation as discussed above. Impacts arising out of construction activities can be mitigated significantly by taking appropriate mitigation measures, as discussed below.

Control of Air Pollution: For the control of air pollution during construction phase of the project, it is suggested that it should be made mandatory for the contractor/s engaged in the construction works to ensure the implementation of pollution control measures as per CPCB guidelines with regular monitoring of ambient air quality in the project area. Vehicles should have valid PUC and all project roads should be metalled.

Control of Noise Pollution:

- Diesel Generator sets are to be placed in acoustic enclosures to reduce the noise.
- Proper and regular maintenance/lubrication of machines should be done.
- Noise producing machines (such as crushers, aggregate processing plants, etc.) should be provided with sound barriers.
- Quieter machines and vehicles with high quality silencers should be used.
- Ambient noise should be monitored periodically at different locations.

Control of Water Pollution:

- Provision of septic tank/ soak pit of adequate capacity for labour camp.
- Commission of suitable treatment facilities to treat the sewage generated from the colony & offices.
- Oil interceptors/ catchers will be provided and residue of petroleum products, batteries, e-wastes, etc. will be disposed in accordance with SPCB guidelines.

- Provision of sedimentation cum grease traps to prevent entry of contaminants to the water bodies.

A lump sum budget of **Rs. 40.0 lakh** per annum has been proposed for the mitigation measures for control of air, noise and water pollution during project construction phase.

11.4 ENVIRONMENTAL MONITORING PROGRAMME

Environmental Monitoring shall be performed during all stages of the project (namely: construction and operation) to ensure that the impacts are no greater than predicted, and to verify the impact predictions.

The monitoring will be carried out by an NABL accredited laboratory for a period of 10 years during the project construction phase or extended if the project construction period gets extended and post construction for 5 years. The monitoring program for the proposed project will be undertaken to meet the following objectives:

- To monitor the environmental conditions of the project area and nearby villages.
- To check on whether mitigation and benefit enhancement measures have actually been adopted and are proving effective in practice.

A total of **Rs. 46.60 lakh** have been allocated to implement various activities envisaged under the Environmental Monitoring Programme.

11.5 ADDITIONAL STUDIES

11.5.1 Resettlement & Rehabilitation Plan

No private land is required for the construction of various components of proposed Uri-I Stage-II HE Project. Hence, requirement of preparation of Resettlement & Rehabilitation Plan is not envisaged in the present case.

11.5.2 Public Consultation

On completion of draft EIA report and its Executive Summary in English and vernacular language (Urdu & Hindi) will be submitted to J&K Pollution Control Committee to initiate the process of Public Hearing (PH).

11.5.3 Local Area Development Plan

The aim of Local Area Development Activities is focused sustainable development to improve the quality of life of neighborhood communities through equitable and proactive smart initiatives in spheres of education, health, rural development, environment, and livelihoods resulting in improvement of the overall social and economic conditions of locals as well as improvement of environmental conditions of their surroundings.

The activities proposed under Local Area Development Activities have been refined after Public Consultation meeting, keeping in view the needs and requirement of local population. Activities to be implemented will be discussed with District Administration and finalized by LADC. A provisional amount of **Rs. 2.50 crore** has been earmarked for local area development activities.

11.6 PROJECT BENEFITS

Operation of Uri-I Stage-II Hydro Electric Project will help in harnessing potential of river Jhelum for generating electricity to the tune of 929.62 MUs in a 90% dependable year annually and bring benefits of renewable energy to state/ Union Territory and country. In addition to this, other benefits from the project are:

- a. **Minimal impact on Environment and Forest Aspect:** There is no requirement of additional private and revenue land for the construction of the said project. The Forest land involved for the construction of HRT, Powerhouse and TRT is underground and hence there is no involvement of trees in their alignment of the structures.
- b. **R&R Aspect/ No displacement of the Population:** No acquisition of private land and displacement of families is involved in the proposed project.
- c. **Optimum Utilization of the additional Kishanganga Water:** By tapping surplus water of inter basin Kishanganga Hydroelectric project, NHPC will be able to generate additional electricity that would be beneficial to the nation.
- d. **Generation of Local Employment and Livelihood sources**
- e. **Benefits to farmers:** Implementation of Catchment Area Treatment shall reduce soil erosion, maintain soil moisture, increase sub-surface water and fertility of fields.
- f. **The future is Clean Ethical Energy**
- g. **Hydro Power Generation:** The harnessing of enormous hydropower potential which can help in overall growth in the Union Territory and country as well.

11.7 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Pollution generation mainly during construction phase will be in the form of air, water and noise pollution, which will be mitigated by adopting various mitigation measures and implementation of environment management plans.

The project level Environment Monitoring Cell (EMC) would coordinate with stakeholders for effective implementation of all environmental safeguard measures prescribed in the EMP & environment and forest clearance letters.

11.7.1 Catchment Area Treatment Plan

The Catchment Area Treatment (CAT) plan highlights the management techniques to control erosion in the catchment area of a water resource project. The life span of a reservoir is greatly reduced due to erosion in the catchment area. Adequate preventive measures are thus needed for the treatment of catchment for its stabilization against future erosion.

In the present study, CAT Plan has been formulated for the free draining catchment till the barrage site on Jhelum River. The total area of the free draining catchment is **135.91 sq km**.

The catchment area treatment involves

- Understanding of the erosion characteristics of the terrain and,
- Suggesting remedial measures to reduce the erosion rate.

The estimated cost of implementation of CAT plan including monitoring and evaluation is **Rs. 1346.05 lakh**.

11.7.2 Compensatory Afforestation Plan and Net Present Value

The Uri-I Stage-II HEP is being constructed in the jurisdiction of Jhelum Valley Forest Division in Baramulla district, UT of Jammu & Kashmir. The total land required for the construction of proposed project activities is approximately **114.0335 ha** out of which **97.0335 ha** is non-forest land and **17.00 ha** is forest land for underground work.

As per the above guidelines Compensatory Afforestation has been proposed on 17.0 ha. The Compensatory Afforestation is proposed to be undertaken on non-forest land identified after consultation with the J&K Forest Department and District administration. The estimated cost of the Compensatory Afforestation Programme determined by J&K Forest Department is **Rs. 71,19,383.55**.

Total forest land requirement for diversion for non-forest use i.e. for the underground activities is 17 ha. As the forest in the project area fall in the Eco Class VI as being of type Himalayan Moist Temperate Forests, Himalayan Dry Temperate Forest with Dense Forest type, therefore NPV of **Rs. 686205.0/ha** (i.e. 50% of Rs. 1372410.0/ha) would be required to be deposited in the Compensatory Afforestation Fund. The total cost of NPV has been determined by J&K Forest Department is **Rs. 1,16,65,485/-**.

The total cost of the compensatory afforestation plan, and NPV is **Rs. 1,87,84,868.55**. Exact costs shall vary, as it will be known after issue of Forest clearance (St-I) letter, as per demand by J&K Forest Department.

11.7.3 Biodiversity Conservation & Wildlife Management Plan

Keeping in view of the anticipated impacts of proposed project on the biodiversity of area, the mitigation measures suggested for biodiversity conservation and wildlife management plan and conservation of Schedule-I species are as follows:

- i. Wildlife Habitat Preservation & Improvement
- ii. Establishment of Eco Park
- iii. Biological fencing
- iv. Veterinary care
- v. Prevention and Control of Forest Fire
- vi. Development of Grazing land/ Pastures
- vii. Awareness promotion
- viii. Strengthening of Infrastructural Facilities of Forest Department
- ix. Biodiversity Management Committee (BMC)

The J&K Fisheries Department shall be the executing agency for implementation of the proposed Plan in the surrounding of proposed project site. The estimated cost of implementation of various activities envisaged in the Biodiversity Conservation and Management Plan would be **Rs. 144.00 lakh**.

11.7.4 Fisheries Management Plan

Proposed Fisheries Development Plan has been prepared with the following objectives:

- Conservation, Management and Stocking by Enrichment of riverine fish fauna
- Strengthen of fishing techniques and skills of fishermen/ women societies
- Upgradation of existing Govt. Fish farms.

- Stocking of Reservoirs.

Budgetary provision of **Rs. 49.00 lakh** has been proposed fisheries in the proposed reservoir of Uri-I Stage-II Hydro Electric Project.

In addition to abovesaid measures mandatory discharge 14.2 cumecs as environmental flow has been maintained to sustain the aquatic life in the downstream stretch through Uri-I Power Station barrage. Fish ladder has been incorporated in the barrage of already constructed barrage of Uri-I Power Station which shall also be used for Uri-I Stage-II HE Project. A fish way provided between barrage bay has provision for releasing discharge of 2.5 cumecs. Balance e-flow of 11.7 cumecs is provisioned to pass through the silt excluder gate or crack opening of one of the radial gate.

11.7.5 Muck Management Plan

The construction would involve about 11,58,300 cum of soil and rock excavation. About 2,80,000 cum of excavated muck to be used for producing coarse and fine aggregate for concrete production and in fillings for developing areas for construction facilities. The total area for the dumping of muck is **16.90 ha** which is already in possession of NHPC and can accommodate more than **21.19 lakh cum** muck.

The main objectives of process of muck dumping and restoration of these muck disposal sites are:

- to protect and control soil erosion;
- to create greenery in the muck disposal areas;
- to improve and develop the sites into recreational sites;
- to ensure maximum utilization of muck for the construction purpose;
- to develop the muck disposal sites/ dumping yards to blend with the surrounding landscape; and
- to minimize damages due to the spoilage of muck in the project area

The estimated cost of the relocation and rehabilitation of excavated material will be **Rs. 2188.16 lakh**.

11.7.6 Landscaping and Restoration of Construction Sites

Landscaping and restoration of construction sites will focus restoration of sites like, Quarry & Borrow sites, job facility area, colony area, and other area engaged during construction. After the completion of mining activity, these areas will be restored to their normal habitat conditions.

These activities will result either in the modification or destruction of the existing landscape of the area. It is therefore imperative that after the project work and related activities are over restoration work should be carried out in these disturbed areas. Various engineering and biological measures will be implemented for the restoration of proposed project affected areas. The landscaping and restoration plan will be implemented with help of landscaping experts and in consultation with Jhelum Valley Forest Division and the coordination and funding will be provided by the project proponent.

The estimated cost for the landscaping and restoration works of quarry and borrow area, job facility area, colony area, and project roads areas, would be **Rs. 130.00 lakh**.

11.7.7 Reservoir Rim Treatment Plan

The reservoir of Uri-I Power Station is under operation since 1997 and no changes are envisaged due to construction of stage-II project. Similarly, though no major active landslide or slope instability is present in the reservoir area.

In addition to ongoing treatment measures taken by Uri-I Power Station, treatment measures for degraded areas with financial provision has been made Catchment Area Treatment Plan. Also, enrichment plantation will be carried out on suitable areas along the banks of Uri-I Power Station reservoir (Jhelum River) under Green Belt Development Plan. Therefore, no additional budget has been allocated for the Reservoir Rim Treatment Plan.

11.7.8 Green Belt Development Plan

Green belt development will comprise plantations at various places like alongside roads, around the construction areas, and at different project offices and colonies.

A temporary nursery has been proposed to cater the requirement of plant material required for plantation proposed under various management measures proposed under Environmental Management Plan of Uri-I Stage-II HEP.

During plantation for development of green belt, precaution should be exercised by not planting large size trees around buildings to avoid accidents. Besides this, it is also proposed to develop a green belt around the working areas for trapping the dust and noise, which will rise from the crusher plant, plantation must be done around the crusher plant area. Plantation of avenue, ornamental, and fruit trees are proposed in these areas along with the area around the office complex. The plants of recreational value, horticultural importance shall be planted within the colony area. The ornamental and fruit plants will be procured from the horticulture department and local market while plants for avenue plantation will be procured from the forest department nursery. For the protection of trees from cattle, iron tree guards shall be required.

A budgetary provision of **Rs. 75.59 lakh** has been kept for the development of the Green Belt in and around the project area.

11.7.9 Sanitation and Solid Waste Management

Solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management for disposal. The project authorities will ensure sewage generated from labour colonies and site office is treated and disposed of as per the PCB guidelines. Various aspects of solid waste management include:

- Reuse/Recycling
- Storage/Segregation
- Collection and Transportation
- Disposal

The waste generated from the project area will be collected, segregated and disposed off in line with the provisions laid down in Solid Waste Management Rules, 2016. The total budget in order to manage the solid waste generated, has been proposed as **Rs. 206.56 lakh**.

11.7.10 Public Health Delivery System

Project construction and operation will bring about several changes in the socio-economic environment of the area including increased threats to health of the community.

- i. New Diseases due to Migratory Population
- ii. Chances of increase in water borne diseases as malaria, and dengue are high
- iii. Chances of increase in respiratory troubles due to increase in suspended particles during the construction phase.
- iv. Chances of occurrence of gastroenteritis, cholera, and typhoid in the labour camps.

Medical services at secondary level play a vital and complimentary role to the tertiary and primary health care systems and together form a comprehensive district-based health care system. Following activities are proposed:

- Ambulance: 2 no. with all the basic Medicare facilities to cater for villages in the project area.
- Budget for running the ambulances including driver, fuel and maintenance for 4 years.
- Two first aid posts including sheds, furniture and basic equipment.
- Budget for running the first aid posts for 4 years.
- Budget for strengthening existing medical facilities.
- Measures to control COVID19 in the project area
- Budget for Health Awareness/ Vaccination Camps for 4 years.

Budgetary estimates for the public health delivery system to be implemented have been worked out as **Rs. 166.00 lakh**.

11.7.11 Energy Conservation Measures

The existing facilities will become insufficient for supply of kitchen fuel for the migrant population during the construction of the project. Therefore, the project authorities would make adequate arrangements such as Community kitchen, Supply of Kitchen fuel, efficient cooking facilities and solar lantern either directly by developer or through contractor to reduce the pressure on natural resources in the project area and minimize impacts on this count. A total budget of **Rs. 152.00 lakh** have been proposed under the Energy Conservation Plan.

11.7.12 Labour Management Plan for their Health and Safety

Construction work has many associated risks and health impacts for the workers who are directly exposed to such health and safety risks. Therefore, there is a need to prepare complete health and safety documents for workers either by project proponent/contractor and proponent shall ensure its implementation. A detailed plan will be prepared covering the above activities before start of construction work. A tentative budget of **Rs. 60.00 lakh** for labour management have been proposed under EMP.

11.7.13 Disaster Management Plan

DAM Safety Review Panel (DSRP) for Uri-I barrage constituted for Review of Safety and Stability of Barrage had submitted its report in October 2020 with conclusion that “The Uri-I Barrage and its appurtenant structures are well maintained and in good condition. All safety norms applicable to dam/barrage safety are adhered and applied to keep the dam/barrage and its appurtenant works in safe condition. The condition of the Uri-I barrage is satisfactory and overall safety category of dam falls under CATEGORY –III”.

Following the guidelines issued by Dam Safety Organization of Central Water Commission (CWC) in May, 2006, Emergency Action Plan (EAP) has been prepared and executed by Uri-I Power Station.

11.8 SUMMARY OF COST

The costs involved for implementation of Environmental Management Plan for Uri-I Stage-II Hydro Electric are summarized in the table given below.

Table 11.1: Cost for Implementing Environmental Management Plan

S. No	Component of EMP	Capital Cost (Rs. In lakh)	Recurring Cost (Rs. In lakh)							Total Cost (Rs. In Lakh)
			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	
1	Catchment Area Treatment Plan	1346.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1346.05
2	Compensatory Afforestation Plan	71.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	71.19
3	Biodiversity Conservation & Wildlife Management Plan	144.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	144.00
4	Fisheries Conservation and Management Plan	17.00	8.00	8.00	8.00	8.00	0.00	0.00	0.00	49.00
5	Muck Dumping and Management Plan	30.00	428.14	637.22	530.19	533.11	9.50	10.00	10.00	2188.16
6	Landscaping, Restoration of Quarry, and Construction Sites	25.00	0.00	25.00	30.00	20.00	15.00	15.00	0.00	130.00
7	Reservoir Treatment Plan*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Green Belt Development Plan	0.00	4.13	4.12	11.01	14.48	19.93	11.18	10.74	75.59
9	Sanitation and Solid Waste Management Plan	111.00	31.64	25.64	21.64	16.64	0.00	0.00	0.00	206.56
10	Public Health Delivery System	50.00	29.00	29.00	29.00	29.00	0.00	0.00	0.00	166.00
11	Energy Conservation Measures	26.00	31.50	31.50	31.50	31.50	0.00	0.00	0.00	152.00
12	Labour Management Plan	35.00	4.00	7.00	7.00	7.00	0.00	0.00	0.00	60.00
13	Disaster Management Plan (Emergency Action Plan) **	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	Control of Air, Noise and Water Pollution	0.00	10.00	10.00	10.00	10.00	0.00	0.00	0.00	40.00
15	Environmental Monitoring Programme	0.00	11.65	11.65	11.65	11.65	0.00	0.00	0.00	46.60
16	Rehabilitation and Resettlement Plan***	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Local Area Development Plan	250.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	250.00
	Total	2105.24	558.06	789.13	689.99	681.38	44.43	36.18	20.74	4925.15
18	NPV under B-land [#]	116.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	116.66
	Total	2221.90	558.06	789.13	689.99	681.38	44.43	36.18	20.74	5041.81

* Reservoir Rim Management Plan is already implemented by Uri-I Power Station and Plantation is proposed under Greenbelt Development Plan.

** Emergency Action Plan is already implemented by Uri-I Power Station.

*** Rehabilitation and Resettlement Plan Not required as no private land is acquired for the project.

The cost of NPV shall come under the B-LAND in the DPR.

Chapter 12

DISCLOSURE BY THE CONSULTANT

12.1 DISCLOSURE BY THE CONSULTANT

Final EIA report of Uri-I Stage-II Hydro Electric Project has been prepared by M/s R S Envirolink Technologies Pvt. Ltd., (RSET) Gurgaon which is a QCI-NABET accredited company to undertake River Valley, Hydroelectric, Drainage and Irrigation Projects (Category 'A') according to the TOR approved by MoEF&CC. Certification and contact details are:

Certificate No	: NABET/EIA/2225/RA 0274
Validity	: 15 th August 2025
Contact Person	: Mr. Ravinder Bhatia
Name of Sector	: River Valley and Hydroelectric Projects
Category	: A
MoEF Schedule	: I(C)
Address	: 403, Bestech Chambers, Block-B, Sushant Lok Phase I, Sector 43, Gurugram, Haryana - 122009.
E-mail	: ravi@rstechnologies.co.in
Land Line	: (0124) 4295383
Cellular	: (+91) 9810136853

A copy of the Accreditation certificate along with the list of experts involved is appended at the beginning of the report.

R S Envirolink Technologies Pvt. Ltd (RSET) is a multi-disciplinary environmental consulting company with a special focus on River Valley, Hydel, Drainage and Irrigation projects. RSET was established in 2007 as a specialized consulting Service Company, focused on providing a entire gamut of environmental services for water resource development projects. We have in-house expertise and have a compact team of consulting professionals providing comprehensive, responsive and high-quality services primarily in the field of natural resources management, environment, environmental audits and due diligence, environmental impact assessment, environmental management plan, environmental modeling, environmental monitoring and compliance status evaluation, hydrology, geology, Remote Sensing & GIS and modeling using these latest tools, techniques and technologies with projects extending across the Himalaya and hilly and mountainous regions of India. Various studies, we undertake, include:

- Environmental Impact Assessment
- Environmental Management Planning and Implementation
- River Basin/Carrying Capacity Studies
- Ecological Studies including Aquatic Ecology
- Biodiversity Conservation and Management Planning
- Assessment of Ecological Flow Requirement
- Glacial Lake Outburst Flood (GLOF) Modeling

- Dam Break Modeling and Disaster Management Plan; Hydrological and Hydro-dynamic modelling
- Catchment Area Treatment (CAT) Plan, Watershed modelling, Watershed Analysis, Rehabilitation, Inventories and Management Planning
- Remote Sensing and GIS: All aspects related to applications of Remote Sensing and GIS especially in the field of natural resources management.
- Socio-economic studies
- Surface Water Hydrology, Water Quality, and Erosion Control
- Environmental Monitoring

RSET is on the list of Consultants who are permitted to appear before Expert Appraisal Committee (EAC) and State Expert Appraisal Committee (SEAC) and can certify various documents including Environment Impact Assessment (EIA)/ Environment Management Plan (EMP) reports under the accreditation scheme for EIA consultants with Quality Council of India (QCI)/National Accreditation Board for Education and Training (NABET). Environment Impact Assessment (EIA) Consultant Accreditation Scheme has been developed which has been adapted as minimum requirement by Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India.

We would like to mention that RSET has significant experience of working on environmental impact assessment studies. We have successfully completed and got environmental clearances from MoEF&CC/SEIAA for 42 River Valley, Hydel, Drainage and Irrigation projects. Presently we are involved with around 10 similar studies which are at various stages of progress.

RSET's core competence includes **Environment & Social Impact Assessment (ESIA)** of hydro power, solar power, drinking water supply and transmission & distribution projects according to **World Bank, IFC's performance standards, NDB and Equator principles**.



F. No. J-12011/08/2021-IA.I (R)]
Ministry of Environment, Forest & Climate Change
Government of India
(Impact Assessment Division)

Indira Paryavan Bhavan
2nd Floor, Vayu Wing
Aliganj, Jor Bagh Road
New Delhi - 110 003

Date: 10th June, 2021

To,

The Executive Director (EDM)
NHPC Limited
NHPC Office Complex, Sector-33,
Faridabad - 121 003, Haryana

Subject: Uri-I Stage-II Hydroelectric project of 240 MW as Run of River scheme in an area of 102 ha by M/s NHPC Limited in Tehsil Uri, District of Baramulla (Jammu and Kashmir) - Terms of Reference (ToR) - Reg.

Sir,

This is with reference to your Proposal No. IA/JK/RIV/204853/2021 & letter NH/PC/8395 dated 19.03.2021 on the above cited subject.

2. The proposal was considered by the sectoral Expert Appraisal Committee (EAC) River Valley and Hydro Electric Power Projects (RV&HEP) in the Ministry in its 10th EAC meeting held on 15th April, 2021 through Video Conferencing. The details of the project, as per the documents submitted by the project proponent, and also as informed during the meeting, are reported to be under:

- (i) Project proponent informed to the EAC that NHPC Limited proposes to construct of Uri-I Stage-II Hydroelectric project of 240 MW, a run off the river scheme, is situated on river Jhelum in Uri Tehsil of Baramulla district in Jammu and Kashmir.
- (ii) It is about 72 km from Srinagar and 362 km from Jammu. The nearest rail head is Udhampur which is 275 km from project. Project location (Coordinates): Lat. 34° 8' 37" N Long. 74° 11' 14" E.
- (iii) URI-I Stage-II H.E. Project is the extension of URI-I H.E. Project. Utilizing the gross head of about 250 m between the Full Reservoir Level (FRL)/Full supply level as 1491.0m at Barrage and normal Tail Water Level (TWL) as 1241.0m at TRT outlet.
- (iv) The main components of the project are as follows:
 - a) 4.3.1. Constructed structures (URI-I Power Station) - Uri-I Power station Barrage 95m long and 21.5m high from its deepest foundation level.
 - b) The full supply water level upstream of the barrage is EL 1491.00m and barrage top is at EL 1495.50m. Spillway consisting of 6 bays of 8.0m(width) x 7.5m (height) and 3 No. under sluice bays 8m(width) x 8.25m (height).
 - c) A fish way is provided between bay No. 6 and bay No. 7. It is about 150 m long with the inlet at El 1489.0 m and the outlet at El 1475.50 m.

- d) Head regulator of 34m length, four bays of cut and cover culvert, 44- 66m wide desilting basin with two bays of 300m length. Headrace canal of about 470m length and 12m width and side slopes in 1V:1.5 H. Intake forebay at the downstream end of the canal of 195m. A siphon type surplus escape at a water level of El 1491.30m
- e) Proposed structures (URI-I Stage-II H.E. Project- 1 No HRT of size 6.5m Horse shoe shape in left bank and parallel in valley side to existing HRT. 1 no. 5 m dia Steel lined pressure tunnels/shafts and further bifurcated to 2 no. 3.25m dia. Steel lined pressure tunnel for auxiliary units. Underground power house cavern of size 91.0 m (L) x 20 m (W) x 40.7 m (H), housing 2 no. main units of 120 MW each. Transformer cavern of size 79 m (L) x 16.5 m (W) x 23.5 m (H) located d/s of power house cavern. 1 no. main TRT of size 6.5m Horse shoe shape having tailrace surge galleries.
- (v) **Land requirement:** Total land requirement of the project is about 102 ha of which about 85 ha is private land and about 17 ha is forest land (for underground works). Private land required for the project is in possession of NHPC.
- (vi) There is no submergence due to the project, wildlife sanctuary, tiger reserve, elephant corridor, critically polluted area within to 10 km of the project.
- (vii) **Project benefit:** The project will generate clean and green power of 120 MW which will help in reduction of GHG emissions from conventional source of energy. It will bring about local area development and will provide employment opportunities locally with contractors.
- (viii) **Water availability studies:** The average 10-daily water availability flow series from 1994-95 to 2019-20 (26 years) at Uri-I Barrage has been approved by CWC Hydrology (N) Directorate vide their file no. T-11025/1//2021-HYD(N) DTE, dated 15-03-2021. The average annual yield for the series Jun-94 to May-20 is 8080 Mcum (i.e. 633.7 mm). Uri-I (Stage-II) H. E. project also utilizes diverted (additional) waters available after generation of Kishanganga Power station. The water availability series of Kishanganga PS from 1971 to 2004 has been developed and approved by CWC and the same is used for Uri-I (Stage-II) H. E. project.
- (ix) **Power Generation:** The 10-daily inflow series was taken from 1975-76 to 2019-20 of Uri-I power station and from 1971-72 to 2019-20 for Kishanganga Power station was taken for power potential study. Only the turbine discharge of Kishanganga Power station has been considered which is being added to Wular Lake and further to Jhelum River.
- (x) In view of recent NGT order, provision of e-flow as 15% of average of inflow in the lean season, needs to be made in dam/barrage of existing power plant. Accordingly, 15% of average inflow of all the water series in the lean season i.e., during Oct-Jan, has been calculated as 13.05 Cumecs. There is already a provision of 2.5 cumecs downstream discharge through fish ladder of barrage of Uri power station. As such, provision of additional downstream discharge of 10.55 Cumecs as e-flow, has been kept from the barrage of Uri Power station.
- (xi) As Uri-I Stage-II Project is utilizing the surplus water of Uri Power Station, the e-flow discharge is going to have negligible impact on power potential of Uri-I Stage-II Project. The power potential study carried out based on the 10-daily series indicates that an installed capacity of 240 MW comprising 2 nos generating units of 120 MW each would be the best option for Uri-I stage-II HEP. Design energy of the project has been estimated as 662.20 MU.



- (xii) **Inter-State Matters:** The project lies entirely in the UT of J&K and no inter-state issues are involved.
- (xiii) **INTERNATIONAL MATTERS:** The projects on river Jhelum are covered under Indus Water treaty for which Clearance will be taken after firming up of DPR.
- (xiv) **COST ESTIMATE:** The preliminary estimated project cost at November 2020 price level has been worked out as Rs. 1930.00 crores
- (xv) **Status of other statutory clearances:**
- a) Environment clearance was accorded to Uri-I Project on 27.06.1980 by Department of Science & technology (DST) and additional conditions were given by MoEF&CC on 30.05.1989. Forest clearance for diversion of 54.7 ha land was accorded by MoEF vide letter dated 21.05.1986. For the present extension proposal of for Uri-I St-II HEP, EC process has been started.
 - b) Forest proposal is being formulated for diversion of approx. 17 ha forest land required for the project. DPR formulation for Concurrence by CEA is also in process.
- (xvi) **Background of the project:**
- a) NHPC Limited signed a Memorandum of Understanding with the Government of Jammu and Kashmir on 3rd January 2021 for execution of URI-I Stage-II HE Project (240 MW) on Build, Own, Operate & Transfer (BOOT) basis for the period of 40 years on the River Jhelum, in Uri Tehsil of Baramullah district in Jammu and Kashmir.
 - b) URI-I Stage-II H.E. Project is the extension of URI-I H. E. Project (480MW). Stage-I of URI H.E. Project a purely run –of-the river scheme which was allotted to NHPC Limited and was commissioned in 1997 and since then operating successfully.
 - c) URI-I Stage –II H.E. Project is planned as per provision kept in the DPR of URI-I H.E Project. In addition to Barrage, the provision of surface water conveyance system for URI-I Stage-II Project from Head regulator to the Intake of HRT has been utilized from URI-I Power Station already constructed. This project also utilizes diverted (additional) waters available after generation of Kishanganga Power station.
 - d) The general layout of the Project, size and dimensions of various components/ structures have been adopted based upon built in structures of URI-I Power Station.
 - e) Separate water conveyance structures and separate Power house complex structures are proposed to be constructed for URI-I Stage-II H.E. Project.

3. EAC deliberated on the information submitted (Form 1, PFR, km. file, etc.) and as presented in the meeting and observed that the project is located on the river Jhelum. The project is for developing a 240 MW Capacity on the Jhelum River. The project is located in Tehsil Uri, District of Baramulla, Jammu and Kashmir. URI-I Stage-II H.E. Project is the extension of URI-I H.E. Project. Utilizing the gross head of about 250 m between the Full Reservoir Level (FRL) /Full supply level as 1491.0m at Barrage and normal Tail Water Level (TWL) as 1241.0m at TRT outlet. The tentative land to be acquired/ diverted for the project is about 102 ha of which about 85 ha is private land and about 17 ha is forest land (for underground works). Private land required for the project is in possession of NHPC. Application for Forest Clearance yet to be submitted. There is no submergence due to the project, wildlife sanctuary, tiger reserve, elephant corridor, critically polluted area within to 10 km of the project.

4. The Expert Appraisal Committee after detailed deliberations in its 10th meeting held on 15th April, 2021 on the information submitted and as presented, **recommended** the proposal for grant of Standard TOR applicable for Hydro Power projects along with additional TOR to the proposed project.
5. Matter was further examined in the Ministry and additional clarification was sought from M/s NHPC in view of CEA's suggestion regarding dropping the proposed project. As submitted by the PP vide their letter dated 7.06.2021, matter has been taken up with CEA for reconsideration of their recommendation and CEA has opined that Stage-II in isolation, does not appear commercially viable. However, in case beneficiaries of existing Uri-I Stage-I HE Project agree for purchase of power from planned project, tariff of both the projects combined together may be reasonable (as indicated by M/s NHPC Ltd.).
6. Based on the recommendations of the EAC, followed by further examination, the Ministry of Environment, Forest and Climate Change hereby grants approval to the following Terms of References (TOR) to Uri-I Stage-II Hydroelectric project of 240 MW by M/s NHPC Limited in Tehsil Uri, District of Baramulla, Jammu and Kashmir for preparation of EIA/EMP reports, under the provisions of the Environment Impact Assessment Notification, 2006 and subsequent amendments/circulars thereto:
- i. EIA report for the proposed expansion project Uri-I Stage-II should be prepared keeping in view the cumulative impact of existing Uri-I HE Project and proposed Uri-I Stage-II HE Project.
 - ii. Three season (Pre-monsoon, Monsoon and winter season) baseline data of all the environmental attributes including biological environment as mentioned in the Standard ToR shall be collected for preparation of EIA/EMP report.
 - iii. Requisite studies like simulation study for the E-flow shall also be undertaken.
 - iv. The project involves diversion of 17ha of forestland. Forest clearance shall be obtained as per the prevailing norms of Forest (Conservation) Act, 1980. Application to obtain prior approval of Central Government under the Forest (Conservation) Act, 1980 for diversion of forestland required should be submitted as soon as the actual extent of forestland required for the project is known, and in any case, within six months of issuance of this letter.
 - v. CAT plan, Dam break analysis, Disaster Management Plan and Fisheries Management Plan be prepared along with other EMPs and incorporated in the EIA/EMP report.
 - vi. The EIA report should also describe the cumulative environmental effects due to proximity to other existing or planned projects with similar effects, if any.
 - vii. All the tasks including conducting public hearing shall be done as per the provisions of EIA Notification, 2006 and as amended from time to time. Public hearing issues raised and compliance of the same shall be incorporated in the EIA/EMP report in the relevant chapter.
 - viii. An undertaking as part of the EIA report from Project proponent, owning the contents (information and data) of the EIA report with the declaration about the contents of the EIA report pertaining to a project have not been copied from other EIA reports.
 - ix. Consolidated EIA/EMP report is to be submitted as per the generic structure (Appendix III & IIIA) given in the EIA Notification, 2006.



- x. Conservation plan for the Scheduled I species, if any, in the project study area shall be prepared and submitted to the Competent Authority for approval.
- xi. Pre-DPR Chapters viz., Hydrology, Layout Map and Power Potential Studies duly approved by CWC/CEA shall be submitted.
- xii. Environmental matrix during construction and operational phase needs to be submitted.
- xiii. Both capital and recurring expenditure under EMP shall be submitted.
- xiv. The salient features to be intimated to the Indus water commission.
- xv. Environmental Cost benefit analysis for the proposed project shall be done duly keeping in view the actual cost-benefit of the existing operational Uri-I HE Project and that of proposed expansion of the same.
- xvi. PP shall apply to obtain prior approval of Central Government under the Forest Conservation Act, 1980 for diversion of forest land required for such projects will be submitted as soon as the actual extent of forest land required for the project is known to the project proponent, and in case, within 6 months of issuance of ToRs.

7. Further, Ministry in suppression of OM dated 1st May 2018 regarding CER has issued an another OM dated 30.09.2020 (enclosed). In this regard, it is advised that issues raised during Public hearing and activities proposed to address such issues shall be made part of EMP.

8. **Standard ToR:** The EIA/EMP report should contain the information in accordance with provisions & stipulations as given in the standard ToR for Hydroprojects (please visit the following link to download the Standard ToR: <http://environmentclearance.nic.in/writereaddata/standardtorreference.pdf>)

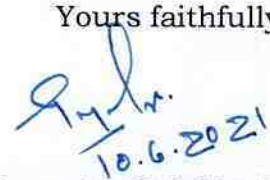
9. This grant of Terms of Reference (ToR) for the said project is further subject to the general conditions as under:

- i. All documents should be properly indexed, page numbered.
- ii. Period/date of data collection should be clearly indicated.
- iii. Authenticated English translation of all material provided in Regional languages.
- iv. After the preparation of the draft EIA-EMP Report as per the aforesaid TOR, the proponent shall get the Public Hearing conducted as prescribed in the EIA Notification 2006 and take necessary action for obtaining environmental clearance under the provisions of the EIA Notification 2006.
- v. The letter/application for EC should quote the Ministry's file No. and also attach a copy of the letter prescribing the ToR.
- vi. The copy of the letter received from the Ministry on the Tor prescribed for the project should be attached as an annexure to the final EIA-EMP Report.
- vii. General Instructions for the preparation and presentation before the EAC of TOR/EC projects of Coal Sector should be incorporated/followed.
- viii. The aforesaid ToR has a validity of five years only.
- ix. Grant of ToR does not necessarily mean grant of EC.
- x. Grant of ToR to the present project does not necessarily mean grant of TOR/EC to the captive/linked project.
- xi. Grant of ToR to the present project does not necessarily mean grant of approvals under the Forest (Conservation) Act, 1980 or the Wildlife (Protection) Act, 1972.



- xii. Grant of EC is also subject to circulars issued under the EIA Notification 2006, which are available on the Ministry's website.
- xiii. You are required to submit the final EIA/EMP prepared as per TORs to the Ministry within 5 years as per this Ministry's Notification vide S.O. 751 (E) dated 17th February, 2020 for considering the proposal for environmental clearance.
10. You are required to submit the final EIA/EMP prepared as per TORs to the Ministry within 5 years as per this Ministry's Notification vide S.O. 751 (E) dated 17th February, 2020 for considering the proposal for environmental clearance.
11. The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India/National Accreditation Board of Education and training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and data provided by other organizations(s)/laboratories including their status of approvals etc. vide Notification of the MoEF dated 19th July, 2013.
12. This issue with the approval of the Competent Authority.

Yours faithfully,


(Yogendra Pal Singh)
Scientist 'E'

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi - 110 001.
2. The Secretary, Ministry of Water Resources, RD & GR, Shram Shakti Bhawan, Rafi Marg, New Delhi - 110 001.
3. The Secretary, Department of Power, Government of Jammu and Kashmir, Civil Secretariat, Jammu, Jammu & Kashmir.
4. The Secretary, Department of Forest, Environment & Wildlife Management, Government of Jammu and Kashmir, Civil Secretariat, Jammu, Jammu & Kashmir.
5. The Chief Engineer, Project Appraisal Directorate, Central Electricity Authority, Sewa Bhawan, R. K. Puram, New Delhi - 110 066.
6. The DDG of Forests (Central), Ministry of Environment, Forest & Climate Change, Integrated Regional Office, Jammu IWDP Complex, Gladin, Narwal, Near J&K Pollution Control Board, Jammu - 180 006.
7. The Chairman, Jammu and Kashmir State Pollution Control Board, Gladin, Narwal, Jammu, Jammu & Kashmir - 180 004.
8. NIC Cell - uploading in MoEF&CC's website.
9. Guard file.


(Yogendra Pal Singh)
Scientist 'E'

ToR Compliance – Uri-I Stage-II Hydro Electric Project

S. No	Clause in Standard ToR	Compliance
1	Scope of EIA study	Chapter 1: Introduction, Section 1.4; Page 1.7
2	Details of the Project and site	
	General introduction about the proposed project.	Chapter 1: Introduction, Section 1.3; Page 1.2
	Details of project (existing and proposed) and site L-sections of all U/S and D/S projects of river with relevant maps and figures.	Chapter 1: Introduction, Section 1.3.1, Page 1.2; Section 1.3.6, Page 1.4; Figure 1.2 Page 1.6
	A map of boundary of the project site.	Chapter 2: Project Description, Figure 2.2; Page 2.4
	Location details on a map of the project area	Chapter 2: Project Description, Section 2.3, Page 2.1; Figure 2.1; Page 2.2
	Layout details and map of the project	Chapter 2: Project Description, Figure 2.2; Page 2.4; Figure 2.3; Page 2.5
	Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area	Chapter 3: Description of The Environment: Section 3.2.14; Figure 3.20; Page 3.88
	Drainage pattern and map of the river catchment up to the proposed project site.	Chapter 3: Description of The Environment: Project Description, Section 3.2.4.1 Figure 3.10; Page 3.23
	Delineation of critically degraded areas in the directly draining catchment on the basis of silt yield	Chapter 10: EMP; Section 10.2 Catchment Area Treatment Plan page 10.3
	Soil characteristic and map of the project area.	Chapter 3: Description of The Environment: Section 3.2.7, Page 3.30; Figure 3.18; Page 3.32
	Geological and Seismic-tectonic details and maps of the area surrounding the proposed project	Chapter 3: Description of The Environment: Section 3.2.3, Page 3.19; Figure 3.9, Page 3.20
	Remote sensing studies, interpretation of satellite imagery, topographic sheets	Chapter 3: Baseline Environment: Figure 3.1, 3.4, 3.5, 3.6, 3.7 and 3.8: Page 3.3, 3.14, 3.15, 3.16, 3.17 and 3.18 respectively
	Land details including forests, private and other land.	Chapter 2: Project Description: Section 2.4.1; Table 2.2; Page 2.10
3	Description of Environment and Baseline data	
	To know the present status of environment in the area, baseline data with respect to environmental components air, water, noise, soil, land and biology & biodiversity (flora & fauna), wildlife, socio-economic status etc. the study area should comprise off the following: - Catchment area up to the dam site - Submergence area	Chapter 3: Description of The Environment Section 3.1.1 Page 3.1; Figure 3.1, Page 3.3

S. No	Clause in Standard ToR	Compliance
	- Project area or the direct impact area should comprise of area falling within 10 km radius from the periphery of reservoir, land coming under submergence and area downstream of dam up to the point where tail race Tunnel (TRT) meets the river. - Downstream up to 10km from the tip off the reservoir.	
4	Details of the Methodology	Chapter 3 Description of The Environment Section 3.1.4; Page 3.3
5	Methodology for collection of Biodiversity data	
	- The number of sampling locations should be adequate to get a reasonable idea off the diversity and other attributes of flora and fauna. - The entire area should be divided in grids. - The R.E.T. species referred should include species listed in schedule I and II of Wildlife (protection) Act, 1972.	Chapter 3: Description of The Environment Section 3.1.4; Page 3.4; Figure 3.3; Page 3.9 Chapter 3: Description of The Environment Figure 3.1; Page 3.3 Chapter 3: Description of The Environment Section 3.2.12.2 Page 3.57 and 3.2.13.5 Page 3.77
6	Components of the EIA study	
A	Physical and Chemical Environment	
i	Geological & Geophysical Aspects and Seismo-Tectonics	
	- Physical Geography, Topography, Regional Geological aspects and structure of the catchment. - Tectonics, Seismicity and History of past earthquakes in the area. A site-specific study of earthquake parameters will be done. The results of the site-specific earthquake design shall be sent for approval of the NCSDP (National Committee of Seismic design parameters, Central Water Commission, New Delhi for large dams. - Landslide zone or area prone to landslides existing in the study area should be examined. - Presence of important economic mineral deposit, if any. - Justification for location & execution of the project in relation to structural components (dam height).	Chapter 3: Description of The Environment Section 3.2.1; Page 3.14 Chapter 3: Description of The Environment Section 3.2.3.5; Page 3.21. Chapter 10: Section 10.8.2 Page 10.91 Chapter 3: Description of The Environment Section 3.2.15.4; Page 3.97. Chapter 5: Analysis of Alternatives
ii	Meteorology, Air and Noise	
	- Meteorology (viz., Temperature, Relative Humidity, wind speed/direction etc.) to be collected from nearest IMD station. - Ambient Air Quality with parameters viz., Suspended Particulate Matter (SPM), Repairable	Chapter 3: Description of The Environment Section 3.2.6; Page 3.26 Chapter 3: Description of The Environment Section 3.2.8; Page 3.36

S. No	Clause in Standard ToR	Compliance
	Suspended Particulate Matter (RSPM) i.e., suspended particulate materials <10-microns, Sulphur Dioxide (SO₂), Oxides of Nitrogen (NO_x), in the study area at 6 locations. Existing noise levels and traffic density in the study area at 6 locations.	Chapter 3: Description of The Environment Section 3.2.9; Page 3.41
iii	Soil Characteristics	
	Soil classification, physical parameters (viz., texture, porosity, bulk density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity, Magnesium, calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR, nitrogen and salinity, etc.,) (6 locations).	Chapter 3: Description of The Environment Section 3.2.7, Page 3.30; Figure 3.18, Page 3.32; Table 3.12; Page 3.30; Table 3.13, Page 3.33; Table 3.15, Page 3.34
iv	Remote sensing and GIS Studies	
	- Generation of thematic maps viz., slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an erosion intensity map should be prepared. - New Configuration map to be given in EIA report	Chapter 10: Environment Management Plan Section 10.2 CAT Plan, Figure 10.3; Page 10.9, Figure 10.4; Page 10.11, Figure 10.5; Page 10.12 and Figure 10.6; Page 10.14 Chapter 3: Description of The Environment Section 3.3; Page 3.98
V	Water Quality	
	- History of the ground water table fluctuation in the study area. - Water quality for both surface water and ground water for (i)Physical parameters'(pH, temperature, electrical conductivity, TSS); (ii)Chemical parameters (Alkalinity, Hardness, BOD, COD, NO₂, PO₄, Cl, SO₄, Na, K, Ca Mg, Silica, Oil & Grease, phenolic compounds, residual sodium carbonate); (iii)Bacteriological parameters (MPN, Total coliforms) and (iv) Heavy Metals (Pb, As, Hg, cd, cr-6, total Cr, Cu, Zn, Fe). - Delineation of sub and micro-watersheds, their locations and extent based on the All-India Soil and Land Use Survey of India (AISLUS), Department of Agriculture, Government of India. Erosion levels in each micro-watershed and prioritization of micro-watershed through silt yield index (SYI) method of AISLUS.	Chapter 3: Description of The Environment Section 3.2.4.9, Page 3.25 Chapter 3: Description of The Environment. Section 3.2.10: Water Environment; Page 3.44 Table 3.20; Page 3.45; Table 3.23, Page 3.49 Chapter 10 EMP: Section 10.2 Catchment Area Treatment Plan, Page 10.3, Figure 10.2, Page 10.7, Table 10.2; Page 10.7
B	Water Environment & Hydrology	
	Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and	Chapter 3: Description of The Environment Section 3.2.6; Page 3.26

S. No	Clause in Standard ToR	Compliance
	data acquisition system for inflows monitoring. - Run-off, discharge, water availability for the project, sedimentation rate, etc. - Basin characteristic's - Catastrophic events like cloud bursts and flash floods, if any, should be documented. - For estimation of Sedimentation Rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for a minimum of one year. Actual silt flow rate to be expressed in ha-m km² year⁻¹. - Set-up a G&D monitoring station and a few rain-gauge stations in the catchment area for collecting data during the investigation. - Flow series, 10 daily with 90%, 75% and 50% dependable years discharges. - A table of 10-daily water discharges corresponding to 90% dependable year showing the intercepted discharge at the barrage, the environmental flow to be released and the other flow releases downstream of the barrage and spills to be provided in hydrology section of EIA. - Norms for release of Environmental flow i.e. 30% in monsoon, 20% in lean season and 25% in non-monsoon & non-lean season to be followed corresponding to 90% dependable year. A site-specific study on minimum environmental flow should be carried out. - Hydrological studies/data as approved by CWC shall be utilized in the preparation of EIA/ EMP report. Actual hydrological annual yield may also be given in the report. - A minimum of 1 km distance from the top of the reservoir to the tail race tunnel should be maintained between upstream and downstream projects.	Chapter 3: Description of The Environment Section 3.2.4.2; Page 3.22 Chapter 3: Description of The Environment Section 3.2.4; Page 3.22 Chapter 3: Description of The Environment Section 3.2.5; Page 3.25 Chapter 3: Description of The Environment Section 3.2.4.8; Page 3.25 Chapter 3: Description of The Environment Section 3.2.4.1; Page 3.22 Chapter 3: Description of The Environment Section 3.2.4.2; Page 3.22 Chapter 3: Description of The Environment Section 3.2.4.2; Page 3.22. Chapter 4: Assessment of Impact, Section 4.1.3.3 (g) Page 4.8 Chapter 3: Description of The Environment Section 3.2.4; Page 3.22 Chapter 1: Introduction, Section 1.3.1; Page 1.2 Section 1.3.6; Page 1.4
C	Biological Environment	
	Flora: Characterization of forest types (as per Champion and Seth method) in the study area and extent of each forest type as per the Forest Working Plan.	Chapter 3: Description of The Environment Section 3.2.11; Page 3.52

S. No	Clause in Standard ToR	Compliance
	- Documentation of all plant species i.e. Angiosperm, Gymnosperm, Pteridophytes, Bryophytes (all groups). - General vegetation profile and floral diversity covering all groups of flora including. A species-wise list may be provided. - Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index (IVI, Shannon Weiner index etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of locations of quadrates, size of quadrates etc. to be reported within the study area in different ecosystems. - Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area, if, any, should be detailed. - Economically important species like medicinal plants, timber, fuel wood etc. - Details of endemic species found in the project area. - Flora under RET categories should be documented using International Union for the Conservation of Nature and Natural Resources (IUCN) criteria and Botanical Survey of India's Red Data list along-with economic significance. Species diversity curve for RET species should be given. - Cropping pattern and Horticulture Practices in the study area. Fauna: - Fauna study and Inventorisation should be carried out for all groups of animals in the study area. Their present status along with Schedule of the species. - Documentation of fauna plankton (phyto and zooplankton), periphyton, benthos and fish should be done and analyzed. - Information (authenticated) on Avi-fauna and wildlife in the study area. - Status of avifauna their resident/ migratory/ passage migrants etc.	Chapter 3: Description of The Environment Section 3.2.12.1; Page 3.53 Chapter 3: Description of The Environment Section 3.2.12.3; Page 3.58 Chapter 3: Description of The Environment Section 3.1.4.2 Page 3.8 Section 3.2.12.3; Page 3.58, Table 3.33 to 3.37 Section 3.2.12.4 Page 3.67 Section 3.2.12.5 page 3.69 Section 3.2.12.6 Page 3.69 Chapter 3: Description of The Environment Section 3.2.14; Figure 3.20; Page 3.88 Chapter 3: Description of The Environment Section 3.2.12.7; Table 3.43; Page 3.71 Chapter 3: Description of The Environment Section 3.2.12.2; Page 3.57 Chapter 3: Description of The Environment Section 3.2.12.2; Table 3.32; Page 3.57 Chapter 3: Description of The Environment Section 3.2.12.8; Page 3.72 Chapter 3: Description of The Environment Section 3.2.13; Page 3.72; Table 3.46; Page 3.73 Table 3.47; Page 3.74, Table 3.48 & 3.49 Page 3.77, Chapter 3: Description of The Environment Section 3.2.13.6; Page 3.78; Table 3.50 to 3.58 Page 3.78 to 3.85 Chapter 3: Description of The Environment Section 3.2.13.2; Table 3.47; Page 3.74 Chapter 3: Description of The Environment Section 3.2.13.2; Table 3.47; Page 3.74

S. No	Clause in Standard ToR	Compliance
	- Documentation of butterflies, if any, found in the area. - Details of endemic species found in the project area. - RET species-voucher specimens should be collected along with GPS readings to facilitate rehabilitation. RET faunal species to be classified as per IUCN Red Data list and as per different schedule of Indian Wildlife (Protection) Act, 1972. - Existence of barriers and corridors, if any, for wild animals. - Compensatory afforestation to compensate the green belt area that will be removed, if any, as part of the proposed project development and loss of biodiversity. - Collection of primary data on agricultural activity, crop and their productivity and irrigation facilities components. - For categorization of sub-catchment into classes and for the consequent CAT plan, the entire catchment (Indian Portion) is to be considered and not only the directly the draining catchment.	Section 3.2.13.4; Table 3.49; Page 3.77 Chapter 3: Description of The Environment Section 3.2.13.5; Page 3.77 Chapter 3: Description of The Environment Section 3.2.13.5; Page 3.77 Chapter 3: Description of The Environment Section 3.2.14; Page 3.87 Chapter 10: Environmental Management Plan Section 10.3; Page 10.33 Chapter 3: Description of The Environment Section 3.2.12.8; Page 3.72 3.2.15.2 (g); Page 3.96 Chapter 10: Environmental Management Plan Section 10.2; Page 10.3
D	Aquatic Biology	
	- Documentation of aquatic fauna like macro-invertebrates, zooplankton, phytoplankton benthos etc. - Fish and fisheries, their migration and breeding grounds. - Fish diversity composition and maximum length & weight of the measured populations to be studied for estimation of environmental flow. - Conservation status of aquatic fauna. - Sampling for aquatic ecology and fisheries must be conducted during three seasons Pre-monsoon (summer) and monsoon. Sizes (length & weight) off important fish species need to be collected and breeding and feeding grounds should also be identified along the project site or in vicinity.	Chapter 3: Description of The Environment Section 3.2.13.6; Page 3.78; Table 3.50 to 3.58 Page 3.78 to 3.85
E	Socio-economic Environment	
	Collection of baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including sources of livelihood, job opportunities and safety and security of workers and surroundings population.	Chapter 3: Description of The Environment Section 3.2.15 Page 3.89

S. No	Clause in Standard ToR	Compliance
	- Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent. - Collection of information on sensitive habitat of historical, cultural and religious and ecological importance. - The socio-economic survey/ profile within 10 km of the study area for demographic profile; Economic Structure; Developmental Profile; Agricultural Practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc. - List of all the Project Affected Families with their names, age, education qualification, family size, religion, caste, source of income, land & house holdings, other properties, occupation, source of income, house/land to be acquired for the project and house/land left with the family, and other property, possession of cattle, type off houses etc.	Chapter 3: Description of The Environment Section 3.2.15 Page 3.89 Chapter 3: Description of The Environment Section 3.2.15 Page 3.89 Chapter 3: Description of The Environment Section 3.2.15 Page 3.89 Figure 3.21; Page 3.91 NA
7	Impact Prediction and Mitigation Measures	
	The adverse impact due to the proposed project should be assessed and effective mitigation steps to abate these impacts should be described.	Chapter 4: Anticipated Environmental Impact and Mitigation Measures
i	Air Environment	
	- Changes in ambient and ground level concentrations due to total emissions from point, line and area sources. - Effect on soil, material, vegetation and human health. - Impact of emissions from DG set used for power during the construction, if any, on air environment. - Pollution due to fuel combustion in equipment and vehicles - Fugitive emissions from various sources.	Chapter 4: Anticipated Environmental Impact and Mitigation Measures Section 4.1.1 Page 4.2
ii	Water Environment	
	- Changes in surface and ground water quality. - Steps to develop pisci-culture and recreational facilities. - Changes in hydraulic regime and downstream flow. - Water pollution due to disposal of sewage - Water pollution from labor colonies/ camps and washing equipment.	Chapter 4 Anticipated Impact and Mitigation Measures Section 4.1.3 Page 4.6
3	Land Environment	
	Adverse impact on land stability, catchment of soil erosion, reservoir sedimentation and spring flow (if any) (a) due to considerable road	Chapter 4: Anticipated Impact and Mitigation Measures

S. No	Clause in Standard ToR	Compliance
	construction/widening activity (b) interference of reservoir with the inflowing stream (c) blasting for commissioning of HRT, TRT and some other structures. • Changes in land use / land cover and drainage pattern • Immigration of labour population • Quarrying operation and muck disposal • Changes in land quality including effects of waste disposal. • River bank and their stability • Impact due to submergence.	Section 4.1.4 Page 4.15
4	Biological Environment	
	• Impact on forests, flora, fauna including wildlife, migratory avi-fauna rare and endangered species, medicinal plants etc. • Pressure on existing natural resources. • Deforestation and disturbance to wildlife, habitat fragmentation and wild animal's migratory corridors. • Compensatory afforestation-identification of suitable native tree species for compensatory afforestation and green belt. • Impact on fish migration and habitat degradation due to decreased flow of water. • Impact on breeding and nesting grounds of animals and fish.	Chapter 4: Anticipated Impact and Mitigation Measures Section 4.1.5 Page 4.17 Chapter 4: Anticipated Impact and Mitigation Measures Section 4.1.5(a) Page 4.17 Chapter 4: Anticipated Impact and Mitigation Measures Section 4.1.5(b) Page 4.18 Chapter 10: Environment Management Plan Section 10.3; Page 10.33 Section 10.9 Page 10.93 Chapter 4 Anticipated Impact and Mitigation Measures, Section 4.1.3.3 (g) Page 4.8 Chapter 4 Anticipated Impact and Mitigation Measures, Section 4.1.3.3; Page 4.8
5	Socio – Economic Aspects	
	• Impact on local community including demographic profile. • Impact on socio-economic status. • Impact on economic status. • Impact on human health due to water / water borne disease. • Impact on increase traffic. • Impact on Holy Places and Tourism. • Impacts of blasting activity during project construction which generally destabilize the land mass and leads to landslides, damage to properties and drying-up of natural springs and cause noise pollution will be studied. Proper record shall be maintained of the baseline information in the post project period. • Positive and negative impacts likely to be accrued due to the project are listed.	Chapter 4: Anticipated Impact and Mitigation Measures Section 4.1.6; Page 4.19
8	Environmental Management Plan (EMP)	

S. No	Clause in Standard ToR	Compliance
1	Catchment Area Treatment (CAT) Plan should be prepared micro-watershed wise. Identification of free draining/ directly draining catchment based upon Remote Sensing and Geographical Information System (GIS) methodology and Sediment Yield Index (SYI) Method of AISLUS, Dept. of Agriculture, Govt. of India coupled with ground survey. Areas or watersheds falling under 'very severe' and 'severe' erosion categories should be provided and required to be treated. Both biological as well as engineering measures should be proposed in consultation with State Forest Department for areas requiring treatment. Year-wise schedule of work and monetary allocation should be provided. Mitigation measures to check shifting cultivation in the catchment area with provision for alternative and better agricultural practices should be included.	Chapter 10: Environment Management Plan Section 10.2; Page 10.4.
2	Compensatory Afforestation shall be prepared by the state forest department in lieu of the forest land proposed to be diverted for construction of the project as per the Forest (Conservation) Act, 1980. Choice of plant for afforestation should include native and RET species, if any. This will be a part of the forest clearance proposal.	Chapter 10: Environment Management Plan Section 10.3; Page 10.31
3	Biodiversity and Wildlife Conservation & Management Plan for conservation and preservation of endemic, rare and endangered species of flora and fauna to be prepared in consultation with State Forest Department	Chapter 10: Environment Management Plan Section 10.4; Page 10.34
4	Fisheries Conservation & Management Plan-Fish fauna inhabiting the affected stretch of river, a specific fisheries management plan should be prepared for river and reservoir.	Chapter 10: Environment Management Plan Section 10.5; Page 10.56
5	Resettlement and Rehabilitation (R&R) Plan needed to be prepared on the basis of findings of the socio-economic survey coupled with the outcome of public consultation held. The R&R package shall be prepared after consultation with the representatives of the project affected families and the State Government. Detailed budgetary estimates are to be provided. Resettlement site should be identified. The plan will also incorporate community development strategies. R&R Plan is to be formulated as per land Acquisition, Resettlement and Rehabilitation Act, 2013 which came into force w.e.f. 1.1.2014	Chapter 7: Additional Studies; Section 7.1. Resettlement and Rehabilitation Plan, Page 7.2
6	Green Belt Development Plan along the periphery of reservoir, colonies, approach road, canals etc. Local plant species must be suggested with physical and financial details. Local plant species suitable for greenbelt development should be selected	Chapter 10 Environmental Management Plan Section 10.9; Page 10.90
7	Reservoir Rim Treatment Plan for stabilization of land	Chapter 10 Environmental Management Plan

S. No	Clause in Standard ToR	Compliance
	slide/land slip zones if any, around the reservoir periphery to be prepared. Suitable engineering and biological measures for treatment of the identified slip zones to be provided with physical and financial schedule.	Section 10.8; Page 10.88
8	Muck Disposal Plan- suitable sites for dumping of excavated material should be identified in consultation with the State Pollution Control Board and Forest Department. All Muck disposal sites should be minimum 30 m away from the HFL of river. Plan for rehabilitation of muck disposal sites should also be given. The L- section/ cross section of muck disposal sites and approach roads to be given. The plan shall have physical and financial details of the measures proposed.	Chapter 10: Environment Management Plan Section 10.6; Page 10.63 Figure 10.10 Page 10.68: Layout Map of Muck Dumping Site Figure 10.11A & B, Page 10.69 & 10.70: L/section/ cross section of muck disposal sites
9	Plan for Restoration of quarry sites and landscaping of colony areas, working areas, roads, etc.	Chapter 10: Environment Management Plan Section 10.7: Landscaping and restoration of Construction Sites Page 10.76
10	Study of Design Earthquake Parameters: A site specific study of earthquake parameters should be done. Results of the site-specific earthquake design parameters should be approved by National Committee of Seismic Design Parameters, Central Water Commission (NCSDP) New Delhi.	Chapter 2: Project Description Section 2.8 (iv); Page 2.18 Chapter3: Description of The Environment; Section 3.2.3.5; Page 3.21
11	Dam Break Analysis and Disaster Management Plan: The outputs of Dam Break Model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam break scenario. Provision for early warning systems should be provided.	Chapter 10 Environmental Management Plan Section 10.14; Page 10.107 Annexure-V
12	Water, Air and Noise Management Plans to be implemented during construction and post construction periods.	Chapter 4: Anticipated Environmental Impacts and Mitigation Measures; Section 4.5 Page 4.26 Chapter 6: Environmental Monitoring Programme
13	Public Health Delivery Plan including the provisions of drinking water supply for local population shall be in the EIA/EMP Report. Status of the existing medical facilities in the project area shall be discussed. Possibilities of strengthening of existing medical facilities, construction of new medical infrastructure etc. will be explored after assessing the need of the labour force and local populace.	Chapter 10 Environmental Management Plan Section 10.11; Page 10.98
14	Labour Management Plan for their Health and Safety.	Chapter 10 Environmental Management Plan Section 10.13; Page 10.105
15	Sanitation and Solid-waste management plan for domestic waste from colonies and labour camps etc.	Chapter 10 Environmental Management Plan Section 10.10; Page 10.94
16	Local Area Development Plan to be formulated in consultation with the Revenue Officials and Village Panchayats. Local skill development schemes should be given. Details of various activities to be undertaken along with its financial layout should be provided.	Chapter 7: Additional Studies; Section 7.2, Local Area Development Plan, Page 7.3

S. No	Clause in Standard ToR	Compliance
17	Environmental safeguards during construction activities including road construction.	Chapter 4: Anticipated Environmental Impacts and Mitigation Measures; Section 4.5 Page 4.26
18	Energy conservation measures for the work force during construction with physical and financial details. Alternatives will be proposed for the labour force so that the exploitation off the natural resource (wood) for the domestic and commercial use is curbed.	Chapter 10 Environmental Management Plan Section 10.12, Page 10.102
19	Environmental Monitoring Programme to monitor the migratory measures implemented at the project site is required will be prepared. Provision for Environment Management Cell should be made. The plan will spell out the aspects required to be monitored, monitoring indicators/parameters with respect to each aspect and the agency responsible for the monitoring of that particular aspect throughout the project implementation.	Chapter 6: Environmental Monitoring Plan Section 6.1, Page 6.1 Section 6.1.4; Page 6.2
20	A summary off cost Estimates for all the plans, cost for implementing all the Environmental Management Plans.	Chapter 11: Summary and Conclusion, Section 11.8, Table 11.1, Page 11.17.

Additional Condition as per Scoping clearance issued by MoEF&CC vide letter no. J-12011/08/2021-IA-I dated 10th June 2021 for 240 MW installed capacity (refer to **Annexure I**).

S. No	ADDITIONAL CONDITONS	COMPLIANCE
i	EIA report for the proposed expansion project Uri-I Stage-II should be prepared keeping in view the cumulative impact of existing Uri-I HE Project and proposed Uri-I Stage Stage-II HE Project.	EIA Chapter 1: Introduction; Section 1.3.6 Page 1.4 EIA Chapter 4: Assessment of Impact: Section 4.1.3.3 Page 4.7
ii	Three season (Pre-monsoon, Monsoon and Winter Season) baseline data of all the environmental attributes including biological environment as mentioned in the standard TOR shall be collected for preparation of EIA/EMP report.	EIA Chapter 2: Description of Environment Section 3.1.2
iii	Requisite studies like simulation study for the E-flow shall also be undertaken.	EIA Chapter 4: Assessment of Impact: Section 4.1.3.3 (g) Page 4.8
iv	The project involves diversion of 17 ha of forest land. Forest clearance shall be obtained as per the prevailing norms of forest (Conservation) Act, 1980. Application to obtain prior approval of central Government under the forest (Conservation) Act, 1980 for diversion of forest land required should be submitted as soon as the actual extent of forest land required for the project is known, and in any case, within six months of issuance of this letter.	For diversion of 17 ha of forest land, an online application has been submitted to MoEF&CC vide Proposal No.: FP/JK/HYD/144277/2021 (http://forestsclearance.nic.in/viewreport.aspx?_pid=FP/JK/HYD/144277/2021)
v	CAT plan, Dam break analysis, Disaster Management Plan and Fisheries Management Plan be prepared along with other EMPs and incorporated in the EIA/EMP report.	EIA Chapter 10 EMP Section 10.2 CAT Plan; Page 10.4 Section 10.5 Fisheries Development Plan; Page 10.56 Section 10.14 Disaster Management Plan Page 10.107 Annexure-V

S. No	ADDITIONAL CONDITONS	COMPLIANCE
vi	The EIA report should also describe the cumulative environmental effects due to proximity to other existing or planned projects with similar effects, if any.	EIA Chapter 1: Introduction; Section 1.3.6 Page 1.3 EIA Chapter 4: Assessment of Impact: Section 4.1.3.3 Page 4.9
vii	All the tasks including conducting public hearing shall be done as per the provision of EAI notification, 2006 and as amended from time to time. Public hearing issues raised and compliance of the same shall be incorporated in the EIA/EMP report in the relevant chapter.	--
viii	An undertaking as part of the EIA report from project proponent, owning the contents (information and data) of the EIA report with the declaration about the contents of the EIA report pertaining to a project have not been copied from other EIA reports.	Appendix-I
ix.	Consolidated EIA/EMP report is to be submitted as per the generic structure (Appendix III & IIIA) given in the EIA notification, 2006.	Draft EIA Report of Uri-I Stage-II HEP
x.	Conservation Plan for Schedule-I species if any, in the project study area shall be prepared and submitted to the Competent Authority for approval.	EIA Chapter 10 EMP Section 10.4 Biodiversity Management and Wildlife Conservation Plan; Page 10.34
xi.	Pre-DPR Chapter viz., Hydrology, Layout, and Power Potential Studies approved by CWC/ CEA shall be submitted.	EIA Chapter 2 Project Description Section 2.5 Page 2.16
xii.	Environmental Matrix during construction and operational phase needs to be submitted	EIA Chapter 4 Assessment of Impact: Section 4.4; Page 4.20, Table 4.8; Page 4.22 & Table 4.9, Page 4.26
xiii.	Both Capital and Recurring expenditure under EMP shall be submitted	Chapter 11: Summary and Conclusion, Section 11.8, Table 11.1, Page 11.17.
xiv.	The salient features to be intimated to the Indus water commission	EIA Chapter 1 Section 1.3.7 Page 1.4
xv.	Environmental Cost benefit analysis for the proposed project shall be done duly keeping in view the actual cost-benefit of the existing operational Uri-I HE Project and that of proposed expansion of the same.	EIA Chapter 9: Cost Benefit Analysis

WEATHER DATA

Annexure IIIa

Table 1: Mean monthly Maximum and Minimum Temperature (°C) (Reference years 2012-2021).

Month	2012		2013		2014		2015		2016		2017		2018		2019		2020		2021	
	Temperature (°C)		Temperature (°C)		Temperature (°C)		Temperature (°C)		Temperature (°C)		Temperature (°C)		Temperature (°C)		Temperature (°C)		Temperature (°C)		Temperature (°C)	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
January	1	0	13	1	13	2	14	2	15	4	11	2	16	4	11	2	9	2	14	4
February	12	1	14	3	14	2	16	5	19	5	17	5	17	5	12	3	15	6	18	8
March	19	6	22	8	18	6	18	7	20	8	19	7	22	10	17	7	16	8	21	10
April	24	11	25	11	24	10	24	11	25	11	27	12	25	13	25	14	23	13	23	11
May	29	14	31	15	29	15	31	16	31	17	31	17	29	17	29	16	28	17	29	17
June	33	19	34	21	34	20	32	18	34	21	33	19	33	21	33	19	33	21	34	21
July	34	21	32	21	32	21	31	21	32	20	31	21	31	21	31	22	33	23	31	23
August	30	19	29	19	30	18	30	19	31	19	30	20	30	20	29	20	28	21	29	20
September	29	16	29	16	29	16	29	16	30	17	29	17	28	17	29	19	29	19	29	18
October	24	10	26	13	24	11	25	12	27	13	27	14	24	11	24	14	27	15	25	13
November	20	6	20	6	20	6	20	8	22	9	21	8	20	8	18	9	18	8	21	9
December	15	3	15	3	15	4	16	4	20	7	17	5	16	4	14	4	14	5	15	4

Table 2: Mean annual average Rainfall (mm) and Numbers of Rainy Days (Reference years 2012-2021).

Months	2012		2013		2014		2015		2016		2017		2018		2019		2020		2021	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
January	67.62	3	22.8	1	20.15	2	31.56	2	48.71	1	256.26	8	7.3	1	223.3	5	273.1	8	131.2	4
February	166.2	7	238.9	8	124.6	3	245.19	7	71.2	2	123.7	4	120.3	4	261.9	11	78.8	2	17.2	3
March	114.9	5	82.1	4	221.1	13	285.4	15	363.8	11	140.1	6	123.6	7	192.4	11	304.1	16	150.8	7
April	217.5	16	102.2	4	106.73	8	183.46	10	129.82	11	203.1	9	166.5	9	110.3	7	220.9	18	121.3	5
May	98.46	7	55.5	2	128.1	6	56.9	1	121.67	5	77.3	3	99.4	7	97.3	6	136.2	9	118.8	10
June	26.31	2	136.3	6	101.7	4	115.19	3	71.12	2	215.5	12	109.9	3	100.4	2	95.2	5	57.6	4
July	118.48	5	196.2	11	260.29	12	270.2	12	289.52	22	315	15	412	15	431.7	18	180.6	7	637.3	13

WEATHER DATA

Annexure IIIa

Months	2012		2013		2014		2015		2016		2017		2018		2019		2020		2021	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
August	256.81	16	325.88	18	290.46	12	266.55	17	193.6	9	220	9	223.6	8	425.7	15	364	15	259.1	14
September	132.84	6	166.5	9	182.8	7	131.67	7	91.94	4	82.2	3	97.03	4	165.6	8	100.6	8	36.3	3
October	49.2	1	40.8	3	57.3	2	108.8	3	14.4	1	6	1	55.21	2	69.4	8	0	0	30.3	5
November	16.9	2	13.4	1	39.88	2	58.7	1	0.83	1	2.2	1	52.4	4	144.2	8	67.9	3	0	0
December	104.4	4	3	1	0	1	60.24	4	5.5	1	67	2	18	1	52.1	3	96.2	4	7.2	2

Note:- A-Rainfall (mm); B-No. of Rainy days

Table 3: Mean Monthly Average Maximum Wind speed (m/s) (Reference years 2012-2021).

Months	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average
January	4.2	4.4	4.3	3.7	3.4	3.3	3.8	2.9	2.6	3.2	3.58
February	3.9	4	4.2	3.5	3.7	3.6	3.8	3	2.9	3.3	3.59
March	4.5	4.2	4	3.6	3.6	3.5	4.1	2.9	3	3.6	3.70
April	4	4.5	4.4	3.9	4	4.2	4.2	3.3	3.1	3.9	3.95
May	4.7	5.2	4.4	4.2	4	4	4.2	3.5	3.8	3.8	4.18
June	4.7	4	4.5	3.6	3.5	3.6	3.9	3.9	3.6	4	3.93
July	3.7	3.6	3.5	2.8	3	3	3.4	3.2	3.3	3.2	3.27
August	3.4	3.2	3.3	3	3	3.3	3.2	2.3	2.5	3	3.02
September	3.7	3.4	3.3	3.5	3.2	3.5	3.5	2.6	2.7	2.5	3.19
October	4.3	3.7	3.8	3.6	3.7	3.7	4	2.6	2.9	2.9	3.52
November	4.2	4.3	4.6	3.5	3.6	3.7	3.8	3.3	2.8	2.8	3.66
December	4.4	4.4	4.4	3.5	3.5	4.1	3.7	2.6	2.8	2.9	3.63

Table 4: Mean Monthly Average Humidity (%) (Reference years 2012-2021).

Months	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average
January	42	37	34	30	37	53	24	48	62	41	41
February	53	53	43	51	35	47	38	59	49	38	47
March	44	41	50	55	53	47	41	53	66	49	50

WEATHER DATA**Annexure IIIa**

Months	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average
April	50	39	44	47	45	40	43	46	60	51	47
May	36	28	40	32	34	36	34	36	48	46	37
June	27	36	31	37	36	43	35	36	41	37	36
July	44	55	54	62	59	60	57	62	46	58	56
August	66	71	59	63	56	58	64	72	74	69	65
September	53	59	59	47	47	48	53	62	53	69	55
October	36	45	44	40	28	28	37	49	29	53	39
November	27	29	30	39	21	28	33	55	41	33	34
December	37	26	21	36	20	28	25	42	48	37	32

Wind Rose Data

Annexure-IIIb

Table 1: Wind Rose data August 2021

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2021	8	1	0:00	202.5	2
2	2021	8	1	3:00	292.5	1
3	2021	8	1	6:00	315	1
4	2021	8	1	9:00	225	2
5	2021	8	1	12:00	337.5	2
6	2021	8	1	15:00	315	2
7	2021	8	1	18:00	292.5	2
8	2021	8	1	21:00	225	1
9	2021	8	2	0:00	180	2
10	2021	8	2	3:00	180	2
11	2021	8	2	6:00	180	1
12	2021	8	2	9:00	225	1
13	2021	8	2	12:00	360	2
14	2021	8	2	15:00	337.5	2
15	2021	8	2	18:00	270	1
16	2021	8	2	21:00	157.5	1
17	2021	8	3	0:00	202.5	2
18	2021	8	3	3:00	202.5	1
19	2021	8	3	6:00	157.5	1
20	2021	8	3	9:00	202.5	1
21	2021	8	3	12:00	337.5	3
22	2021	8	3	15:00	337.5	2
23	2021	8	3	18:00	315	1
24	2021	8	3	21:00	247.5	1
25	2021	8	4	0:00	225	2
26	2021	8	4	3:00	315	3
27	2021	8	4	6:00	157.5	2
28	2021	8	4	9:00	202.5	2
29	2021	8	4	12:00	337.5	2
30	2021	8	4	15:00	337.5	3
31	2021	8	4	18:00	315	2
32	2021	8	4	21:00	202.5	1
33	2021	8	8	0:00	202.5	2
34	2021	8	8	3:00	202.5	2
35	2021	8	8	6:00	157.5	2
36	2021	8	8	9:00	225	2
37	2021	8	8	12:00	315	3
38	2021	8	8	15:00	315	3
39	2021	8	8	18:00	292.5	1
40	2021	8	8	21:00	202.5	1
41	2021	8	6	0:00	180	2
42	2021	8	6	3:00	180	2
43	2021	8	6	6:00	180	2
44	2021	8	6	9:00	270	1
45	2021	8	6	12:00	337.5	3
46	2021	8	6	15:00	337.5	2
47	2021	8	6	18:00	292.5	1
48	2021	8	6	21:00	157.5	1
49	2021	8	7	0:00	180	3
50	2021	8	7	3:00	180	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
51	2021	8	7	6:00	157.5	2
52	2021	8	7	9:00	202.5	1
53	2021	8	7	12:00	360	2
54	2021	8	7	15:00	337.5	2
55	2021	8	7	18:00	315	2
56	2021	8	7	21:00	202.5	2
57	2021	8	8	0:00	180	2
58	2021	8	8	3:00	180	2
59	2021	8	8	6:00	157.5	1
60	2021	8	8	9:00	202.5	1
61	2021	8	8	12:00	337.5	3
62	2021	8	8	15:00	337.5	2
63	2021	8	8	18:00	292.5	2
64	2021	8	8	21:00	202.5	2
65	2021	8	9	0:00	180	2
66	2021	8	9	3:00	180	2
67	2021	8	9	6:00	180	2
68	2021	8	9	9:00	225	2
69	2021	8	9	12:00	337.5	3
70	2021	8	9	15:00	337.5	3
71	2021	8	9	18:00	292.5	2
72	2021	8	9	21:00	180	1
73	2021	8	10	0:00	180	3
74	2021	8	10	3:00	180	2
75	2021	8	10	6:00	180	2
76	2021	8	10	9:00	225	1
77	2021	8	10	12:00	337.5	2
78	2021	8	10	15:00	337.5	3
79	2021	8	10	18:00	315	2
80	2021	8	10	21:00	202.5	2
81	2021	8	11	0:00	157.5	2
82	2021	8	11	3:00	157.5	3
83	2021	8	11	6:00	157.5	2
84	2021	8	11	9:00	202.5	1
85	2021	8	11	12:00	360	2
86	2021	8	11	15:00	360	2
87	2021	8	11	18:00	315	2
88	2021	8	11	21:00	180	2
89	2021	8	12	0:00	157.5	3
90	2021	8	12	3:00	157.5	3
91	2021	8	12	6:00	157.5	2
92	2021	8	12	9:00	202.5	2
93	2021	8	12	12:00	360	2
94	2021	8	12	15:00	337.5	2
95	2021	8	12	18:00	315	2
96	2021	8	12	21:00	157.5	3
97	2021	8	13	0:00	157.5	3
98	2021	8	13	3:00	157.5	3
99	2021	8	13	6:00	157.5	3
100	2021	8	13	9:00	225	2

Wind Rose Data

Annexure-IIIb

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
101	2021	8	13	12:00	315	2
102	2021	8	13	15:00	292.5	2
103	2021	8	13	18:00	225	2
104	2021	8	13	21:00	180	3
105	2021	8	14	0:00	157.5	4
106	2021	8	14	3:00	157.5	5
107	2021	8	14	6:00	157.5	5
108	2021	8	14	9:00	157.5	4
109	2021	8	14	12:00	157.5	3
110	2021	8	14	15:00	157.5	2
111	2021	8	14	18:00	157.5	1
112	2021	8	14	21:00	157.5	3
113	2021	8	18	0:00	157.5	5
114	2021	8	18	3:00	202.5	3
115	2021	8	18	6:00	225	2
116	2021	8	18	9:00	270	2
117	2021	8	18	12:00	22.5	2
118	2021	8	18	15:00	360	2
119	2021	8	18	18:00	315	1
120	2021	8	18	21:00	157.5	2
121	2021	8	16	0:00	157.5	3
122	2021	8	16	3:00	157.5	3
123	2021	8	16	6:00	157.5	3
124	2021	8	16	9:00	202.5	1
125	2021	8	16	12:00	360	1
126	2021	8	16	15:00	360	2
127	2021	8	16	18:00	315	1
128	2021	8	16	21:00	180	2
129	2021	8	17	0:00	180	3
130	2021	8	17	3:00	180	3
131	2021	8	17	6:00	157.5	2
132	2021	8	17	9:00	202.5	2
133	2021	8	17	12:00	360	2
134	2021	8	17	15:00	360	2
135	2021	8	17	18:00	315	1
136	2021	8	17	21:00	180	2
137	2021	8	18	0:00	180	3
138	2021	8	18	3:00	180	3
139	2021	8	18	6:00	180	3
140	2021	8	18	9:00	225	2
141	2021	8	18	12:00	337.5	2
142	2021	8	18	15:00	360	2
143	2021	8	18	18:00	315	2
144	2021	8	18	21:00	180	2
145	2021	8	19	0:00	180	3
146	2021	8	19	3:00	180	3
147	2021	8	19	6:00	180	2
148	2021	8	19	9:00	202.5	2
149	2021	8	19	12:00	360	3
150	2021	8	19	15:00	360	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
151	2021	8	19	18:00	315	2
152	2021	8	19	21:00	180	2
153	2021	8	20	0:00	180	3
154	2021	8	20	3:00	180	2
155	2021	8	20	6:00	180	1
156	2021	8	20	9:00	225	1
157	2021	8	20	12:00	360	2
158	2021	8	20	15:00	360	3
159	2021	8	20	18:00	315	2
160	2021	8	20	21:00	247.5	2
161	2021	8	21	0:00	202.5	2
162	2021	8	21	3:00	202.5	1
163	2021	8	21	6:00	157.5	1
164	2021	8	21	9:00	202.5	1
165	2021	8	21	12:00	337.5	3
166	2021	8	21	15:00	315	3
167	2021	8	21	18:00	292.5	1
168	2021	8	21	21:00	202.5	2
169	2021	8	22	0:00	202.5	2
170	2021	8	22	3:00	202.5	2
171	2021	8	22	6:00	180	1
172	2021	8	22	9:00	202.5	1
173	2021	8	22	12:00	360	3
174	2021	8	22	15:00	337.5	2
175	2021	8	22	18:00	315	1
176	2021	8	22	21:00	202.5	1
177	2021	8	23	0:00	180	2
178	2021	8	23	3:00	180	2
179	2021	8	23	6:00	180	2
180	2021	8	23	9:00	225	1
181	2021	8	23	12:00	360	3
182	2021	8	23	15:00	360	2
183	2021	8	23	18:00	315	2
184	2021	8	23	21:00	180	2
185	2021	8	24	0:00	180	2
186	2021	8	24	3:00	180	2
187	2021	8	24	6:00	225	2
188	2021	8	24	9:00	315	1
189	2021	8	24	12:00	360	2
190	2021	8	24	15:00	360	2
191	2021	8	24	18:00	315	2
192	2021	8	24	21:00	202.5	2
193	2021	8	28	0:00	180	3
194	2021	8	28	3:00	180	3
195	2021	8	28	6:00	225	1
196	2021	8	28	9:00	337.5	1
197	2021	8	28	12:00	360	2
198	2021	8	28	15:00	360	2
199	2021	8	28	18:00	315	2
200	2021	8	28	21:00	180	2

Wind Rose Data

Annexure-IIIb

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
201	2021	8	26	0:00	180	3
202	2021	8	26	3:00	180	3
203	2021	8	26	6:00	202.5	2
204	2021	8	26	9:00	45	0
205	2021	8	26	12:00	360	2
206	2021	8	26	15:00	360	2
207	2021	8	26	18:00	22.5	1
208	2021	8	26	21:00	202.5	2
209	2021	8	27	0:00	180	3
210	2021	8	27	3:00	202.5	2
211	2021	8	27	6:00	202.5	2
212	2021	8	27	9:00	157.5	1
213	2021	8	27	12:00	360	3
214	2021	8	27	15:00	337.5	3
215	2021	8	27	18:00	45	1
216	2021	8	27	21:00	180	3
217	2021	8	28	0:00	157.5	4
218	2021	8	28	3:00	157.5	3
219	2021	8	28	6:00	157.5	4
220	2021	8	28	9:00	157.5	3
221	2021	8	28	12:00	337.5	1
222	2021	8	28	15:00	22.5	2
223	2021	8	28	18:00	22.5	0
224	2021	8	28	21:00	157.5	3

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
225	2021	8	29	0:00	157.5	4
226	2021	8	29	3:00	180	3
227	2021	8	29	6:00	157.5	3
228	2021	8	29	9:00	157.5	1
229	2021	8	29	12:00	337.5	3
230	2021	8	29	15:00	337.5	2
231	2021	8	29	18:00	337.5	1
232	2021	8	29	21:00	180	3
233	2021	8	30	0:00	180	3
234	2021	8	30	3:00	180	3
235	2021	8	30	6:00	157.5	3
236	2021	8	30	9:00	157.5	2
237	2021	8	30	12:00	337.5	1
238	2021	8	30	15:00	337.5	3
239	2021	8	30	18:00	337.5	1
240	2021	8	30	21:00	180	3
241	2021	8	31	0:00	202.5	1
242	2021	8	31	3:00	180	3
243	2021	8	31	6:00	180	4
244	2021	8	31	9:00	202.5	3
245	2021	8	31	12:00	180	2
246	2021	8	31	15:00	337.5	2
247	2021	8	31	18:00	337.5	2
248	2021	8	31	21:00	180	2

YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Table 2: Frequency Distribution (Period 01/08/2021 to 31/08/2021)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0	8.06	2.02	0	0	0	0	10.08
2	NNE	0.4	1.21	0	0	0	0	0	1.61
3	NE	0.4	0.4	0	0	0	0	0	0.8
4	ENE	0	0	0	0	0	0	0	0
5	East	0	0	0	0	0	0	0	0
6	ESE	0	0	0	0	0	0	0	0
7	SE	0	0	0	0	0	0	0	0
8	SSE	0	7.26	8.87	1.21	0	0	0	17.34
9	South	0	13.31	9.68	0	0	0	0	22.99
10	SSW	0	13.31	0.81	0	0	0	0	14.12
11	SW	0	6.05	0	0	0	0	0	6.05
12	WSW	0	0.81	0	0	0	0	0	0.81
13	West	0	1.21	0	0	0	0	0	1.21
14	WNW	0	3.23	0	0	0	0	0	3.23
15	NW	0	8.06	1.61	0	0	0	0	9.67
16	NNW	0	7.66	4.44	0	0	0	0	12.1
Total		0.8	70.57	27.43	1.21	0	0	0	100

Table 3: Wind Rose data September 2021

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2021	9	1	0:00	180	2
2	2021	9	1	3:00	180	2
3	2021	9	1	6:00	157.5	2
4	2021	9	1	9:00	135	1
5	2021	9	1	12:00	360	3
6	2021	9	1	15:00	360	2
7	2021	9	1	18:00	360	1
8	2021	9	1	21:00	202.5	1
9	2021	9	2	0:00	180	2
10	2021	9	2	3:00	180	2
11	2021	9	2	6:00	180	2
12	2021	9	2	9:00	45	0
13	2021	9	2	12:00	360	2
14	2021	9	2	15:00	360	2
15	2021	9	2	18:00	360	1
16	2021	9	2	21:00	180	2
17	2021	9	3	0:00	180	3
18	2021	9	3	3:00	180	2
19	2021	9	3	6:00	180	2
20	2021	9	3	9:00	135	1
21	2021	9	3	12:00	360	2
22	2021	9	3	15:00	360	2
23	2021	9	3	18:00	315	1
24	2021	9	3	21:00	202.5	2
25	2021	9	4	0:00	180	2
26	2021	9	4	3:00	180	2
27	2021	9	4	6:00	180	2
28	2021	9	4	9:00	45	1
29	2021	9	4	12:00	360	2
30	2021	9	4	15:00	360	2
31	2021	9	4	18:00	22.5	1
32	2021	9	4	21:00	180	2
33	2021	9	8	0:00	180	2
34	2021	9	8	3:00	180	2
35	2021	9	8	6:00	202.5	2
36	2021	9	8	9:00	315	1
37	2021	9	8	12:00	360	3
38	2021	9	8	15:00	22.5	2
39	2021	9	8	18:00	45	0
40	2021	9	8	21:00	180	2
41	2021	9	6	0:00	180	2
42	2021	9	6	3:00	180	2
43	2021	9	6	6:00	202.5	2
44	2021	9	6	9:00	337.5	1
45	2021	9	6	12:00	360	3
46	2021	9	6	15:00	360	1
47	2021	9	6	18:00	22.5	1
48	2021	9	6	21:00	180	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
49	2021	9	7	0:00	180	2
50	2021	9	7	3:00	180	2
51	2021	9	7	6:00	202.5	2
52	2021	9	7	9:00	360	1
53	2021	9	7	12:00	360	3
54	2021	9	7	15:00	337.5	2
55	2021	9	7	18:00	22.5	0
56	2021	9	7	21:00	202.5	2
57	2021	9	8	0:00	180	2
58	2021	9	8	3:00	202.5	2
59	2021	9	8	6:00	180	2
60	2021	9	8	9:00	292.5	1
61	2021	9	8	12:00	315	2
62	2021	9	8	15:00	315	2
63	2021	9	8	18:00	315	1
64	2021	9	8	21:00	225	1
65	2021	9	9	0:00	202.5	2
66	2021	9	9	3:00	247.5	1
67	2021	9	9	6:00	180	1
68	2021	9	9	9:00	225	2
69	2021	9	9	12:00	315	2
70	2021	9	9	15:00	315	1
71	2021	9	9	18:00	202.5	1
72	2021	9	9	21:00	202.5	1
73	2021	9	10	0:00	180	2
74	2021	9	10	3:00	180	2
75	2021	9	10	6:00	202.5	2
76	2021	9	10	9:00	315	1
77	2021	9	10	12:00	315	2
78	2021	9	10	15:00	315	3
79	2021	9	10	18:00	315	1
80	2021	9	10	21:00	180	2
81	2021	9	11	0:00	180	2
82	2021	9	11	3:00	180	2
83	2021	9	11	6:00	180	2
84	2021	9	11	9:00	360	1
85	2021	9	11	12:00	315	3
86	2021	9	11	15:00	360	2
87	2021	9	11	18:00	360	1
88	2021	9	11	21:00	270	1
89	2021	9	12	0:00	180	2
90	2021	9	12	3:00	180	2
91	2021	9	12	6:00	180	2
92	2021	9	12	9:00	90	1
93	2021	9	12	12:00	337.5	2
94	2021	9	12	15:00	337.5	3
95	2021	9	12	18:00	337.5	1
96	2021	9	12	21:00	180	2

Wind Rose Data

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
97	2021	9	13	0:00	180	2
98	2021	9	13	3:00	180	2
99	2021	9	13	6:00	180	2
100	2021	9	13	9:00	112.5	1
101	2021	9	13	12:00	22.5	2
102	2021	9	13	15:00	360	2
103	2021	9	13	18:00	22.5	0
104	2021	9	13	21:00	180	2
105	2021	9	14	0:00	180	2
106	2021	9	14	3:00	180	2
107	2021	9	14	6:00	180	2
108	2021	9	14	9:00	90	1
109	2021	9	14	12:00	22.5	2
110	2021	9	14	15:00	22.5	2
111	2021	9	14	18:00	337.5	0
112	2021	9	14	21:00	202.5	2
113	2021	9	18	0:00	180	2
114	2021	9	18	3:00	180	2
115	2021	9	18	6:00	180	2
116	2021	9	18	9:00	90	1
117	2021	9	18	12:00	22.5	2
118	2021	9	18	15:00	22.5	2
119	2021	9	18	18:00	360	0
120	2021	9	18	21:00	202.5	2
121	2021	9	16	0:00	180	2
122	2021	9	16	3:00	180	2
123	2021	9	16	6:00	180	1
124	2021	9	16	9:00	67.5	1
125	2021	9	16	12:00	360	2
126	2021	9	16	15:00	337.5	2
127	2021	9	16	18:00	315	1
128	2021	9	16	21:00	225	2
129	2021	9	17	0:00	180	2
130	2021	9	17	3:00	202.5	1
131	2021	9	17	6:00	180	1
132	2021	9	17	9:00	45	0
133	2021	9	17	12:00	360	3
134	2021	9	17	15:00	337.5	2
135	2021	9	17	18:00	337.5	1
136	2021	9	17	21:00	202.5	1
137	2021	9	18	0:00	202.5	2
138	2021	9	18	3:00	202.5	2
139	2021	9	18	6:00	202.5	1
140	2021	9	18	9:00	22.5	1
141	2021	9	18	12:00	337.5	3
142	2021	9	18	15:00	337.5	2
143	2021	9	18	18:00	315	1
144	2021	9	18	21:00	202.5	1
145	2021	9	19	0:00	180	2
146	2021	9	19	3:00	180	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
147	2021	9	19	6:00	180	1
148	2021	9	19	9:00	22.5	0
149	2021	9	19	12:00	360	3
150	2021	9	19	15:00	337.5	3
151	2021	9	19	18:00	337.5	1
152	2021	9	19	21:00	202.5	2
153	2021	9	20	0:00	180	2
154	2021	9	20	3:00	157.5	3
155	2021	9	20	6:00	202.5	2
156	2021	9	20	9:00	22.5	0
157	2021	9	20	12:00	337.5	1
158	2021	9	20	15:00	337.5	1
159	2021	9	20	18:00	180	0
160	2021	9	20	21:00	18	2
161	2021	9	21	0:00	157.5	3
162	2021	9	21	3:00	180	2
163	2021	9	21	6:00	135	3
164	2021	9	21	9:00	135	3
165	2021	9	21	12:00	135	1
166	2021	9	21	15:00	315	2
167	2021	9	21	18:00	135	0
168	2021	9	21	21:00	157.5	2
169	2021	9	22	0:00	180	3
170	2021	9	22	3:00	180	2
171	2021	9	22	6:00	180	2
172	2021	9	22	9:00	157.5	2
173	2021	9	22	12:00	337.5	3
174	2021	9	22	15:00	337.5	3
175	2021	9	22	18:00	360	1
176	2021	9	22	21:00	180	2
177	2021	9	23	0:00	180	2
178	2021	9	23	3:00	180	2
179	2021	9	23	6:00	157.5	2
180	2021	9	23	9:00	90	0
181	2021	9	23	12:00	337.5	3
182	2021	9	23	15:00	337.5	2
183	2021	9	23	18:00	315	1
184	2021	9	23	21:00	225	2
185	2021	9	24	0:00	180	2
186	2021	9	24	3:00	180	2
187	2021	9	24	6:00	180	2
188	2021	9	24	9:00	45	1
189	2021	9	24	12:00	337.5	3
190	2021	9	24	15:00	337.5	3
191	2021	9	24	18:00	315	1
192	2021	9	24	21:00	180	2
193	2021	9	28	0:00	157.5	2
194	2021	9	28	3:00	180	2
195	2021	9	28	6:00	157.5	2
196	2021	9	28	9:00	67.5	0

Wind Rose Data

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
197	2021	9	28	12:00	360	2
198	2021	9	28	15:00	337.5	2
199	2021	9	28	18:00	315	0
200	2021	9	28	21:00	180	2
201	2021	9	26	0:00	180	2
202	2021	9	26	3:00	202.5	2
203	2021	9	26	6:00	202.5	2
204	2021	9	26	9:00	90	1
205	2021	9	26	12:00	360	2
206	2021	9	26	15:00	360	2
207	2021	9	26	18:00	337.5	1
208	2021	9	26	21:00	180	2
209	2021	9	27	0:00	202.5	2
210	2021	9	27	3:00	202.5	2
211	2021	9	27	6:00	180	2
212	2021	9	27	9:00	45	0
213	2021	9	27	12:00	360	2
214	2021	9	27	15:00	337.5	2
215	2021	9	27	18:00	337.5	1
216	2021	9	27	21:00	202.5	1
217	2021	9	28	0:00	180	2
218	2021	9	28	3:00	180	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
219	2021	9	28	6:00	180	2
220	2021	9	28	9:00	67.5	1
221	2021	9	28	12:00	360	3
222	2021	9	28	15:00	360	2
223	2021	9	28	18:00	315	1
224	2021	9	28	21:00	180	2
225	2021	9	29	0:00	180	2
226	2021	9	29	3:00	180	2
227	2021	9	29	6:00	180	2
228	2021	9	29	9:00	360	0
229	2021	9	29	12:00	360	3
230	2021	9	29	15:00	360	2
231	2021	9	29	18:00	315	1
232	2021	9	29	21:00	202.5	2
233	2021	9	30	0:00	202.5	2
234	2021	9	30	3:00	180	2
235	2021	9	30	6:00	180	2
236	2021	9	30	9:00	180	0
237	2021	9	30	12:00	360	3
238	2021	9	30	15:00	360	3
239	2021	9	30	18:00	315	1
240	2021	9	30	21:00	180	2

YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Table 4: Frequency Distribution (Period 01/09/2021 to 30/09/2021)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0.83	9.58	4.17	0	0	0	0	14.58
2	NNE	1.67	4.17	0	0	0	0	0	5.84
3	NE	1.67	0.83	0	0	0	0	0	2.5
4	ENE	0.42	0.83	0	0	0	0	0	1.25
5	East	0.42	1.67	0	0	0	0	0	2.09
6	ESE	0	0.42	0	0	0	0	0	0.42
7	SE	0.42	1.25	0.83	0	0	0	0	2.5
8	SSE	0	2.5	0.83	0	0	0	0	3.33
9	South	0.83	32.08	0.83	0	0	0	0	33.74
10	SSW	0	11.67	0	0	0	0	0	11.67
11	SW	0	1.67	0	0	0	0	0	1.67
12	WSW	0	0.42	0	0	0	0	0	0.42
13	West	0	0.42	0	0	0	0	0	0.42
14	WNW	0	0.42	0	0	0	0	0	0.42
15	NW	0.42	7.5	0.83	0	0	0	0	8.75
16	NNW	0.42	6.67	3.33	0	0	0	0	10.42
Total		7.1	82.1	10.82	0	0	0	0	100

Table 5: Wind Rose data October 2021

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2021	10	1	0:00	180	2
2	2021	10	1	3:00	180	2
3	2021	10	1	6:00	180	2
4	2021	10	1	9:00	22.5	1
5	2021	10	1	12:00	337.5	2
6	2021	10	1	15:00	315	3
7	2021	10	1	18:00	225	2
8	2021	10	1	21:00	202.5	2
9	2021	10	2	0:00	180	3
10	2021	10	2	3:00	225	2
11	2021	10	2	6:00	180	3
12	2021	10	2	9:00	157.5	1
13	2021	10	2	12:00	315	2
14	2021	10	2	15:00	315	2
15	2021	10	2	18:00	292.5	1
16	2021	10	2	21:00	202.5	2
17	2021	10	3	0:00	180	2
18	2021	10	3	3:00	157.5	2
19	2021	10	3	6:00	157.5	2
20	2021	10	3	9:00	157.5	1
21	2021	10	3	12:00	337.5	2
22	2021	10	3	15:00	337.5	2
23	2021	10	3	18:00	292.5	1
24	2021	10	3	21:00	180	2
25	2021	10	4	0:00	157.5	3
26	2021	10	4	3:00	157.5	3
27	2021	10	4	6:00	157.5	3
28	2021	10	4	9:00	157.5	1
29	2021	10	4	12:00	337.5	2
30	2021	10	4	15:00	337.5	3
31	2021	10	4	18:00	315	0
32	2021	10	4	21:00	180	2
33	2021	10	8	0:00	180	2
34	2021	10	8	3:00	180	3
35	2021	10	8	6:00	180	2
36	2021	10	8	9:00	135	1
37	2021	10	8	12:00	22.5	2
38	2021	10	8	15:00	360	2
39	2021	10	8	18:00	270	1
40	2021	10	8	21:00	180	2
41	2021	10	6	0:00	157.5	2
42	2021	10	6	3:00	157.5	2
43	2021	10	6	6:00	157.5	2
44	2021	10	6	9:00	135	1
45	2021	10	6	12:00	22.5	2
46	2021	10	6	15:00	22.5	2
47	2021	10	6	18:00	270	0
48	2021	10	6	21:00	157.5	2
49	2021	10	7	0:00	157.5	3

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
50	2021	10	7	3:00	180	2
51	2021	10	7	6:00	180	3
52	2021	10	7	9:00	180	1
53	2021	10	7	12:00	337.5	2
54	2021	10	7	15:00	315	2
55	2021	10	7	18:00	225	1
56	2021	10	7	21:00	202.5	2
57	2021	10	8	0:00	157.5	3
58	2021	10	8	3:00	157.5	3
59	2021	10	8	6:00	180	3
60	2021	10	8	9:00	157.5	1
61	2021	10	8	12:00	337.5	2
62	2021	10	8	15:00	337.5	3
63	2021	10	8	18:00	292.5	1
64	2021	10	8	21:00	202.5	2
65	2021	10	9	0:00	180	3
66	2021	10	9	3:00	180	3
67	2021	10	9	6:00	180	3
68	2021	10	9	9:00	157.5	1
69	2021	10	9	12:00	337.5	2
70	2021	10	9	15:00	337.5	3
71	2021	10	9	18:00	225	1
72	2021	10	9	21:00	180	2
73	2021	10	10	0:00	180	3
74	2021	10	10	3:00	180	3
75	2021	10	10	6:00	180	3
76	2021	10	10	9:00	180	1
77	2021	10	10	12:00	337.5	2
78	2021	10	10	15:00	315	3
79	2021	10	10	18:00	225	1
80	2021	10	10	21:00	202.5	3
81	2021	10	11	0:00	180	3
82	2021	10	11	3:00	157.5	3
83	2021	10	11	6:00	157.5	3
84	2021	10	11	9:00	135	4
85	2021	10	11	12:00	135	1
86	2021	10	11	15:00	225	3
87	2021	10	11	18:00	180	4
88	2021	10	11	21:00	157.5	4
89	2021	10	12	0:00	157.5	4
90	2021	10	12	3:00	157.5	4
91	2021	10	12	6:00	157.5	4
92	2021	10	12	9:00	157.5	3
93	2021	10	12	12:00	45	1
94	2021	10	12	15:00	337.5	3
95	2021	10	12	18:00	157.5	2
96	2021	10	12	21:00	157.5	3
97	2021	10	13	0:00	157.5	3
98	2021	10	13	3:00	157.5	3

Wind Rose Data

Annexure-IIIb

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
99	2021	10	13	6:00	157.5	3
100	2021	10	13	9:00	135	2
101	2021	10	13	12:00	45	2
102	2021	10	13	15:00	22.5	2
103	2021	10	13	18:00	202.5	1
104	2021	10	13	21:00	135	2
105	2021	10	14	0:00	157.5	3
106	2021	10	14	3:00	157.5	3
107	2021	10	14	6:00	157.5	3
108	2021	10	14	9:00	135	2
109	2021	10	14	12:00	22.5	2
110	2021	10	14	15:00	22.5	2
111	2021	10	14	18:00	157.5	1
112	2021	10	14	21:00	157.5	3
113	2021	10	18	0:00	157.5	3
114	2021	10	18	3:00	157.5	3
115	2021	10	18	6:00	157.5	3
116	2021	10	18	9:00	180	1
117	2021	10	18	12:00	337.5	2
118	2021	10	18	15:00	337.5	2
119	2021	10	18	18:00	225.5	1
120	2021	10	18	21:00	202.5	2
121	2021	10	16	0:00	157.5	3
122	2021	10	16	3:00	157.5	3
123	2021	10	16	6:00	157.5	3
124	2021	10	16	9:00	180	1
125	2021	10	16	12:00	360	2
126	2021	10	16	15:00	360	2
127	2021	10	16	18:00	225	1
128	2021	10	16	21:00	202.5	2
129	2021	10	17	0:00	18	2
130	2021	10	17	3:00	180	3
131	2021	10	17	6:00	180	3
132	2021	10	17	9:00	180	1
133	2021	10	17	12:00	337.5	3
134	2021	10	17	15:00	315	3
135	2021	10	17	18:00	292.5	1
136	2021	10	17	21:00	202.5	2
137	2021	10	18	0:00	157.5	3
138	2021	10	18	3:00	157.5	2
139	2021	10	18	6:00	180	2
140	2021	10	18	9:00	337.5	1
141	2021	10	18	12:00	337.5	3
142	2021	10	18	15:00	315	3
143	2021	10	18	18:00	225	1
144	2021	10	18	21:00	180	2
145	2021	10	19	0:00	180	2
146	2021	10	19	3:00	157.5	2
147	2021	10	19	6:00	157.5	2
148	2021	10	19	9:00	135	1

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
149	2021	10	19	12:00	22.5	2
150	2021	10	19	15:00	22.5	2
151	2021	10	19	18:00	225	0
152	2021	10	19	21:00	157.5	2
153	2021	10	20	0:00	180	2
154	2021	10	20	3:00	180	3
155	2021	10	20	6:00	180	2
156	2021	10	20	9:00	157.5	1
157	2021	10	20	12:00	22.5	2
158	2021	10	20	15:00	360	2
159	2021	10	20	18:00	247.5	1
160	2021	10	20	21:00	180	2
161	2021	10	21	0:00	180	2
162	2021	10	21	3:00	180	3
163	2021	10	21	6:00	180	3
164	2021	10	21	9:00	180	1
165	2021	10	21	12:00	360	2
166	2021	10	21	15:00	337.5	2
167	2021	10	21	18:00	225	1
168	2021	10	21	21:00	202.5	2
169	2021	10	22	0:00	180	3
170	2021	10	22	3:00	180	3
171	2021	10	22	6:00	180	3
172	2021	10	22	9:00	180	1
173	2021	10	22	12:00	337.5	2
174	2021	10	22	15:00	315	3
175	2021	10	22	18:00	315	1
176	2021	10	22	21:00	270	3
177	2021	10	23	0:00	157.5	2
178	2021	10	23	3:00	157.5	3
179	2021	10	23	6:00	180	3
180	2021	10	23	9:00	157.5	1
181	2021	10	23	12:00	337.5	2
182	2021	10	23	15:00	315	3
183	2021	10	23	18:00	202.5	3
184	2021	10	23	21:00	202.5	3
185	2021	10	24	0:00	135	3
186	2021	10	24	3:00	135	3
187	2021	10	24	6:00	180	2
188	2021	10	24	9:00	135	2
189	2021	10	24	12:00	135	1
190	2021	10	24	15:00	67.5	1
191	2021	10	24	18:00	112.5	3
192	2021	10	24	21:00	135	2
193	2021	10	28	0:00	157.5	3
194	2021	10	28	3:00	157.5	3
195	2021	10	28	6:00	157.5	3
196	2021	10	28	9:00	135	2
197	2021	10	28	12:00	90	2
198	2021	10	28	15:00	45	1

Wind Rose Data

Annexure-IIIb

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
199	2021	10	28	18:00	225	0
200	2021	10	28	21:00	157.5	2
201	2021	10	26	0:00	157.5	2
202	2021	10	26	3:00	157.5	3
203	2021	10	26	6:00	180	3
204	2021	10	26	9:00	157.5	2
205	2021	10	26	12:00	360	2
206	2021	10	26	15:00	337.5	3
207	2021	10	26	18:00	202.5	1
208	2021	10	26	21:00	180	2
209	2021	10	27	0:00	157.5	2
210	2021	10	27	3:00	157.5	2
211	2021	10	27	6:00	157.5	2
212	2021	10	27	9:00	135	1
213	2021	10	27	12:00	22.5	2
214	2021	10	27	15:00	22.5	2
215	2021	10	27	18:00	225	1
216	2021	10	27	21:00	157.5	2
217	2021	10	28	0:00	157.5	5
218	2021	10	28	3:00	157.5	5
219	2021	10	28	6:00	157.5	5
220	2021	10	28	9:00	135	1
221	2021	10	28	12:00	360	3
222	2021	10	28	15:00	337.5	3
223	2021	10	28	18:00	225	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
224	2021	10	28	21:00	180	4
225	2021	10	29	0:00	157.5	2
226	2021	10	29	3:00	157.5	2
227	2021	10	29	6:00	180	3
228	2021	10	29	9:00	135	1
229	2021	10	29	12:00	22.5	2
230	2021	10	29	15:00	360	2
231	2021	10	29	18:00	225	1
232	2021	10	29	21:00	157.5	2
233	2021	10	30	0:00	157.5	3
234	2021	10	30	3:00	157.5	3
235	2021	10	30	6:00	157.5	3
236	2021	10	30	9:00	135	2
237	2021	10	30	12:00	45	2
238	2021	10	30	15:00	360	2
239	2021	10	30	18:00	202.5	1
240	2021	10	30	21:00	157.5	3
241	2021	10	31	0:00	157.5	3
242	2021	10	31	3:00	157.5	3
243	2021	10	31	6:00	157.5	3
244	2021	10	31	9:00	135	2
245	2021	10	31	12:00	22.5	2
246	2021	10	31	15:00	360	2
247	2021	10	31	18:00	225	1
248	2021	10	31	21:00	202.5	2

YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Table 6: Frequency Distribution (Period 01/10/2021 to 31/10/2021)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0	3.63	0.4	0	0	0	0	4.03
2	NNE	0	6.05	0	0	0	0	0	6.05
3	NE	0	1.61	0	0	0	0	0	1.61
4	ENE	0	0.4	0	0	0	0	0	0.4
5	East	0	0.4	0	0	0	0	0	0.4
6	ESE	0	0	0.4	0	0	0	0	0.4
7	SE	0	6.45	1.21	0	0	0	0	7.66
8	SSE	0	12.1	16.13	1.21	0	0	0	29.44
9	South	0	10.89	10.08	0	0	0	0	20.97
10	SSW	0	4.84	1.21	0	0	0	0	6.05
11	SW	0.81	5.24	0.4	0	0	0	0	6.45
12	WSW	0	0.4	0	0	0	0	0	0.4
13	West	0.4	0.4	0.4	0	0	0	0	1.2
14	WNW	0	1.61	0	0	0	0	0	1.61
15	NW	0.4	1.61	2.42	0	0	0	0	4.43
16	NNW	0	5.65	3.23	0	0	0	0	8.88
Total		1.61	61.28	35.88	1.21	0	0	0	100

Table 7: Wind Rose data November 2021

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2021	11	1	0:00	180	2
2	2021	11	1	3:00	180	2
3	2021	11	1	6:00	180	2
4	2021	11	1	9:00	180	1
5	2021	11	1	12:00	337.5	2
6	2021	11	1	15:00	337.5	3
7	2021	11	1	18:00	225	1
8	2021	11	1	21:00	202.5	2
9	2021	11	2	0:00	180	3
10	2021	11	2	3:00	180	3
11	2021	11	2	6:00	180	3
12	2021	11	2	9:00	157.5	2
13	2021	11	2	12:00	22.5	2
14	2021	11	2	15:00	360	3
15	2021	11	2	18:00	225	1
16	2021	11	2	21:00	135	3
17	2021	11	3	0:00	180	3
18	2021	11	3	3:00	180	3
19	2021	11	3	6:00	180	3
20	2021	11	3	9:00	157.5	2
21	2021	11	3	12:00	22.5	2
22	2021	11	3	15:00	360	3
23	2021	11	3	18:00	225	1
24	2021	11	3	21:00	180	2
25	2021	11	4	0:00	180	3
26	2021	11	4	3:00	180	3
27	2021	11	4	6:00	180	3
28	2021	11	4	9:00	157.5	2
29	2021	11	4	12:00	337.5	2
30	2021	11	4	15:00	337.5	3
31	2021	11	4	18:00	225	1
32	2021	11	4	21:00	180	2
33	2021	11	8	0:00	180	2
34	2021	11	8	3:00	180	3
35	2021	11	8	6:00	135	3
36	2021	11	8	9:00	157.5	3
37	2021	11	8	12:00	157.5	4
38	2021	11	8	15:00	157.5	4
39	2021	11	8	18:00	157.5	3
40	2021	11	8	21:00	157.5	3
41	2021	11	6	0:00	157.5	4
42	2021	11	6	3:00	157.5	3
43	2021	11	6	6:00	157.5	3
44	2021	11	6	9:00	157.5	2
45	2021	11	6	12:00	45	2
46	2021	11	6	15:00	22.5	2
47	2021	11	6	18:00	225	1

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
48	2021	11	6	21:00	135	2
49	2021	11	7	0:00	157.5	3
50	2021	11	7	3:00	157.5	3
51	2021	11	7	6:00	157.5	3
52	2021	11	7	9:00	135	2
53	2021	11	7	12:00	45	1
54	2021	11	7	15:00	45	2
55	2021	11	7	18:00	225	1
56	2021	11	7	21:00	135	3
57	2021	11	8	0:00	157.5	3
58	2021	11	8	3:00	157.5	3
59	2021	11	8	6:00	157.5	3
60	2021	11	8	9:00	135	2
61	2021	11	8	12:00	45	2
62	2021	11	8	15:00	22.5	2
63	2021	11	8	18:00	202.5	1
64	2021	11	8	21:00	157.5	3
65	2021	11	9	0:00	157.5	3
66	2021	11	9	3:00	157.5	3
67	2021	11	9	6:00	157.5	3
68	2021	11	9	9:00	157.5	2
69	2021	11	9	12:00	22.5	2
70	2021	11	9	15:00	360	2
71	2021	11	9	18:00	225	1
72	2021	11	9	21:00	180	2
73	2021	11	10	0:00	180	3
74	2021	11	10	3:00	180	3
75	2021	11	10	6:00	180	3
76	2021	11	10	9:00	157.5	2
77	2021	11	10	12:00	360	1
78	2021	11	10	15:00	360	2
79	2021	11	10	18:00	225	1
80	2021	11	10	21:00	180	2
81	2021	11	11	0:00	180	3
82	2021	11	11	3:00	180	3
83	2021	11	11	6:00	180	3
84	2021	11	11	9:00	157.5	2
85	2021	11	11	12:00	22.5	2
86	2021	11	11	15:00	22.5	2
87	2021	11	11	18:00	225	1
88	2021	11	11	21:00	180	2
89	2021	11	12	0:00	180	3
90	2021	11	12	3:00	180	3
91	2021	11	12	6:00	180	3
92	2021	11	12	9:00	135	2
93	2021	11	12	12:00	45	2
94	2021	11	12	15:00	22.5	1

Wind Rose Data

Annexure-IIIb

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
95	2021	11	12	18:00	202.5	2
96	2021	11	12	21:00	180	2
97	2021	11	13	0:00	180	3
98	2021	11	13	3:00	180	3
99	2021	11	13	6:00	180	3
100	2021	11	13	9:00	157.5	2
101	2021	11	13	12:00	22.5	2
102	2021	11	13	15:00	22.5	2
103	2021	11	13	18:00	157.5	2
104	2021	11	13	21:00	180	2
105	2021	11	14	0:00	180	2
106	2021	11	14	3:00	180	3
107	2021	11	14	6:00	180	3
108	2021	11	14	9:00	180	1
109	2021	11	14	12:00	315	3
110	2021	11	14	15:00	315	3
111	2021	11	14	18:00	247.5	1
112	2021	11	14	21:00	180	2
113	2021	11	18	0:00	180	2
114	2021	11	18	3:00	180	3
115	2021	11	18	6:00	180	3
116	2021	11	18	9:00	135	1
117	2021	11	18	12:00	45	2
118	2021	11	18	15:00	360	2
119	2021	11	18	18:00	180	1
120	2021	11	18	21:00	180	2
121	2021	11	16	0:00	180	2
122	2021	11	16	3:00	180	3
123	2021	11	16	6:00	180	3
124	2021	11	16	9:00	135	2
125	2021	11	16	12:00	45	1
126	2021	11	16	15:00	22.5	2
127	2021	11	16	18:00	180	1
128	2021	11	16	21:00	180	3
129	2021	11	17	0:00	180	3
130	2021	11	17	3:00	180	3
131	2021	11	17	6:00	180	3
132	2021	11	17	9:00	157.5	2
133	2021	11	17	12:00	315	2
134	2021	11	17	15:00	315	2
135	2021	11	17	18:00	225	1
136	2021	11	17	21:00	180	2
137	2021	11	18	0:00	180	2
138	2021	11	18	3:00	180	2
139	2021	11	18	6:00	180	2
140	2021	11	18	9:00	202.5	0
141	2021	11	18	12:00	337.5	2
142	2021	11	18	15:00	337.5	3
143	2021	11	18	18:00	225	1
144	2021	11	18	21:00	180	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
145	2021	11	19	0:00	180	2
146	2021	11	19	3:00	180	2
147	2021	11	19	6:00	180	2
148	2021	11	19	9:00	157.5	1
149	2021	11	19	12:00	22.5	2
150	2021	11	19	15:00	360	2
151	2021	11	19	18:00	180	1
152	2021	11	19	21:00	180	2
153	2021	11	20	0:00	180	2
154	2021	11	20	3:00	180	3
155	2021	11	20	6:00	180	3
156	2021	11	20	9:00	157.5	1
157	2021	11	20	12:00	22.5	2
158	2021	11	20	15:00	180	2
159	2021	11	20	18:00	202.5	1
160	2021	11	20	21:00	180	2
161	2021	11	21	0:00	180	2
162	2021	11	21	3:00	180	3
163	2021	11	21	6:00	180	3
164	2021	11	21	9:00	225	1
165	2021	11	21	12:00	45	2
166	2021	11	21	15:00	22.5	2
167	2021	11	21	18:00	225	1
168	2021	11	21	21:00	180	2
169	2021	11	22	0:00	180	2
170	2021	11	22	3:00	180	3
171	2021	11	22	6:00	180	3
172	2021	11	22	9:00	157.5	2
173	2021	11	22	12:00	45	2
174	2021	11	22	15:00	360	2
175	2021	11	22	18:00	180	1
176	2021	11	22	21:00	180	3
177	2021	11	23	0:00	180	3
178	2021	11	23	3:00	180	3
179	2021	11	23	6:00	180	3
180	2021	11	23	9:00	180	2
181	2021	11	23	12:00	22.5	1
182	2021	11	23	15:00	360	2
183	2021	11	23	18:00	202.5	1
184	2021	11	23	21:00	180	2
185	2021	11	24	0:00	180	2
186	2021	11	24	3:00	180	3
187	2021	11	24	6:00	180	3
188	2021	11	24	9:00	157.5	2
189	2021	11	24	12:00	360	2
190	2021	11	24	15:00	360	3
191	2021	11	24	18:00	225	1
192	2021	11	24	21:00	180	2
193	2021	11	28	0:00	180	2
194	2021	11	28	3:00	180	2

Wind Rose Data

Annexure-IIIb

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
195	2021	11	28	6:00	180	2
196	2021	11	28	9:00	135	1
197	2021	11	28	12:00	45	2
198	2021	11	28	15:00	360	2
199	2021	11	28	18:00	202.5	1
200	2021	11	28	21:00	180	2
201	2021	11	26	0:00	180	2
202	2021	11	26	3:00	180	2
203	2021	11	26	6:00	180	2
204	2021	11	26	9:00	135	1
205	2021	11	26	12:00	45	2
206	2021	11	26	15:00	22.5	2
207	2021	11	26	18:00	225	1
208	2021	11	26	21:00	157	2
209	2021	11	27	0:00	180	2
210	2021	11	27	3:00	180	2
211	2021	11	27	6:00	180	2
212	2021	11	27	9:00	135	1
213	2021	11	27	12:00	360	2
214	2021	11	27	15:00	337.5	2
215	2021	11	27	18:00	270	1
216	2021	11	27	21:00	225	2
217	2021	11	28	0:00	180	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
218	2021	11	28	3:00	180	2
219	2021	11	28	6:00	180	2
220	2021	11	28	9:00	225	2
221	2021	11	28	12:00	22.5	2
222	2021	11	28	15:00	337.5	2
223	2021	11	28	18:00	270	1
224	2021	11	28	21:00	180	2
225	2021	11	29	0:00	180	2
226	2021	11	29	3:00	180	2
227	2021	11	29	6:00	180	2
228	2021	11	29	9:00	135	2
229	2021	11	29	12:00	45	2
230	2021	11	29	15:00	22.5	2
231	2021	11	29	18:00	225	1
232	2021	11	29	21:00	135	2
233	2021	11	30	0:00	157.5	3
234	2021	11	30	3:00	157.5	3
235	2021	11	30	6:00	157.5	3
236	2021	11	30	9:00	135	2
237	2021	11	30	12:00	45	1
238	2021	11	30	15:00	22.5	2
239	2021	11	30	18:00	180	1
240	2021	11	30	21:00	180	2

YYYY-Year; **MM**-Month; **DD**-Date; **HH**-Hour; **W_dir**-Wind Direction (Degree); **W_Sp**-Wind Speed (m/s).

Table 8: Frequency Distribution (Period 01/11/2021 to 30/11/2021)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0	4.17	1.25	0	0	0	0	5.42
2	NNE	0	7.92	0	0	0	0	0	7.92
3	NE	0	5.42	0	0	0	0	0	5.42
4	ENE	0	0	0	0	0	0	0	0
5	East	0	0	0	0	0	0	0	0
6	ESE	0	0	0	0	0	0	0	0
7	SE	0	5	1.25	0	0	0	0	6.25
8	SSE	0	6.25	8.75	0	0	0	0	15
9	South	0	25	18.33	0	0	0	0	43.33
10	SSW	0.42	2.5	0	0	0	0	0	2.92
11	SW	0	7.5	0	0	0	0	0	7.5
12	WSW	0	0.42	0	0	0	0	0	0.42
13	West	0	0.83	0	0	0	0	0	0.83
14	WNW	0	0	0	0	0	0	0	0
15	NW	0	0.83	0.83	0	0	0	0	1.66
16	NNW	0	2.08	1.25	0	0	0	0	3.33
Total		0.42	67.92	31.66	0	0	0	0	100

Wind Rose Data

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Table 9: Wind Rose data October 2021

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2021	12	1	0:00	180	2
2	2021	12	1	3:00	180	2
3	2021	12	1	6:00	180	2
4	2021	12	1	9:00	157.5	2
5	2021	12	1	12:00	337.5	2
6	2021	12	1	15:00	360	2
7	2021	12	1	18:00	225	1
8	2021	12	1	21:00	180	2
9	2021	12	2	0:00	180	2
10	2021	12	2	3:00	180	2
11	2021	12	2	6:00	157.5	3
12	2021	12	2	9:00	157.5	2
13	2021	12	2	12:00	45	1
14	2021	12	2	15:00	360	2
15	2021	12	2	18:00	180	1
16	2021	12	2	21:00	180	2
17	2021	12	3	0:00	180	2
18	2021	12	3	3:00	180	2
19	2021	12	3	6:00	180	2
20	2021	12	3	9:00	180	1
21	2021	12	3	12:00	360	2
22	2021	12	3	15:00	337.5	2
23	2021	12	3	18:00	45	1
24	2021	12	3	21:00	202.2	2
25	2021	12	4	0:00	180	2
26	2021	12	4	3:00	180	2
27	2021	12	4	6:00	180	3
28	2021	12	4	9:00	157.5	2
29	2021	12	4	12:00	22.5	1
30	2021	12	4	15:00	360	2
31	2021	12	4	18:00	247.5	2
32	2021	12	4	21:00	202.5	2
33	2021	12	8	0:00	202.5	2
34	2021	12	8	3:00	180	2
35	2021	12	8	6:00	180	3
36	2021	12	8	9:00	180	2
37	2021	12	8	12:00	135	1
38	2021	12	8	15:00	337.5	0
39	2021	12	8	18:00	157.5	2
40	2021	12	8	21:00	180	3
41	2021	12	6	0:00	157.5	3
42	2021	12	6	3:00	135	3
43	2021	12	6	6:00	157.5	3
44	2021	12	6	9:00	157.5	1
45	2021	12	6	12:00	22.5	1
46	2021	12	6	15:00	360	2
47	2021	12	6	18:00	202.5	0
48	2021	12	6	21:00	157.5	2
49	2021	12	7	0:00	157.5	3

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
50	2021	12	7	3:00	157.5	3
51	2021	12	7	6:00	180	3
52	2021	12	7	9:00	157.5	2
53	2021	12	7	12:00	45	1
54	2021	12	7	15:00	360	2
55	2021	12	7	18:00	315	1
56	2021	12	7	21:00	135	2
57	2021	12	8	0:00	157.5	3
58	2021	12	8	3:00	180	3
59	2021	12	8	6:00	180	3
60	2021	12	8	9:00	180	2
61	2021	12	8	12:00	337.5	1
62	2021	12	8	15:00	337.5	2
63	2021	12	8	18:00	225	1
64	2021	12	8	21:00	180	2
65	2021	12	9	0:00	180	2
66	2021	12	9	3:00	180	3
67	2021	12	9	6:00	180	3
68	2021	12	9	9:00	157.5	2
69	2021	12	9	12:00	22.5	1
70	2021	12	9	15:00	360	2
71	2021	12	9	18:00	202.5	1
72	2021	12	9	21:00	180	2
73	2021	12	10	0:00	157.5	3
74	2021	12	10	3:00	157.5	3
75	2021	12	10	6:00	157.5	3
76	2021	12	10	9:00	157.5	2
77	2021	12	10	12:00	67.5	1
78	2021	12	10	15:00	22.5	2
79	2021	12	10	18:00	157.5	1
80	2021	12	10	21:00	157.5	3
81	2021	12	11	0:00	157.5	3
82	2021	12	11	3:00	180	3
83	2021	12	11	6:00	157.5	3
84	2021	12	11	9:00	157.5	2
85	2021	12	11	12:00	315	0
86	2021	12	11	15:00	360	2
87	2021	12	11	18:00	225	1
88	2021	12	11	21:00	180	2
89	2021	12	12	0:00	157.5	3
90	2021	12	12	3:00	157.5	3
91	2021	12	12	6:00	157.5	3
92	2021	12	12	9:00	157.5	2
93	2021	12	12	12:00	360	1
94	2021	12	12	15:00	360	2
95	2021	12	12	18:00	225	1
96	2021	12	12	21:00	180	2
97	2021	12	13	0:00	180	2
98	2021	12	13	3:00	180	3

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
99	2021	12	13	6:00	180	3
100	2021	12	13	9:00	180	2
101	2021	12	13	12:00	337.5	1
102	2021	12	13	15:00	360	2
103	2021	12	13	18:00	225	1
104	2021	12	13	21:00	202.5	2
105	2021	12	14	0:00	202.5	2
106	2021	12	14	3:00	202.5	2
107	2021	12	14	6:00	202.5	2
108	2021	12	14	9:00	202.5	1
109	2021	12	14	12:00	337.5	2
110	2021	12	14	15:00	337.5	3
111	2021	12	14	18:00	247.5	1
112	2021	12	14	21:00	180	2
113	2021	12	18	0:00	180	2
114	2021	12	18	3:00	180	2
115	2021	12	18	6:00	180	3
116	2021	12	18	9:00	157.5	2
117	2021	12	18	12:00	360	1
118	2021	12	18	15:00	360	3
119	2021	12	18	18:00	225	1
120	2021	12	18	21:00	180	2
121	2021	12	16	0:00	180	2
122	2021	12	16	3:00	180	2
123	2021	12	16	6:00	180	2
124	2021	12	16	9:00	157.5	2
125	2021	12	16	12:00	22.5	2
126	2021	12	16	15:00	360	3
127	2021	12	16	18:00	247.5	1
128	2021	12	16	21:00	180	2
129	2021	12	17	0:00	157.5	2
130	2021	12	17	3:00	157.5	2
131	2021	12	17	6:00	157.5	3
132	2021	12	17	9:00	135	2
133	2021	12	17	12:00	45	2
134	2021	12	17	15:00	135	2
135	2021	12	17	18:00	157.5	1
136	2021	12	17	21:00	157.5	3
137	2021	12	18	0:00	157.5	3
138	2021	12	18	3:00	157.5	4
139	2021	12	18	6:00	157.5	4
140	2021	12	18	9:00	157.5	3
141	2021	12	18	12:00	135	2
142	2021	12	18	15:00	45	2
143	2021	12	18	18:00	135	2
144	2021	12	18	21:00	135	3
145	2021	12	19	0:00	157.5	4
146	2021	12	19	3:00	157.5	4
147	2021	12	19	6:00	157.5	4
148	2021	12	19	9:00	157.5	3
149	2021	12	19	12:00	45	0

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
150	2021	12	19	15:00	45	1
151	2021	12	19	18:00	135	1
152	2021	12	19	21:00	157.5	3
153	2021	12	20	0:00	157.5	2
154	2021	12	20	3:00	157.5	3
155	2021	12	20	6:00	157.5	3
156	2021	12	20	9:00	157.5	2
157	2021	12	20	12:00	337.5	1
158	2021	12	20	15:00	360	2
159	2021	12	20	18:00	225	1
160	2021	12	20	21:00	180	2
161	2021	12	21	0:00	180	2
162	2021	12	21	3:00	157.5	2
163	2021	12	21	6:00	157.5	3
164	2021	12	21	9:00	135	2
165	2021	12	21	12:00	90	1
166	2021	12	21	15:00	360	2
167	2021	12	21	18:00	180	2
168	2021	12	21	21:00	157.5	2
169	2021	12	22	0:00	180	2
170	2021	12	22	3:00	180	2
171	2021	12	22	6:00	180	2
172	2021	12	22	9:00	157.5	1
173	2021	12	22	12:00	22.5	1
174	2021	12	22	15:00	360	2
175	2021	12	22	18:00	247.5	1
176	2021	12	22	21:00	202.5	1
177	2021	12	23	0:00	180	2
178	2021	12	23	3:00	202.5	2
179	2021	12	23	6:00	180	2
180	2021	12	23	9:00	180	1
181	2021	12	23	12:00	90	1
182	2021	12	23	15:00	135	2
183	2021	12	23	18:00	157.5	2
184	2021	12	23	21:00	180	3
185	2021	12	24	0:00	180	2
186	2021	12	24	3:00	180	3
187	2021	12	24	6:00	180	3
188	2021	12	24	9:00	180	2
189	2021	12	24	12:00	22.5	1
190	2021	12	24	15:00	360	2
191	2021	12	24	18:00	225	1
192	2021	12	24	21:00	180	2
193	2021	12	28	0:00	180	3
194	2021	12	28	3:00	180	3
195	2021	12	28	6:00	180	3
196	2021	12	28	9:00	180	2
197	2021	12	28	12:00	112.5	0
198	2021	12	28	15:00	315	2
199	2021	12	28	18:00	225	1
200	2021	12	28	21:00	180	2

Wind Rose Data**Annexure-IIIb**

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
201	2021	12	26	0:00	157.5	2
202	2021	12	26	3:00	157.5	3
203	2021	12	26	6:00	157.5	3
204	2021	12	26	9:00	135	2
205	2021	12	26	12:00	157.5	2
206	2021	12	26	15:00	180	1
207	2021	12	26	18:00	135	2
208	2021	12	26	21:00	157.5	2
209	2021	12	27	0:00	180	3
210	2021	12	27	3:00	157.5	3
211	2021	12	27	6:00	157.5	2
212	2021	12	27	9:00	157.5	2
213	2021	12	27	12:00	337.5	1
214	2021	12	27	15:00	22.5	0
215	2021	12	27	18:00	135	2
216	2021	12	27	21:00	180	2
217	2021	12	28	0:00	180	2
218	2021	12	28	3:00	180	3
219	2021	12	28	6:00	180	3
220	2021	12	28	9:00	157.5	2
221	2021	12	28	12:00	360	1
222	2021	12	28	15:00	360	2
223	2021	12	28	18:00	180	1
224	2021	12	28	21:00	157.5	3
225	2021	12	29	0:00	157.5	3
226	2021	12	29	3:00	157.5	3
227	2021	12	29	6:00	157.5	2
228	2021	12	29	9:00	157.5	2
229	2021	12	29	12:00	45	2
230	2021	12	29	15:00	22.5	1
231	2021	12	29	18:00	180	3
232	2021	12	29	21:00	157.5	1
233	2021	12	30	0:00	180	3
234	2021	12	30	3:00	180	3
235	2021	12	30	6:00	180	3
236	2021	12	30	9:00	157.5	2
237	2021	12	30	12:00	45	1
238	2021	12	30	15:00	45	2
239	2021	12	30	18:00	180	0
240	2021	12	30	21:00	157.5	2
241	2021	12	31	0:00	180	2
242	2021	12	31	3:00	157.5	3
243	2021	12	31	6:00	180	3
244	2021	12	31	9:00	157.5	2
245	2021	12	31	12:00	45	1
246	2021	12	31	15:00	22.5	2
247	2021	12	31	18:00	157.5	2
248	2021	12	31	21:00	157.5	2

Wind Rose Data

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YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Table 10: Frequency Distribution (Period 01/12/2021 to 31/12/2021)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0	7.26	0.81	0	0	0	0	8.07
2	NNE	0.4	3.63	0	0	0	0	0	4.03
3	NE	0.4	4.03	0	0	0	0	0	4.43
4	ENE	0	0.4	0	0	0	0	0	0.4
5	East	0	0.81	0	0	0	0	0	0.81
6	ESE	0.4	0	0	0	0	0	0	0.4
7	SE	0	4.84	0.81	0	0	0	0	5.65
8	SSE	0	14.92	14.52	0	0	0	0	29.44
9	South	0.4	20.56	10.48	0	0	0	0	31.44
10	SSW	0.4	4.44	0	0	0	0	0	4.84
11	SW	0	3.63	0	0	0	0	0	3.63
12	WSW	0	1.61	0	0	0	0	0	1.61
13	West	0	0	0	0	0	0	0	0
14	WNW	0	0	0	0	0	0	0	0
15	NW	0.4	0.81	0	0	0	0	0	1.21
16	NNW	0.4	3.23	0.4	0	0	0	0	4.03
Total		2.8	70.17	27.02	0	0	0	0	100

Table 11: Wind Rose January data 2022

S.No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2022	1	1	0:00	180	3
2	2022	1	1	3:00	180	2
3	2022	1	1	6:00	180	3
4	2022	1	1	9:00	157.5	2
5	2022	1	1	12:00	90	1
6	2022	1	1	15:00	22.5	1
7	2022	1	1	18:00	315	0
8	2022	1	1	21:00	157.5	2
9	2022	1	2	0:00	157.5	3
10	2022	1	2	3:00	180	3
11	2022	1	2	6:00	180	3
12	2022	1	2	9:00	157.5	2
13	2022	1	2	12:00	22.5	1
14	2022	1	2	15:00	45	1
15	2022	1	2	18:00	22.5	1
16	2022	1	2	21:00	157	2
17	2022	1	3	0:00	157.5	3
18	2022	1	3	3:00	157.5	3
19	2022	1	3	6:00	157.5	2
20	2022	1	3	9:00	157.5	2
21	2022	1	3	12:00	157.5	1
22	2022	1	3	15:00	360	0
23	2022	1	3	18:00	135	2
24	2022	1	3	21:00	135	2
25	2022	1	4	0:00	360	1
26	2022	1	4	3:00	157.5	2

S.No.	YYYY	MM	DD	HH	W_dir	W_Sp
27	2022	1	4	6:00	157.5	2
28	2022	1	4	9:00	157.5	2
29	2022	1	4	12:00	157.5	2
30	2022	1	4	15:00	157.5	1
31	2022	1	4	18:00	157.5	1
32	2022	1	4	21:00	157.5	1
33	2022	1	8	0:00	135	1
34	2022	1	8	3:00	180	2
35	2022	1	8	6:00	135	1
36	2022	1	8	9:00	202.5	1
37	2022	1	8	12:00	135	2
38	2022	1	8	15:00	157.5	2
39	2022	1	8	18:00	157.5	3
40	2022	1	8	21:00	180	2
41	2022	1	6	0:00	157.5	2
42	2022	1	6	3:00	157.5	3
43	2022	1	6	6:00	157.5	2
44	2022	1	6	9:00	157.5	2
45	2022	1	6	12:00	157.5	1
46	2022	1	6	15:00	157.5	2
47	2022	1	6	18:00	157.5	3
48	2022	1	6	21:00	157.5	3
49	2022	1	7	0:00	157.5	3
50	2022	1	7	3:00	180	3
51	2022	1	7	6:00	180	2
52	2022	1	7	9:00	180	2

Wind Rose Data

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S.No.	YYYY	MM	DD	HH	W_dir	W_Sp
53	2022	1	7	12:00	135	1
54	2022	1	7	15:00	45	1
55	2022	1	7	18:00	135	2
56	2022	1	7	21:00	157.5	3
57	2022	1	8	0:00	180	3
58	2022	1	8	3:00	180	3
59	2022	1	8	6:00	180	2
60	2022	1	8	9:00	135	3
61	2022	1	8	12:00	135	3
62	2022	1	8	15:00	135	4
63	2022	1	8	18:00	180	4
64	2022	1	8	21:00	180	3
65	2022	1	9	0:00	180	2
66	2022	1	9	3:00	157.5	1
67	2022	1	9	6:00	180	2
68	2022	1	9	9:00	157.5	1
69	2022	1	9	12:00	45	1
70	2022	1	9	15:00	45	1
71	2022	1	9	18:00	180	1
72	2022	1	9	21:00	157.5	3
73	2022	1	10	0:00	180	2
74	2022	1	10	3:00	157.5	2
75	2022	1	10	6:00	157.5	3
76	2022	1	10	9:00	157.5	2
77	2022	1	10	12:00	157.5	0
78	2022	1	10	15:00	225	1
79	2022	1	10	18:00	202.5	2
80	2022	1	10	21:00	180	2
81	2022	1	11	0:00	180	2
82	2022	1	11	3:00	157.5	3
83	2022	1	11	6:00	157.5	3
84	2022	1	11	9:00	157.5	3
85	2022	1	11	12:00	157.5	2
86	2022	1	11	15:00	135	1
87	2022	1	11	18:00	180	2
88	2022	1	11	21:00	157.5	3
89	2022	1	12	0:00	157.5	3
90	2022	1	12	3:00	157.5	3
91	2022	1	12	6:00	157.5	4
92	2022	1	12	9:00	157.5	2
93	2022	1	12	12:00	135	1
94	2022	1	12	15:00	22.5	2
95	2022	1	12	18:00	225	0
96	2022	1	12	21:00	157.5	2
97	2022	1	13	0:00	180	2
98	2022	1	13	3:00	180	2
99	2022	1	13	6:00	180	2
100	2022	1	13	9:00	180	1
101	2022	1	13	12:00	360	1
102	2022	1	13	15:00	360	2

S.No.	YYYY	MM	DD	HH	W_dir	W_Sp
103	2022	1	13	18:00	180	0
104	2022	1	13	21:00	157.5	2
105	2022	1	14	0:00	157.5	2
106	2022	1	14	3:00	157.5	3
107	2022	1	14	6:00	157.5	3
108	2022	1	14	9:00	157.5	2
109	2022	1	14	12:00	45	1
110	2022	1	14	15:00	22.5	2
111	2022	1	14	18:00	225	0
112	2022	1	14	21:00	157.5	2
113	2022	1	18	0:00	157.5	3
114	2022	1	18	3:00	157.5	3
115	2022	1	18	6:00	157.5	3
116	2022	1	18	9:00	157.5	2
117	2022	1	18	12:00	90	1
118	2022	1	18	15:00	45	1
119	2022	1	18	18:00	135	1
120	2022	1	18	21:00	157.5	2
121	2022	1	16	0:00	157.5	3
122	2022	1	16	3:00	157.5	2
123	2022	1	16	6:00	157.5	2
124	2022	1	16	9:00	157.5	2
125	2022	1	16	12:00	90	1
126	2022	1	16	15:00	90	1
127	2022	1	16	18:00	135	2
128	2022	1	16	21:00	157.5	1
129	2022	1	17	0:00	157.5	3
130	2022	1	17	3:00	157.5	3
131	2022	1	17	6:00	157.5	3
132	2022	1	17	9:00	157.5	1
133	2022	1	17	12:00	360	1
134	2022	1	17	15:00	360	1
135	2022	1	17	18:00	315	1
136	2022	1	17	21:00	135	1
137	2022	1	18	0:00	225	1
138	2022	1	18	3:00	135	3
139	2022	1	18	6:00	135	3
140	2022	1	18	9:00	135	2
141	2022	1	18	12:00	45	0
142	2022	1	18	15:00	22.5	2
143	2022	1	18	18:00	315	1
144	2022	1	18	21:00	135	2
145	2022	1	19	0:00	135	2
146	2022	1	19	3:00	180	2
147	2022	1	19	6:00	180	2
148	2022	1	19	9:00	180	1
149	2022	1	19	12:00	45	2
150	2022	1	19	15:00	90	1
151	2022	1	19	18:00	135	1
152	2022	1	19	21:00	180	1

Wind Rose Data

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S.No.	YYYY	MM	DD	HH	W_dir	W_Sp
153	2022	1	20	0:00	135	3
154	2022	1	20	3:00	135	2
155	2022	1	20	6:00	13	2
156	2022	1	20	9:00	5	1
157	2022	1	20	12:00	157.5	1
158	2022	1	20	15:00	337.5	2
159	2022	1	20	18:00	315	1
160	2022	1	20	21:00	180	0
161	2022	1	21	0:00	202.5	1
162	2022	1	21	3:00	180	2
163	2022	1	21	6:00	180	2
164	2022	1	21	9:00	135	2
165	2022	1	21	12:00	337.5	2
166	2022	1	21	15:00	360	1
167	2022	1	21	18:00	135	3
168	2022	1	21	21:00	157.5	3
169	2022	1	22	0:00	202.5	2
170	2022	1	22	3:00	157.5	2
171	2022	1	22	6:00	157.5	2
172	2022	1	22	9:00	360	0
173	2022	1	22	12:00	337.5	2
174	2022	1	22	15:00	337.5	3
175	2022	1	22	18:00	337.5	1
176	2022	1	22	21:00	135	1
177	2022	1	23	0:00	135	1
178	2022	1	23	3:00	135	2
179	2022	1	23	6:00	135	1
180	2022	1	23	9:00	135	2
181	2022	1	23	12:00	135	2
182	2022	1	23	15:00	135	2
183	2022	1	23	18:00	157.5	2
184	2022	1	23	21:00	157.5	2
185	2022	1	24	0:00	135	1
186	2022	1	24	3:00	157.5	1
187	2022	1	24	6:00	225	1
188	2022	1	24	9:00	157.5	1
189	2022	1	24	12:00	22.5	1
190	2022	1	24	15:00	337.5	1
191	2022	1	24	18:00	315	1
192	2022	1	24	21:00	112.5	1
193	2022	1	28	0:00	157.5	2
194	2022	1	28	3:00	180	2
195	2022	1	28	6:00	180	3
196	2022	1	28	9:00	157.5	2
197	2022	1	28	12:00	22.5	0
198	2022	1	28	15:00	337.5	2
199	2022	1	28	18:00	315	1
200	2022	1	28	21:00	157.5	2

S.No.	YYYY	MM	DD	HH	W_dir	W_Sp
201	2022	1	26	0:00	157.5	2
202	2022	1	26	3:00	157.5	3
203	2022	1	26	6:00	157.5	2
204	2022	1	26	9:00	135	2
205	2022	1	26	12:00	45	1
206	2022	1	26	15:00	360	2
207	2022	1	26	18:00	315	1
208	2022	1	26	21:00	157.5	2
209	2022	1	27	0:00	157.5	2
210	2022	1	27	3:00	157.5	3
211	2022	1	27	6:00	157.5	3
212	2022	1	27	9:00	90	2
213	2022	1	27	12:00	90	1
214	2022	1	27	15:00	22.5	2
215	2022	1	27	18:00	315	1
216	2022	1	27	21:00	135	2
217	2022	1	28	0:00	135	3
218	2022	1	28	3:00	135	3
219	2022	1	28	6:00	135	3
220	2022	1	28	9:00	135	3
221	2022	1	28	12:00	90	1
222	2022	1	28	15:00	45	1
223	2022	1	28	18:00	315	1
224	2022	1	28	21:00	135	2
225	2022	1	29	0:00	90	2
226	2022	1	29	3:00	90	3
227	2022	1	29	6:00	90	2
228	2022	1	29	9:00	157.5	1
229	2022	1	29	12:00	360	1
230	2022	1	29	15:00	360	2
231	2022	1	29	18:00	270	0
232	2022	1	29	21:00	157.5	2
233	2022	1	30	0:00	157.5	2
234	2022	1	30	3:00	157.5	2
235	2022	1	30	6:00	157.5	3
236	2022	1	30	9:00	135	2
237	2022	1	30	12:00	90	1
238	2022	1	30	15:00	45	2
239	2022	1	30	18:00	315	1
240	2022	1	30	21:00	157.5	2
241	2022	1	31	0:00	180	2
242	2022	1	31	3:00	180	2
243	2022	1	31	6:00	180	2
244	2022	1	31	9:00	180	2
245	2022	1	31	12:00	337.5	1
246	2022	1	31	15:00	337.5	3
247	2022	1	31	18:00	315	1
248	2022	1	31	21:00	157.5	2

YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Wind Rose Data

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Table 12: Frequency Distribution (Period 01/01/2022 to 31/01/2022)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0.81	4.03	0	0	0	0	0	4.84
2	NNE	0.4	3.63	0	0	0	0	0	4.03
3	NE	0.4	4.03	0	0	0	0	0	4.43
4	ENE	0	0	0	0	0	0	0	0
5	East	0	4.44	0.4	0	0	0	0	4.84
6	ESE	0	0.4	0	0	0	0	0	0.4
7	SE	0	12.1	4.44	0	0	0	0	16.54
8	SSE	0.4	23.39	12.9	0	0	0	0	36.69
9	South	0.81	11.29	4.03	0	0	0	0	16.13
10	SSW	0	1.61	0	0	0	0	0	1.61
11	SW	0.81	1.21	0	0	0	0	0	2.02
12	WSW	0	0	0	0	0	0	0	0
13	West	0.4	0	0	0	0	0	0	0.4
14	WNW	0	0	0	0	0	0	0	0
15	NW	0.4	4.03	0	0	0	0	0	4.43
16	NNW	0	2.82	0.81	0	0	0	0	3.63
Total		4.43	72.98	22.58	0	0	0	0	100

Table 13: Wind Rose data February 2022

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2022	2	1	0:00	180	2
2	2022	2	1	3:00	180	2
3	2022	2	1	6:00	180	2
4	2022	2	1	9:00	135	1
5	2022	2	1	12:00	467.5	2
6	2022	2	1	15:00	45	2
7	2022	2	1	18:00	315	1
8	2022	2	1	21:00	135	2
9	2022	2	2	0:00	135	2
10	2022	2	2	3:00	180	3
11	2022	2	2	6:00	180	3
12	2022	2	2	9:00	180	2
13	2022	2	2	12:00	225	0
14	2022	2	2	15:00	337.5	1
15	2022	2	2	18:00	315	2
16	2022	2	2	21:00	225	1
17	2022	2	3	0:00	180	2
18	2022	2	3	3:00	157.5	2
19	2022	2	3	6:00	157.5	2
20	2022	2	3	9:00	157.5	2
21	2022	2	3	12:00	22.5	1
22	2022	2	3	15:00	360	2
23	2022	2	3	18:00	315	1
24	2022	2	3	21:00	180	1
25	2022	2	4	0:00	157.5	1
26	2022	2	4	3:00	157.5	1
27	2022	2	4	6:00	157.5	1
28	2022	2	4	9:00	135	1
29	2022	2	4	12:00	22.5	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
30	2022	2	4	15:00	360	3
31	2022	2	4	18:00	315	2
32	2022	2	4	21:00	180	1
33	2022	2	8	0:00	180	2
34	2022	2	8	3:00	180	2
35	2022	2	8	6:00	157.5	2
36	2022	2	8	9:00	157.5	2
37	2022	2	8	12:00	360	1
38	2022	2	8	15:00	360	3
39	2022	2	8	18:00	315	1
40	2022	2	8	21:00	180	2
41	2022	2	6	0:00	180	1
42	2022	2	6	3:00	180	2
43	2022	2	6	6:00	180	1
44	2022	2	6	9:00	180	1
45	2022	2	6	12:00	360	1
46	2022	2	6	15:00	360	2
47	2022	2	6	18:00	337.5	1
48	2022	2	6	21:00	315	1
49	2022	2	7	0:00	135	3
50	2022	2	7	3:00	135	3
51	2022	2	7	6:00	135	2
52	2022	2	7	9:00	135	1
53	2022	2	7	12:00	22.5	1
54	2022	2	7	15:00	360	2
55	2022	2	7	18:00	315	1
56	2022	2	7	21:00	157.5	1
57	2022	2	8	0:00	157.5	2
58	2022	2	8	3:00	157.5	2

Wind Rose Data

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
59	2022	2	8	6:00	157.5	3
60	2022	2	8	9:00	135	1
61	2022	2	8	12:00	315	1
62	2022	2	8	15:00	315	3
63	2022	2	8	18:00	292.5	2
64	2022	2	8	21:00	225	1
65	2022	2	9	0:00	135	2
66	2022	2	9	3:00	360	2
67	2022	2	9	6:00	90	2
68	2022	2	9	9:00	135	2
69	2022	2	9	12:00	45	2
70	2022	2	9	15:00	337.5	1
71	2022	2	9	18:00	315	1
72	2022	2	9	21:00	135	1
73	2022	2	10	0:00	157.5	2
74	2022	2	10	3:00	157.5	2
75	2022	2	10	6:00	157.5	2
76	2022	2	10	9:00	135	2
77	2022	2	10	12:00	45	2
78	2022	2	10	15:00	360	2
79	2022	2	10	18:00	315	1
80	2022	2	10	21:00	157.5	1
81	2022	2	11	0:00	157.5	2
82	2022	2	11	3:00	157.5	2
83	2022	2	11	6:00	157.5	3
84	2022	2	11	9:00	135	2
85	2022	2	11	12:00	90	2
86	2022	2	11	15:00	45	2
87	2022	2	11	18:00	22.5	0
88	2022	2	11	21:00	157.5	0
89	2022	2	12	0:00	157.5	3
90	2022	2	12	3:00	157.5	3
91	2022	2	12	6:00	157.5	3
92	2022	2	12	9:00	135	2
93	2022	2	12	12:00	22.5	1
94	2022	2	12	15:00	360	2
95	2022	2	12	18:00	315	1
96	2022	2	12	21:00	157.5	1
97	2022	2	13	0:00	180	2
98	2022	2	13	3:00	180	3
99	2022	2	13	6:00	180	2
100	2022	2	13	9:00	157.5	2
101	2022	2	13	12:00	360	2
102	2022	2	13	15:00	360	1
103	2022	2	13	18:00	315	1
104	2022	2	13	21:00	225	1
105	2022	2	14	0:00	180	2
106	2022	2	14	3:00	180	2
107	2022	2	14	6:00	180	1
108	2022	2	14	9:00	157.5	1

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
109	2022	2	14	12:00	22.5	2
110	2022	2	14	15:00	360	2
111	2022	2	14	18:00	315	1
112	2022	2	14	21:00	225	1
113	2022	2	18	0:00	180	2
114	2022	2	18	3:00	157.5	2
115	2022	2	18	6:00	157.5	2
116	2022	2	18	9:00	180	1
117	2022	2	18	12:00	135	2
118	2022	2	18	15:00	360	3
119	2022	2	18	18:00	315	1
120	2022	2	18	21:00	180	1
121	2022	2	16	0:00	180	2
122	2022	2	16	3:00	180	2
123	2022	2	16	6:00	180	2
124	2022	2	16	9:00	135	2
125	2022	2	16	12:00	22.5	2
126	2022	2	16	15:00	315	2
127	2022	2	16	18:00	180	1
128	2022	2	16	21:00	180	1
129	2022	2	17	0:00	180	2
130	2022	2	17	3:00	180	2
131	2022	2	17	6:00	180	2
132	2022	2	17	9:00	135	2
133	2022	2	17	12:00	22.5	2
134	2022	2	17	15:00	315	2
135	2022	2	17	18:00	202.5	1
136	2022	2	17	21:00	180	2
137	2022	2	18	0:00	180	3
138	2022	2	18	3:00	180	3
139	2022	2	18	6:00	180	3
140	2022	2	18	9:00	157.5	2
141	2022	2	18	12:00	45	1
142	2022	2	18	15:00	360	3
143	2022	2	18	18:00	180	3
144	2022	2	18	21:00	180	3
145	2022	2	19	0:00	180	3
146	2022	2	19	3:00	180	3
147	2022	2	19	6:00	180	3
148	2022	2	19	9:00	157.5	2
149	2022	2	19	12:00	45	1
150	2022	2	19	15:00	360	3
151	2022	2	19	18:00	315	1
152	2022	2	19	21:00	315	1
153	2022	2	20	0:00	157.5	2
154	2022	2	20	3:00	157.5	2
155	2022	2	20	6:00	157.5	3
156	2022	2	20	9:00	135	2
157	2022	2	20	12:00	45	2
158	2022	2	20	15:00	45	3

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
159	2022	2	20	18:00	22.5	1
160	2022	2	20	21:00	135	2
161	2022	2	21	0:00	157.5	3
162	2022	2	21	3:00	157.5	4
163	2022	2	21	6:00	157.5	3
164	2022	2	21	9:00	157.5	2
165	2022	2	21	12:00	135	1
166	2022	2	21	15:00	112.5	2
167	2022	2	21	18:00	315	2
168	2022	2	21	21:00	157.5	2
169	2022	2	22	0:00	180	3
170	2022	2	22	3:00	180	2
171	2022	2	22	6:00	180	3
172	2022	2	22	9:00	157.5	4
173	2022	2	22	12:00	157.5	5
174	2022	2	22	15:00	157.5	5
175	2022	2	22	18:00	157.5	4
176	2022	2	22	21:00	157.5	4
177	2022	2	23	0:00	90	2
178	2022	2	23	3:00	135	2
179	2022	2	23	6:00	135	3
180	2022	2	23	9:00	135	2
181	2022	2	23	12:00	135	2
182	2022	2	23	15:00	180	1
183	2022	2	23	18:00	157.5	2
184	2022	2	23	21:00	135	2
185	2022	2	24	0:00	90	2
186	2022	2	24	3:00	135	2
187	2022	2	24	6:00	135	3
188	2022	2	24	9:00	135	2
189	2022	2	24	12:00	135	2
190	2022	2	24	15:00	157.5	1
191	2022	2	24	18:00	157.5	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
192	2022	2	24	21:00	135	2
193	2022	2	28	0:00	180	3
194	2022	2	28	3:00	180	3
195	2022	2	28	6:00	180	3
196	2022	2	28	9:00	157.5	2
197	2022	2	28	12:00	270	1
198	2022	2	28	15:00	315	2
199	2022	2	28	18:00	135	3
200	2022	2	28	21:00	135	3
201	2022	2	26	0:00	180	3
202	2022	2	26	3:00	180	3
203	2022	2	26	6:00	180	3
204	2022	2	26	9:00	180	1
205	2022	2	26	12:00	315	2
206	2022	2	26	15:00	315	2
207	2022	2	26	18:00	315	1
208	2022	2	26	21:00	180	2
209	2022	2	27	0:00	157.5	3
210	2022	2	27	3:00	157.5	3
211	2022	2	27	6:00	157.5	3
212	2022	2	27	9:00	157.5	3
213	2022	2	27	12:00	90	1
214	2022	2	27	15:00	45	1
215	2022	2	27	18:00	360	1
216	2022	2	27	21:00	135	3
217	2022	2	28	0:00	157.5	1
218	2022	2	28	3:00	157.5	2
219	2022	2	28	6:00	157.5	3
220	2022	2	28	9:00	157.5	2
221	2022	2	28	12:00	45	1
222	2022	2	28	15:00	45	2
223	2022	2	28	18:00	180	2
224	2022	2	28	21:00	180	3

YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Table 14: Frequency Distribution (Period 01/02/2022 to 28/02/2022)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	WSW	0	5.38	2.24	0	0	0	0	7.62
2	WNW	0.45	3.59	0	0	0	0	0	4.04
3	West	0	4.48	0.45	0	0	0	0	4.93
4	SW	0	0	0	0	0	0	0	0
5	SSW	0	2.24	0	0	0	0	0	2.24
6	SSE	0	0.45	0	0	0	0	0	0.45
7	South	0	12.11	3.14	0	0	0	0	15.25
8	SE	0.45	15.7	7.62	0.9	0	0	0	24.67
9	NW	0	16.14	8.97	0	0	0	0	25.11
10	North	0	0.45	0	0	0	0	0	0.45
11	NNW	0.45	1.79	0	0	0	0	0	2.24
12	NNE	0	0	0	0	0	0	0	0

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S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
13	NE	0	0.45	0	0	0	0	0	0.45
14	ESE	0	0.45	0	0	0	0	0	0.45
15	ENE	0	10.31	0.45	0	0	0	0	10.76
16	East	0	1.35	0	0	0	0	0	1.35
Total		1.35	74.89	22.87	0.9	0	0	0	100

Table 15: Wind Rose data March 2022

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2022	3	1	0:00	180	3
2	2022	3	1	3:00	157.5	3
3	2022	3	1	6:00	157.5	2
4	2022	3	1	9:00	157.5	1
5	2022	3	1	12:00	45	2
6	2022	3	1	15:00	360	1
7	2022	3	1	18:00	315	2
8	2022	3	1	21:00	135	2
9	2022	3	2	0:00	157.5	3
10	2022	3	2	3:00	157.5	3
11	2022	3	2	6:00	157.5	3
12	2022	3	2	9:00	135	2
13	2022	3	2	12:00	90	1
14	2022	3	2	15:00	360	2
15	2022	3	2	18:00	157.5	0
16	2022	3	2	21:00	157.5	2
17	2022	3	3	0:00	180	2
18	2022	3	3	3:00	315	2
19	2022	3	3	6:00	202.5	1
20	2022	3	3	9:00	135	4
21	2022	3	3	12:00	112.5	4
22	2022	3	3	15:00	135	1
23	2022	3	3	18:00	135	3
24	2022	3	3	21:00	135	3
25	2022	3	4	0:00	135	3
26	2022	3	4	3:00	157.5	4
27	2022	3	4	6:00	157.5	3
28	2022	3	4	9:00	135	3
29	2022	3	4	12:00	135	2
30	2022	3	4	15:00	45	1
31	2022	3	4	18:00	360	1
32	2022	3	4	21:00	135	1
33	2022	3	8	0:00	157.5	3
34	2022	3	8	3:00	157.5	3
35	2022	3	8	6:00	157.5	3
36	2022	3	8	9:00	135	2
37	2022	3	8	12:00	90	0
38	2022	3	8	15:00	360	2
39	2022	3	8	18:00	135	0
40	2022	3	8	21:00	180	1
41	2022	3	6	0:00	180	2
42	2022	3	6	3:00	180	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
43	2022	3	6	6:00	135	2
44	2022	3	6	9:00	135	2
45	2022	3	6	12:00	135	3
46	2022	3	6	15:00	225	1
47	2022	3	6	18:00	135	2
48	2022	3	6	21:00	135	3
49	2022	3	7	0:00	157.5	2
50	2022	3	7	3:00	157.5	3
51	2022	3	7	6:00	157.5	3
52	2022	3	7	9:00	157.5	3
53	2022	3	7	12:00	135	1
54	2022	3	7	15:00	180	1
55	2022	3	7	18:00	157.5	1
56	2022	3	7	21:00	157.5	3
57	2022	3	8	0:00	180	4
58	2022	3	8	3:00	180	4
59	2022	3	8	6:00	180	4
60	2022	3	8	9:00	180	3
61	2022	3	8	12:00	135	2
62	2022	3	8	15:00	90	2
63	2022	3	8	18:00	135	2
64	2022	3	8	21:00	180	3
65	2022	3	9	0:00	180	3
66	2022	3	9	3:00	180	3
67	2022	3	9	6:00	135	3
68	2022	3	9	9:00	135	3
69	2022	3	9	12:00	90	3
70	2022	3	9	15:00	112.5	4
71	2022	3	9	18:00	135	4
72	2022	3	9	21:00	135	5
73	2022	3	10	0:00	157.5	4
74	2022	3	10	3:00	157.5	4
75	2022	3	10	6:00	157.5	3
76	2022	3	10	9:00	157.5	3
77	2022	3	10	12:00	135	1
78	2022	3	10	15:00	90	2
79	2022	3	10	18:00	90	1
80	2022	3	10	21:00	157.5	3
81	2022	3	11	0:00	157.5	2
82	2022	3	11	3:00	180	3
83	2022	3	11	6:00	180	3
84	2022	3	11	9:00	135	2

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
85	2022	3	11	12:00	45	2
86	2022	3	11	15:00	360	2
87	2022	3	11	18:00	315	0
88	2022	3	11	21:00	135	2
89	2022	3	12	0:00	157.5	3
90	2022	3	12	3:00	180	3
91	2022	3	12	6:00	180	3
92	2022	3	12	9:00	157.5	2
93	2022	3	12	12:00	90	1
94	2022	3	12	15:00	45	2
95	2022	3	12	18:00	202.5	1
96	2022	3	12	21:00	180	2
97	2022	3	13	0:00	157.5	3
98	2022	3	13	3:00	157.5	3
99	2022	3	13	6:00	157.5	3
100	2022	3	13	9:00	135	2
101	2022	3	13	12:00	45	2
102	2022	3	13	15:00	360	3
103	2022	3	13	18:00	225	0
104	2022	3	13	21:00	180	2
105	2022	3	14	0:00	180	2
106	2022	3	14	3:00	180	3
107	2022	3	14	6:00	180	3
108	2022	3	14	9:00	135	1
109	2022	3	14	12:00	202.5	2
110	2022	3	14	15:00	360	3
111	2022	3	14	18:00	270	0
112	2022	3	14	21:00	180	2
113	2022	3	18	0:00	180	2
114	2022	3	18	3:00	180	3
115	2022	3	18	6:00	180	3
116	2022	3	18	9:00	135	1
117	2022	3	18	12:00	22.5	2
118	2022	3	18	15:00	360	3
119	2022	3	18	18:00	315	1
120	2022	3	18	21:00	157.5	2
121	2022	3	16	0:00	180	2
122	2022	3	16	3:00	180	3
123	2022	3	16	6:00	180	3
124	2022	3	16	9:00	135	1
125	2022	3	16	12:00	22.5	2
126	2022	3	16	15:00	360	3
127	2022	3	16	18:00	315	1
128	2022	3	16	21:00	157.5	2
129	2022	3	17	0:00	157.5	3
130	2022	3	17	3:00	157.5	4
131	2022	3	17	6:00	157.5	3
132	2022	3	17	9:00	135	2
133	2022	3	17	12:00	45	1
134	2022	3	17	15:00	45	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
135	2022	3	17	18:00	315	1
136	2022	3	17	21:00	180	3
137	2022	3	18	0:00	180	3
138	2022	3	18	3:00	180	3
139	2022	3	18	6:00	180	3
140	2022	3	18	9:00	180	2
141	2022	3	18	12:00	315	2
142	2022	3	18	15:00	315	4
143	2022	3	18	18:00	270	1
144	2022	3	18	21:00	180	3
145	2022	3	19	0:00	180	4
146	2022	3	19	3:00	180	3
147	2022	3	19	6:00	180	4
148	2022	3	19	9:00	180	2
149	2022	3	19	12:00	90	2
150	2022	3	19	15:00	315	4
151	2022	3	19	18:00	225	1
152	2022	3	19	21:00	180	3
153	2022	3	20	0:00	180	4
154	2022	3	20	3:00	157.5	4
155	2022	3	20	6:00	157.5	4
156	2022	3	20	9:00	157.5	3
157	2022	3	20	12:00	225	1
158	2022	3	20	15:00	315	4
159	2022	3	20	18:00	315	2
160	2022	3	20	21:00	180	2
161	2022	3	21	0:00	180	4
162	2022	3	21	3:00	180	4
163	2022	3	21	6:00	180	4
164	2022	3	21	9:00	180	3
165	2022	3	21	12:00	157.5	1
166	2022	3	21	15:00	360	4
167	2022	3	21	18:00	360	1
168	2022	3	21	21:00	315	2
169	2022	3	22	0:00	157.5	3
170	2022	3	22	3:00	157.5	3
171	2022	3	22	6:00	157.5	3
172	2022	3	22	9:00	157.5	2
173	2022	3	22	12:00	360	1
174	2022	3	22	15:00	360	3
175	2022	3	22	18:00	315	2
176	2022	3	22	21:00	180	2
177	2022	3	23	0:00	180	3
178	2022	3	23	3:00	180	3
179	2022	3	23	6:00	180	3
180	2022	3	23	9:00	157.5	3
181	2022	3	23	12:00	360	2
182	2022	3	23	15:00	360	4
183	2022	3	23	18:00	315	1
184	2022	3	23	21:00	180	2

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
185	2022	3	24	0:00	180	3
186	2022	3	24	3:00	180	3
187	2022	3	24	6:00	180	3
188	2022	3	24	9:00	157.5	3
189	2022	3	24	12:00	360	2
190	2022	3	24	15:00	360	4
191	2022	3	24	18:00	315	1
192	2022	3	24	21:00	180	2
193	2022	3	28	0:00	180	3
194	2022	3	28	3:00	180	3
195	2022	3	28	6:00	180	3
196	2022	3	28	9:00	135	2
197	2022	3	28	12:00	45	2
198	2022	3	28	15:00	45	3
199	2022	3	28	18:00	45	1
200	2022	3	28	21:00	157.5	2
201	2022	3	26	0:00	157.5	3
202	2022	3	26	3:00	157.5	4
203	2022	3	26	6:00	157.5	4
204	2022	3	26	9:00	135	3
205	2022	3	26	12:00	45	2
206	2022	3	26	15:00	22.5	3
207	2022	3	26	18:00	315	1
208	2022	3	26	21:00	180	2
209	2022	3	27	0:00	180	3
210	2022	3	27	3:00	180	4
211	2022	3	27	6:00	180	3
212	2022	3	27	9:00	180	1
213	2022	3	27	12:00	360	2
214	2022	3	27	15:00	360	0
215	2022	3	27	18:00	90	3
216	2022	3	27	21:00	360	3

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
217	2022	3	28	0:00	180	3
218	2022	3	28	3:00	180	4
219	2022	3	28	6:00	180	3
220	2022	3	28	9:00	180	2
221	2022	3	28	12:00	315	2
222	2022	3	28	15:00	315	4
223	2022	3	28	18:00	270	2
224	2022	3	28	21:00	180	2
225	2022	3	29	0:00	180	3
226	2022	3	29	3:00	180	3
227	2022	3	29	6:00	180	3
228	2022	3	29	9:00	180	2
229	2022	3	29	12:00	315	4
230	2022	3	29	15:00	315	5
231	2022	3	29	18:00	337.5	1
232	2022	3	29	21:00	180	3
233	2022	3	30	0:00	180	3
234	2022	3	30	3:00	180	3
235	2022	3	30	6:00	180	4
236	2022	3	30	9:00	180	2
237	2022	3	30	12:00	315	4
238	2022	3	30	15:00	315	6
239	2022	3	30	18:00	45	1
240	2022	3	30	21:00	157.5	2
241	2022	3	31	0:00	157.5	3
242	2022	3	31	3:00	157.5	3
243	2022	3	31	6:00	157.5	3
244	2022	3	31	9:00	135	2
245	2022	3	31	12:00	315	1
246	2022	3	31	15:00	315	4
247	2022	3	31	18:00	315	1
248	2022	3	31	21:00	180	2

YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Table 16: Frequency Distribution (Period 01/03/2022 to 31/03/2022)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0.4	4.03	3.63	0	0	0	0	8.06
2	NNE	0	0.81	0.4	0	0	0	0	1.21
3	NE	0	4.44	0.4	0	0	0	0	4.84
4	ENE	0	0	0	0	0	0	0	0
5	East	0.4	2.42	0.81	0	0	0	0	3.63
6	ESE	0	0	0.81	0	0	0	0	0.81
7	SE	0.4	8.87	4.44	0.4	0	0	0	14.11
8	SSE	0.4	5.24	15.73	0	0	0	0	21.37
9	South	0	9.68	21.77	0	0	0	0	31.45
10	SSW	0	1.21	0	0	0	0	0	1.21
11	SW	0.4	1.21	0	0	0	0	0	1.61

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S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
12	WSW	0	0	0	0	0	0	0	0
13	West	0.4	0.81	0	0	0	0	0	1.21
14	WNW	0	0	0	0	0	0	0	0
15	NW	0.4	6.05	2.82	0.81	0	0	0	10.08
16	NNW	0	0.4	0	0	0	0	0	0.4
Total		2.8	45.17	50.81	1.21	0	0	0	100

Table 17: Wind Rose data April 2022

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2022	4	1	0:00	157.5	3
2	2022	4	1	3:00	157.5	4
3	2022	4	1	6:00	157.5	4
4	2022	4	1	9:00	135	2
5	2022	4	1	12:00	22.5	2
6	2022	4	1	15:00	22.5	3
7	2022	4	1	18:00	315	2
8	2022	4	1	21:00	180	2
9	2022	4	2	0:00	180	3
10	2022	4	2	3:00	180	3
11	2022	4	2	6:00	180	3
12	2022	4	2	9:00	180	1
13	2022	4	2	12:00	337.5	3
14	2022	4	2	15:00	337.5	4
15	2022	4	2	18:00	315	1
16	2022	4	2	21:00	180	3
17	2022	4	3	0:00	180	4
18	2022	4	3	3:00	180	4
19	2022	4	3	6:00	180	4
20	2022	4	3	9:00	180	2
21	2022	4	3	12:00	292.5	7
22	2022	4	3	15:00	292.5	6
23	2022	4	3	18:00	315	1
24	2022	4	3	21:00	180	2
25	2022	4	4	0:00	157.5	3
26	2022	4	4	3:00	157.5	3
27	2022	4	4	6:00	157.5	4
28	2022	4	4	9:00	135	2
29	2022	4	4	12:00	360	4
30	2022	4	4	15:00	337.5	2
31	2022	4	4	18:00	315	2
32	2022	4	4	21:00	180	2
33	2022	4	8	0:00	180	3
34	2022	4	8	3:00	180	4
35	2022	4	8	6:00	157.5	4
36	2022	4	8	9:00	157.5	2
37	2022	4	8	12:00	360	2
38	2022	4	8	15:00	337.5	4
39	2022	4	8	18:00	337.5	1
40	2022	4	8	21:00	157.5	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
41	2022	4	6	0:00	180	3
42	2022	4	6	3:00	180	3
43	2022	4	6	6:00	180	3
44	2022	4	6	9:00	135	1
45	2022	4	6	12:00	45	3
46	2022	4	6	15:00	45	4
47	2022	4	6	18:00	315	2
48	2022	4	6	21:00	180	2
49	2022	4	7	0:00	180	3
50	2022	4	7	3:00	180	3
51	2022	4	7	6:00	180	3
52	2022	4	7	9:00	135	2
53	2022	4	7	12:00	45	3
54	2022	4	7	15:00	360	3
55	2022	4	7	18:00	45	1
56	2022	4	7	21:00	180	3
57	2022	4	8	0:00	180	3
58	2022	4	8	3:00	180	3
59	2022	4	8	6:00	180	3
60	2022	4	8	9:00	157.5	2
61	2022	4	8	12:00	360	2
62	2022	4	8	15:00	360	5
63	2022	4	8	18:00	315	2
64	2022	4	8	21:00	180	3
65	2022	4	9	0:00	180	4
66	2022	4	9	3:00	180	4
67	2022	4	9	6:00	180	3
68	2022	4	9	9:00	157.5	1
69	2022	4	9	12:00	360	3
70	2022	4	9	15:00	360	3
71	2022	4	9	18:00	337.5	1
72	2022	4	9	21:00	180	3
73	2022	4	10	0:00	180	4
74	2022	4	10	3:00	180	4
75	2022	4	10	6:00	180	4
76	2022	4	10	9:00	157.5	2
77	2022	4	10	12:00	45	2
78	2022	4	10	15:00	22.5	3
79	2022	4	10	18:00	315	2
80	2022	4	10	21:00	180	2

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
81	2022	4	11	0:00	180	3
82	2022	4	11	3:00	180	4
83	2022	4	11	6:00	180	4
84	2022	4	11	9:00	157.5	2
85	2022	4	11	12:00	360	2
86	2022	4	11	15:00	360	3
87	2022	4	11	18:00	315	1
88	2022	4	11	21:00	202.5	2
89	2022	4	12	0:00	180	4
90	2022	4	12	3:00	180	3
91	2022	4	12	6:00	180	3
92	2022	4	12	9:00	157.5	1
93	2022	4	12	12:00	360	1
94	2022	4	12	15:00	360	3
95	2022	4	12	18:00	180	1
96	2022	4	12	21:00	180	4
97	2022	4	13	0:00	157.5	4
98	2022	4	13	3:00	157.5	4
99	2022	4	13	6:00	157.5	3
100	2022	4	13	9:00	135	3
101	2022	4	13	12:00	45	2
102	2022	4	13	15:00	22.5	2
103	2022	4	13	18:00	135	5
104	2022	4	13	21:00	135	4
105	2022	4	14	0:00	180	4
106	2022	4	14	3:00	180	4
107	2022	4	14	6:00	180	4
108	2022	4	14	9:00	157.5	2
109	2022	4	14	12:00	22.5	2
110	2022	4	14	15:00	22.5	4
111	2022	4	14	18:00	180	2
112	2022	4	14	21:00	180	4
113	2022	4	18	0:00	180	4
114	2022	4	18	3:00	180	4
115	2022	4	18	6:00	180	4
116	2022	4	18	9:00	157.5	2
117	2022	4	18	12:00	22.5	2
118	2022	4	18	15:00	45	2
119	2022	4	18	18:00	157.5	3
120	2022	4	18	21:00	157.5	3
121	2022	4	16	0:00	180	4
122	2022	4	16	3:00	180	4
123	2022	4	16	6:00	180	4
124	2022	4	16	9:00	157.5	2
125	2022	4	16	12:00	360	2
126	2022	4	16	15:00	45	4
127	2022	4	16	18:00	157.5	4
128	2022	4	16	21:00	157.5	4
129	2022	4	17	0:00	180	3
130	2022	4	17	3:00	180	3

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
131	2022	4	17	6:00	180	3
132	2022	4	17	9:00	135	1
133	2022	4	17	12:00	22.5	2
134	2022	4	17	15:00	360	3
135	2022	4	17	18:00	337.5	1
136	2022	4	17	21:00	180	2
137	2022	4	18	0:00	180	4
138	2022	4	18	3:00	180	3
139	2022	4	18	6:00	180	4
140	2022	4	18	9:00	180	2
141	2022	4	18	12:00	22.5	3
142	2022	4	18	15:00	360	2
143	2022	4	18	18:00	90	0
144	2022	4	18	21:00	180	3
145	2022	4	19	0:00	180	4
146	2022	4	19	3:00	202.5	1
147	2022	4	19	6:00	157.5	3
148	2022	4	19	9:00	157.5	4
149	2022	4	19	12:00	157.5	4
150	2022	4	19	15:00	90	5
151	2022	4	19	18:00	157.5	5
152	2022	4	19	21:00	157.5	3
153	2022	4	20	0:00	157.5	5
154	2022	4	20	3:00	157.5	5
155	2022	4	20	6:00	157.5	5
156	2022	4	20	9:00	135	3
157	2022	4	20	12:00	225	2
158	2022	4	20	15:00	292.5	6
159	2022	4	20	18:00	315	2
160	2022	4	20	21:00	157.5	4
161	2022	4	21	0:00	180	4
162	2022	4	21	3:00	180	5
163	2022	4	21	6:00	180	5
164	2022	4	21	9:00	135	4
165	2022	4	21	12:00	202.5	3
166	2022	4	21	15:00	90	2
167	2022	4	21	18:00	135	5
168	2022	4	21	21:00	135	5
169	2022	4	22	0:00	180	4
170	2022	4	22	3:00	180	4
171	2022	4	22	6:00	180	4
172	2022	4	22	9:00	135	2
173	2022	4	22	12:00	45	2
174	2022	4	22	15:00	135	6
175	2022	4	22	18:00	135	4
176	2022	4	22	21:00	135	3
177	2022	4	23	0:00	157.5	3
178	2022	4	23	3:00	157.5	4
179	2022	4	23	6:00	157.5	4
180	2022	4	23	9:00	135	2

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
181	2022	4	23	12:00	360	4
182	2022	4	23	15:00	360	4
183	2022	4	23	18:00	202.5	1
184	2022	4	23	21:00	157.5	4
185	2022	4	24	0:00	157.5	4
186	2022	4	24	3:00	157.5	4
187	2022	4	24	6:00	157.5	4
188	2022	4	24	9:00	135	3
189	2022	4	24	12:00	45	1
190	2022	4	24	15:00	22.5	3
191	2022	4	24	18:00	315	2
192	2022	4	24	21:00	157.5	2
193	2022	4	28	0:00	135	2
194	2022	4	28	3:00	157.5	4
195	2022	4	28	6:00	157.5	3
196	2022	4	28	9:00	135	2
197	2022	4	28	12:00	45	3
198	2022	4	28	15:00	180	5
199	2022	4	28	18:00	135	4
200	2022	4	28	21:00	157.5	4
201	2022	4	26	0:00	157.5	4
202	2022	4	26	3:00	157.5	4
203	2022	4	26	6:00	157.5	4
204	2022	4	26	9:00	135	2
205	2022	4	26	12:00	45	1
206	2022	4	26	15:00	45	2
207	2022	4	26	18:00	67.5	2
208	2022	4	26	21:00	135	3
209	2022	4	27	0:00	157.5	3
210	2022	4	27	3:00	157.5	4

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
211	2022	4	27	6:00	157.5	4
212	2022	4	27	9:00	135	1
213	2022	4	27	12:00	45	2
214	2022	4	27	15:00	45	3
215	2022	4	27	18:00	360	1
216	2022	4	27	21:00	180	2
217	2022	4	28	0:00	180	3
218	2022	4	28	3:00	180	4
219	2022	4	28	6:00	180	4
220	2022	4	28	9:00	135	2
221	2022	4	28	12:00	45	2
222	2022	4	28	15:00	360	3
223	2022	4	28	18:00	315	2
224	2022	4	28	21:00	157.5	5
225	2022	4	29	0:00	157.5	4
226	2022	4	29	3:00	157.5	5
227	2022	4	29	6:00	180	4
228	2022	4	29	9:00	157.5	2
229	2022	4	29	12:00	22.5	1
230	2022	4	29	15:00	360	4
231	2022	4	29	18:00	180	2
232	2022	4	29	21:00	157.5	5
233	2022	4	30	0:00	157.5	5
234	2022	4	30	3:00	157.5	5
235	2022	4	30	6:00	180	4
236	2022	4	30	9:00	135	2
237	2022	4	30	12:00	360	3
238	2022	4	30	15:00	45	3
239	2022	4	30	18:00	157.5	5
240	2022	4	30	21:00	157.5	5

YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Table 18: Frequency Distribution (Period 01/04/2022 to 30/04/2022)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0	2.92	5	0.42	0	0	0	8.34
2	NNE	0	2.5	2.08	0	0	0	0	4.58
3	NE	0	4.17	2.92	0	0	0	0	7.09
4	ENE	0	0.42	0	0	0	0	0	0.42
5	East	0.42	0.42	0	0.42	0	0	0	1.26
6	ESE	0	0	0	0	0	0	0	0
7	SE	0	5.42	3.75	1.67	0	0	0	10.84
8	SSE	0	5	15	4.58	0	0	0	24.58
9	South	0	5.42	25.42	1.25	0	0	0	32.09
10	SSW	0	1.25	0.42	0	0	0	0	1.67
11	SW	0	0.42	0	0	0	0	0	0.42
12	WSW	0	0	0	0	0	0	0	0
13	West	0	0	0	0	0	0	0	0

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S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
14	WNW	0	0	0	0.83	0.42	0	0	1.25
15	NW	0	4.58	0	0	0	0	0	4.58
16	NNW	0	1.67	1.25	0	0	0	0	2.92
Total		0.42	34.19	55.84	9.17	0.42	0	0	100

Table 19: Wind Rose data May 2022

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2022	5	1	0:00	157.5	4
2	2022	5	1	3:00	157.5	4
3	2022	5	1	6:00	180	4
4	2022	5	1	9:00	157.5	2
5	2022	5	1	12:00	45	2
6	2022	5	1	15:00	22.5	4
7	2022	5	1	18:00	135	3
8	2022	5	1	21:00	157.5	4
9	2022	5	2	0:00	180	3
10	2022	5	2	3:00	180	4
11	2022	5	2	6:00	180	4
12	2022	5	2	9:00	315	1
13	2022	5	2	12:00	337.5	3
14	2022	5	2	15:00	360	3
15	2022	5	2	18:00	360	1
16	2022	5	2	21:00	180	4
17	2022	5	3	0:00	180	4
18	2022	5	3	3:00	180	3
19	2022	5	3	6:00	157.5	3
20	2022	5	3	9:00	202.5	1
21	2022	5	3	12:00	292.5	4
22	2022	5	3	15:00	270	5
23	2022	5	3	18:00	180	4
24	2022	5	3	21:00	135	7
25	2022	5	4	0:00	157.5	5
26	2022	5	4	3:00	157.5	5
27	2022	5	4	6:00	157.5	4
28	2022	5	4	9:00	135	5
29	2022	5	4	12:00	180	5
30	2022	5	4	15:00	135	7
31	2022	5	4	18:00	157.5	3
32	2022	5	4	21:00	157.5	3
33	2022	5	8	0:00	157.5	3
34	2022	5	8	3:00	157.5	3
35	2022	5	8	6:00	157.5	3
36	2022	5	8	9:00	135	1
37	2022	5	8	12:00	22.5	2
38	2022	5	8	15:00	135	2
39	2022	5	8	18:00	135	1
40	2022	5	8	21:00	180	4
41	2022	5	6	0:00	180	2

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
42	2022	5	6	3:00	180	3
43	2022	5	6	6:00	180	3
44	2022	5	6	9:00	135	1
45	2022	5	6	12:00	45	3
46	2022	5	6	15:00	225	2
47	2022	5	6	18:00	157.5	4
48	2022	5	6	21:00	157.5	5
49	2022	5	7	0:00	180	4
50	2022	5	7	3:00	180	4
51	2022	5	7	6:00	18	4
52	2022	5	7	9:00	135	2
53	2022	5	7	12:00	45	1
54	2022	5	7	15:00	45	3
55	2022	5	7	18:00	112.5	3
56	2022	5	7	21:00	135	3
57	2022	5	8	0:00	157.5	4
58	2022	5	8	3:00	157.5	4
59	2022	5	8	6:00	157.5	3
60	2022	5	8	9:00	135	1
61	2022	5	8	12:00	45	2
62	2022	5	8	15:00	22.5	4
63	2022	5	8	18:00	22.5	1
64	2022	5	8	21:00	157.5	3
65	2022	5	9	0:00	180	3
66	2022	5	9	3:00	180	3
67	2022	5	9	6:00	180	3
68	2022	5	9	9:00	90	0
69	2022	5	9	12:00	360	3
70	2022	5	9	15:00	337.5	6
71	2022	5	9	18:00	315	2
72	2022	5	9	21:00	180	4
73	2022	5	10	0:00	180	4
74	2022	5	10	3:00	180	4
75	2022	5	10	6:00	180	4
76	2022	5	10	9:00	157.5	2
77	2022	5	10	12:00	22.5	4
78	2022	5	10	15:00	337.5	5
79	2022	5	10	18:00	337.5	4
80	2022	5	10	21:00	180	2
81	2022	5	11	0:00	180	4
82	2022	5	11	3:00	180	4

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
83	2022	5	11	6:00	180	4
84	2022	5	11	9:00	180	1
85	2022	5	11	12:00	45	4
86	2022	5	11	15:00	360	5
87	2022	5	11	18:00	337.5	4
88	2022	5	11	21:00	202.5	2
89	2022	5	12	0:00	180	4
90	2022	5	12	3:00	180	4
91	2022	5	12	6:00	180	4
92	2022	5	12	9:00	157.5	2
93	2022	5	12	12:00	22.5	3
94	2022	5	12	15:00	337.5	5
95	2022	5	12	18:00	22.5	2
96	2022	5	12	21:00	180	3
97	2022	5	13	0:00	157.5	4
98	2022	5	13	3:00	157.5	4
99	2022	5	13	6:00	157.5	3
100	2022	5	13	9:00	135	1
101	2022	5	13	12:00	360	4
102	2022	5	13	15:00	337.5	6
103	2022	5	13	18:00	315	4
104	2022	5	13	21:00	225	2
105	2022	5	14	0:00	180	3
106	2022	5	14	3:00	180	3
107	2022	5	14	6:00	180	3
108	2022	5	14	9:00	135	1
109	2022	5	14	12:00	360	4
110	2022	5	14	15:00	337.5	7
111	2022	5	14	18:00	315	3
112	2022	5	14	21:00	202.5	2
113	2022	5	18	0:00	180	4
114	2022	5	18	3:00	180	4
115	2022	5	18	6:00	180	4
116	2022	5	18	9:00	180	2
117	2022	5	18	12:00	360	4
118	2022	5	18	15:00	337.5	5
119	2022	5	18	18:00	337.5	2
120	2022	5	18	21:00	157.5	4
121	2022	5	16	0:00	157.5	4
122	2022	5	16	3:00	157.5	3
123	2022	5	16	6:00	157.5	3
124	2022	5	16	9:00	135	2
125	2022	5	16	12:00	315	7
126	2022	5	16	15:00	270	2
127	2022	5	16	18:00	360	2
128	2022	5	16	21:00	135	3
129	2022	5	17	0:00	157.5	4
130	2022	5	17	3:00	157.5	4
131	2022	5	17	6:00	157.5	4
132	2022	5	17	9:00	180	1

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
133	2022	5	17	12:00	337.5	5
134	2022	5	17	15:00	270	2
135	2022	5	17	18:00	90	2
136	2022	5	17	21:00	157.5	4
137	2022	5	18	0:00	157.5	4
138	2022	5	18	3:00	157.5	4
139	2022	5	18	6:00	157.5	4
140	2022	5	18	9:00	157.5	1
141	2022	5	18	12:00	360	3
142	2022	5	18	15:00	337.5	6
143	2022	5	18	18:00	337.5	4
144	2022	5	18	21:00	202.5	2
145	2022	5	19	0:00	157.5	4
146	2022	5	19	3:00	157.5	4
147	2022	5	19	6:00	157.5	4
148	2022	5	19	9:00	157.5	2
149	2022	5	19	12:00	337.5	3
150	2022	5	19	15:00	315	5
151	2022	5	19	18:00	135	2
152	2022	5	19	21:00	157.5	5
153	2022	5	20	0:00	157.5	5
154	2022	5	20	3:00	135	5
155	2022	5	20	6:00	135	5
156	2022	5	20	9:00	157.5	3
157	2022	5	20	12:00	225	6
158	2022	5	20	15:00	270	9
159	2022	5	20	18:00	225	3
160	2022	5	20	21:00	180	4
161	2022	5	21	0:00	157.5	4
162	2022	5	21	3:00	157.5	5
163	2022	5	21	6:00	157.5	5
164	2022	5	21	9:00	135	4
165	2022	5	21	12:00	90	2
166	2022	5	21	15:00	135	6
167	2022	5	21	18:00	135	5
168	2022	5	21	21:00	157.5	4
169	2022	5	22	0:00	360	3
170	2022	5	22	3:00	157.5	2
171	2022	5	22	6:00	157.5	2
172	2022	5	22	9:00	315	1
173	2022	5	22	12:00	315	6
174	2022	5	22	15:00	315	6
175	2022	5	22	18:00	180	3
176	2022	5	22	21:00	135	7
177	2022	5	23	0:00	135	5
178	2022	5	23	3:00	135	5
179	2022	5	23	6:00	135	4
180	2022	5	23	9:00	135	3
181	2022	5	23	12:00	135	3
182	2022	5	23	15:00	270	0

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
183	2022	5	23	18:00	135	6
184	2022	5	23	21:00	157.5	4
185	2022	5	24	0:00	225	1
186	2022	5	24	3:00	157.5	3
187	2022	5	24	6:00	180	2
188	2022	5	24	9:00	135	1
189	2022	5	24	12:00	337.5	4
190	2022	5	24	15:00	315	4
191	2022	5	24	18:00	337.5	2
192	2022	5	24	21:00	202.5	1
193	2022	5	28	0:00	157.5	3
194	2022	5	28	3:00	180	3
195	2022	5	28	6:00	180	3
196	2022	5	28	9:00	45	1
197	2022	5	28	12:00	22.5	4
198	2022	5	28	15:00	360	5
199	2022	5	28	18:00	337.5	3
200	2022	5	28	21:00	202.5	1
201	2022	5	26	0:00	180	2
202	2022	5	26	3:00	180	2
203	2022	5	26	6:00	180	2
204	2022	5	26	9:00	337.5	1
205	2022	5	26	12:00	337.5	4
206	2022	5	26	15:00	337.5	4
207	2022	5	26	18:00	45	1
208	2022	5	26	21:00	180	3
209	2022	5	27	0:00	180	3
210	2022	5	27	3:00	180	3
211	2022	5	27	6:00	180	3
212	2022	5	27	9:00	337.5	1
213	2022	5	27	12:00	337.5	4
214	2022	5	27	15:00	337.5	4
215	2022	5	27	18:00	315	3

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
216	2022	5	27	21:00	180	3
217	2022	5	28	0:00	180	4
218	2022	5	28	3:00	157.5	3
219	2022	5	28	6:00	157.5	3
220	2022	5	28	9:00	135	1
221	2022	5	28	12:00	225	1
222	2022	5	28	15:00	337.5	0
223	2022	5	28	18:00	180	4
224	2022	5	28	21:00	157.5	5
225	2022	5	29	0:00	180	4
226	2022	5	29	3:00	157.5	4
227	2022	5	29	6:00	157.5	4
228	2022	5	29	9:00	135	3
229	2022	5	29	12:00	202.5	6
230	2022	5	29	15:00	135	8
231	2022	5	29	18:00	135	6
232	2022	5	29	21:00	135	4
233	2022	5	30	0:00	157.5	4
234	2022	5	30	3:00	157.5	5
235	2022	5	30	6:00	157.5	4
236	2022	5	30	9:00	90	2
237	2022	5	30	12:00	270	1
238	2022	5	30	15:00	135	5
239	2022	5	30	18:00	135	4
240	2022	5	30	21:00	135	4
241	2022	5	31	0:00	135	5
242	2022	5	31	3:00	157.5	4
243	2022	5	31	6:00	157.5	4
244	2022	5	31	9:00	180	1
245	2022	5	31	12:00	135	2
246	2022	5	31	15:00	135	4
247	2022	5	31	18:00	135	3
248	2022	5	31	21:00	135	3

YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Table 20: Frequency Distribution (Period 01/05/2022 to 31/05/2022)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0	0.81	2.82	0.81	0	0	0	4.44
2	NNE	0	1.21	2.42	0	0	0	0	3.63
3	NE	0	2.02	1.21	0	0	0	0	3.23
4	ENE	0	0	0	0	0	0	0	0
5	East	0.4	1.21	0	0	0	0	0	1.61
6	ESE	0	0	0.4	0	0	0	0	0.4
7	SE	0	5.24	5.65	4.44	1.61	0	0	16.94
8	SSE	0	2.82	18.55	3.63	0	0	0	25
9	South	0	4.03	18.15	0.4	0	0	0	22.58
10	SSW	0	2.42	0	0.4	0	0	0	2.82
11	SW	0	1.61	0.4	0.4	0	0	0	2.41
12	WSW	0	0	0	0	0	0	0	0

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S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
13	West	0.4	1.21	0	0.4	0	0.4	0	2.41
14	WNW	0	0	0.4	0	0	0	0	0.4
15	NW	0	1.21	1.61	1.21	0.4	0	0	4.43
16	NNW	0.4	1.61	4.44	2.82	0.4	0	0	9.67
Total		1.2	25.4	56.05	14.51	2.41	0.4	0	100

Table 21: Wind Rose data June 2022

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2022	6	1	0:00	157.5	3
2	2022	6	1	3:00	157.5	4
3	2022	6	1	6:00	157.5	5
4	2022	6	1	9:00	157.5	3
5	2022	6	1	12:00	45	4
6	2022	6	1	15:00	135	5
7	2022	6	1	18:00	135	3
8	2022	6	1	21:00	135	3
9	2022	6	2	0:00	157.5	4
10	2022	6	2	3:00	157.5	4
11	2022	6	2	6:00	157.5	4
12	2022	6	2	9:00	157.5	1
13	2022	6	2	12:00	337.5	3
14	2022	6	2	15:00	315	1
15	2022	6	2	18:00	45	4
16	2022	6	2	21:00	157.5	4
17	2022	6	3	0:00	180	4
18	2022	6	3	3:00	180	4
19	2022	6	3	6:00	157.5	3
20	2022	6	3	9:00	90	1
21	2022	6	3	12:00	360	5
22	2022	6	3	15:00	360	7
23	2022	6	3	18:00	337.5	4
24	2022	6	3	21:00	180	3
25	2022	6	4	0:00	180	3
26	2022	6	4	3:00	180	4
27	2022	6	4	6:00	180	3
28	2022	6	4	9:00	90	1
29	2022	6	4	12:00	360	6
30	2022	6	4	15:00	360	7
31	2022	6	4	18:00	337.5	4
32	2022	6	4	21:00	180	3
33	2022	6	8	0:00	180	4
34	2022	6	8	3:00	180	4
35	2022	6	8	6:00	157.5	3
36	2022	6	8	9:00	337.5	0
37	2022	6	8	12:00	337.5	4
38	2022	6	8	15:00	337.5	7
39	2022	6	8	18:00	337.5	5
40	2022	6	8	21:00	202.5	2
41	2022	6	6	0:00	157.5	4
42	2022	6	6	3:00	180	4

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
43	2022	6	6	6:00	180	3
44	2022	6	6	9:00	22.5	1
45	2022	6	6	12:00	360	5
46	2022	6	6	15:00	337.5	7
47	2022	6	6	18:00	315	5
48	2022	6	6	21:00	202.5	2
49	2022	6	7	0:00	180	3
50	2022	6	7	3:00	180	3
51	2022	6	7	6:00	180	3
52	2022	6	7	9:00	360	1
53	2022	6	7	12:00	360	5
54	2022	6	7	15:00	337.5	7
55	2022	6	7	18:00	360	2
56	2022	6	7	21:00	180	3
57	2022	6	8	0:00	180	3
58	2022	6	8	3:00	157.5	4
59	2022	6	8	6:00	180	2
60	2022	6	8	9:00	45	1
61	2022	6	8	12:00	337.5	6
62	2022	6	8	15:00	360	7
63	2022	6	8	18:00	112.5	3
64	2022	6	8	21:00	157.5	3
65	2022	6	9	0:00	157.5	4
66	2022	6	9	3:00	157.5	4
67	2022	6	9	6:00	157.5	3
68	2022	6	9	9:00	157.5	1
69	2022	6	9	12:00	337.5	5
70	2022	6	9	15:00	360	4
71	2022	6	9	18:00	135	4
72	2022	6	9	21:00	157.5	5
73	2022	6	10	0:00	180	4
74	2022	6	10	3:00	180	4
75	2022	6	10	6:00	180	3
76	2022	6	10	9:00	157.5	0
77	2022	6	10	12:00	337.5	4
78	2022	6	10	15:00	337.5	7
79	2022	6	10	18:00	90	3
80	2022	6	10	21:00	157.5	5
81	2022	6	11	0:00	180	4
82	2022	6	11	3:00	180	4
83	2022	6	11	6:00	180	4
84	2022	6	11	9:00	180	1

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
85	2022	6	11	12:00	360	4
86	2022	6	11	15:00	337.5	7
87	2022	6	11	18:00	360	3
88	2022	6	11	21:00	225	3
89	2022	6	12	0:00	135	5
90	2022	6	12	3:00	135	3
91	2022	6	12	6:00	135	4
92	2022	6	12	9:00	135	2
93	2022	6	12	12:00	337.5	3
94	2022	6	12	15:00	315	4
95	2022	6	12	18:00	180	2
96	2022	6	12	21:00	135	3
97	2022	6	13	0:00	135	5
98	2022	6	13	3:00	157.5	4
99	2022	6	13	6:00	157.5	3
100	2022	6	13	9:00	157.5	1
101	2022	6	13	12:00	337.5	3
102	2022	6	13	15:00	337.5	7
103	2022	6	13	18:00	337.5	6
104	2022	6	13	21:00	180	3
105	2022	6	14	0:00	180	4
106	2022	6	14	3:00	180	4
107	2022	6	14	6:00	180	3
108	2022	6	14	9:00	45	0
109	2022	6	14	12:00	337.5	6
110	2022	6	14	15:00	315	6
111	2022	6	14	18:00	135	3
112	2022	6	14	21:00	157.5	4
113	2022	6	18	0:00	180	4
114	2022	6	18	3:00	180	4
115	2022	6	18	6:00	180	3
116	2022	6	18	9:00	337.5	1
117	2022	6	18	12:00	337.5	5
118	2022	6	18	15:00	315	6
119	2022	6	18	18:00	135	5
120	2022	6	18	21:00	157.5	5
121	2022	6	16	0:00	180	4
122	2022	6	16	3:00	157.5	4
123	2022	6	16	6:00	157.5	3
124	2022	6	16	9:00	157.5	2
125	2022	6	16	12:00	337.5	4
126	2022	6	16	15:00	315	7
127	2022	6	16	18:00	292.5	4
128	2022	6	16	21:00	180	4
129	2022	6	17	0:00	180	4
130	2022	6	17	3:00	180	3
131	2022	6	17	6:00	202.5	2
132	2022	6	17	9:00	45	1
133	2022	6	17	12:00	315	5
134	2022	6	17	15:00	315	5

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
135	2022	6	17	18:00	315	3
136	2022	6	17	21:00	292.5	2
137	2022	6	18	0:00	180	1
138	2022	6	18	3:00	270	1
139	2022	6	18	6:00	180	0
140	2022	6	18	9:00	270	1
141	2022	6	18	12:00	157.5	1
142	2022	6	18	15:00	180	1
143	2022	6	18	18:00	225	1
144	2022	6	18	21:00	157.5	3
145	2022	6	19	0:00	135	3
146	2022	6	19	3:00	180	3
147	2022	6	19	6:00	157.5	2
148	2022	6	19	9:00	135	1
149	2022	6	19	12:00	22.5	0
150	2022	6	19	15:00	135	2
151	2022	6	19	18:00	90	2
152	2022	6	19	21:00	157.5	2
153	2022	6	20	0:00	180	0
154	2022	6	20	3:00	202.5	2
155	2022	6	20	6:00	135	3
156	2022	6	20	9:00	135	1
157	2022	6	20	12:00	135	3
158	2022	6	20	15:00	135	4
159	2022	6	20	18:00	135	3
160	2022	6	20	21:00	180	3
161	2022	6	21	0:00	180	3
162	2022	6	21	3:00	157.5	3
163	2022	6	21	6:00	180	2
164	2022	6	21	9:00	337.5	3
165	2022	6	21	12:00	157.5	3
166	2022	6	21	15:00	90	3
167	2022	6	21	18:00	180	4
168	2022	6	21	21:00	157.5	4
169	2022	6	22	0:00	202.5	2
170	2022	6	22	3:00	157.5	4
171	2022	6	22	6:00	180	3
172	2022	6	22	9:00	135	3
173	2022	6	22	12:00	135	3
174	2022	6	22	15:00	135	2
175	2022	6	22	18:00	45	1
176	2022	6	22	21:00	135	2
177	2022	6	23	0:00	225	2
178	2022	6	23	3:00	157.5	4
179	2022	6	23	6:00	157.5	3
180	2022	6	23	9:00	135	3
181	2022	6	23	12:00	135	3
182	2022	6	23	15:00	135	2
183	2022	6	23	18:00	45	1
184	2022	6	23	21:00	135	2

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
185	2022	6	24	0:00	157.5	3
186	2022	6	24	3:00	157.5	3
187	2022	6	24	6:00	157.5	3
188	2022	6	24	9:00	135	1
189	2022	6	24	12:00	45	2
190	2022	6	24	15:00	360	2
191	2022	6	24	18:00	337.5	2
192	2022	6	24	21:00	180	2
193	2022	6	28	0:00	157.5	3
194	2022	6	28	3:00	180	3
195	2022	6	28	6:00	180	3
196	2022	6	28	9:00	180	1
197	2022	6	28	12:00	360	3
198	2022	6	28	15:00	360	4
199	2022	6	28	18:00	360	2
200	2022	6	28	21:00	202.5	2
201	2022	6	26	0:00	180	3
202	2022	6	26	3:00	180	3
203	2022	6	26	6:00	180	3
204	2022	6	26	9:00	112.5	1
205	2022	6	26	12:00	360	3
206	2022	6	26	15:00	360	4
207	2022	6	26	18:00	337.5	2
208	2022	6	26	21:00	225	2
209	2022	6	27	0:00	202.5	2
210	2022	6	27	3:00	180	3
211	2022	6	27	6:00	180	3
212	2022	6	27	9:00	45	1

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
213	2022	6	27	12:00	360	4
214	2022	6	27	15:00	360	5
215	2022	6	27	18:00	337.5	3
216	2022	6	27	21:00	225	2
217	2022	6	28	0:00	180	2
218	2022	6	28	3:00	180	3
219	2022	6	28	6:00	180	3
220	2022	6	28	9:00	360	1
221	2022	6	28	12:00	337.5	4
222	2022	6	28	15:00	337.5	5
223	2022	6	28	18:00	315	2
224	2022	6	28	21:00	225	2
225	2022	6	29	0:00	180	2
226	2022	6	29	3:00	180	3
227	2022	6	29	6:00	180	3
228	2022	6	29	9:00	315	0
229	2022	6	29	12:00	337.5	4
230	2022	6	29	15:00	337.5	4
231	2022	6	29	18:00	315	2
232	2022	6	29	21:00	225	2
233	2022	6	30	0:00	180	2
234	2022	6	30	3:00	180	3
235	2022	6	30	6:00	180	3
236	2022	6	30	9:00	315	0
237	2022	6	30	12:00	337.5	4
238	2022	6	30	15:00	337.5	4
239	2022	6	30	18:00	315	2
240	2022	6	30	21:00	225	2

YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Table 22: Frequency Distribution (Period 01/06/2022 to 30/06/2022)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0	2.08	3.33	2.08	1.25	0	0	8.74
2	NNE	0.42	0.42	0	0	0	0	0	0.84
3	NE	0.42	2.5	0.83	0	0	0	0	3.75
4	ENE	0	0	0	0	0	0	0	0
5	East	0	1.25	0.83	0	0	0	0	2.08
6	ESE	0	0.42	0.42	0	0	0	0	0.84
7	SE	0	3.75	6.67	1.67	0	0	0	12.09
8	SSE	0.42	2.92	12.92	1.67	0	0	0	17.93
9	South	0.83	4.58	21.25	0	0	0	0	26.66
10	SSW	0	2.92	0	0	0	0	0	2.92
11	SW	0	2.92	0.42	0	0	0	0	3.34
12	WSW	0	0	0	0	0	0	0	0
13	West	0	0.83	0	0	0	0	0	0.83
14	WNW	0	0.42	0.42	0	0	0	0	0.84

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S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
15	NW	0.83	1.67	0.83	2.08	0.42	0	0	5.83
16	NNW	0.42	1.25	6.25	2.92	2.5	0	0	13.34
Total		3.34	27.93	54.17	10.42	4.17	0	0	100

Table 23: Wind Rose data July 2022

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
1	2022	7	1	0:00	225	2
2	2022	7	1	3:00	225	2
3	2022	7	1	6:00	270	1
4	2022	7	1	9:00	315	3
5	2022	7	1	12:00	315	4
6	2022	7	1	15:00	315	2
7	2022	7	1	18:00	337.5	1
8	2022	7	1	21:00	225	1
9	2022	7	2	0:00	247.5	1
10	2022	7	2	3:00	247.5	1
11	2022	7	2	6:00	270	1
12	2022	7	2	9:00	292.5	2
13	2022	7	2	12:00	315	3
14	2022	7	2	15:00	315	3
15	2022	7	2	18:00	315	1
16	2022	7	2	21:00	225	1
17	2022	7	3	0:00	202.5	2
18	2022	7	3	3:00	225	1
19	2022	7	3	6:00	180	1
20	2022	7	3	9:00	315	2
21	2022	7	3	12:00	315	3
22	2022	7	3	15:00	315	2
23	2022	7	3	18:00	247.5	1
24	2022	7	3	21:00	225	2
25	2022	7	4	0:00	202.5	2
26	2022	7	4	3:00	202.5	1
27	2022	7	4	6:00	202.5	1
28	2022	7	4	9:00	270	1
29	2022	7	4	12:00	315	3
30	2022	7	4	15:00	315	3
31	2022	7	4	18:00	245.5	1
32	2022	7	4	21:00	202.5	2
33	2022	7	8	0:00	202.5	2
34	2022	7	8	3:00	270	1
35	2022	7	8	6:00	270	1
36	2022	7	8	9:00	202.5	1
37	2022	7	8	12:00	90	0
38	2022	7	8	15:00	337.5	1
39	2022	7	8	18:00	360	2
40	2022	7	8	21:00	202.5	1
41	2022	7	6	0:00	180	2
42	2022	7	6	3:00	180	3
43	2022	7	6	6:00	157.5	1

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
44	2022	7	6	9:00	135	1
45	2022	7	6	12:00	315	2
46	2022	7	6	15:00	292.5	3
47	2022	7	6	18:00	202.5	3
48	2022	7	6	21:00	360	1
49	2022	7	7	0:00	157.5	2
50	2022	7	7	3:00	225	2
51	2022	7	7	6:00	202.5	1
52	2022	7	7	9:00	315	2
53	2022	7	7	12:00	315	2
54	2022	7	7	15:00	315	1
55	2022	7	7	18:00	135	1
56	2022	7	7	21:00	157.5	2
57	2022	7	8	0:00	180	1
58	2022	7	8	3:00	180	2
59	2022	7	8	6:00	225	2
60	2022	7	8	9:00	315	0
61	2022	7	8	12:00	315	3
62	2022	7	8	15:00	315	3
63	2022	7	8	18:00	315	1
64	2022	7	8	21:00	180	1
65	2022	7	9	0:00	202.5	2
66	2022	7	9	3:00	180	2
67	2022	7	9	6:00	180	2
68	2022	7	9	9:00	315	2
69	2022	7	9	12:00	315	3
70	2022	7	9	15:00	315	2
71	2022	7	9	18:00	202.5	2
72	2022	7	9	21:00	180	2
73	2022	7	10	0:00	202.5	2
74	2022	7	10	3:00	202.5	2
75	2022	7	10	6:00	202.5	1
76	2022	7	10	9:00	315	1
77	2022	7	10	12:00	315	3
78	2022	7	10	15:00	315	3
79	2022	7	10	18:00	315	1
80	2022	7	10	21:00	225	1
81	2022	7	11	0:00	202.5	2
82	2022	7	11	3:00	180	2
83	2022	7	11	6:00	225	1
84	2022	7	11	9:00	225	1
85	2022	7	11	12:00	337.5	3
86	2022	7	11	15:00	315	3

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S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
87	2022	7	11	18:00	315	2
88	2022	7	11	21:00	202.5	1
89	2022	7	12	0:00	180	2
90	2022	7	12	3:00	180	2
91	2022	7	12	6:00	180	2
92	2022	7	12	9:00	315	1
93	2022	7	12	12:00	315	3
94	2022	7	12	15:00	315	3
95	2022	7	12	18:00	315	1
96	2022	7	12	21:00	180	1
97	2022	7	13	0:00	180	2
98	2022	7	13	3:00	202.5	2
99	2022	7	13	6:00	180	2
100	2022	7	13	9:00	292.5	2
101	2022	7	13	12:00	315	3
102	2022	7	13	15:00	315	3
103	2022	7	13	18:00	315	2
104	2022	7	13	21:00	225	2
105	2022	7	14	0:00	225	2
106	2022	7	14	3:00	135	2
107	2022	7	14	6:00	180	1
108	2022	7	14	9:00	135	1
109	2022	7	14	12:00	270	0
110	2022	7	14	15:00	337.5	3
111	2022	7	14	18:00	360	1
112	2022	7	14	21:00	225	1
113	2022	7	18	0:00	225	1
114	2022	7	18	3:00	180	2
115	2022	7	18	6:00	180	2
116	2022	7	18	9:00	360	1
117	2022	7	18	12:00	337.5	3
118	2022	7	18	15:00	315	3
119	2022	7	18	18:00	270	1
120	2022	7	18	21:00	157.5	2
121	2022	7	16	0:00	135	2
122	2022	7	16	3:00	157.5	2
123	2022	7	16	6:00	157.5	2
124	2022	7	16	9:00	180	1
125	2022	7	16	12:00	225	1
126	2022	7	16	15:00	315	1
127	2022	7	16	18:00	225	1
128	2022	7	16	21:00	180	2
129	2022	7	17	0:00	202.5	2
130	2022	7	17	3:00	180	2
131	2022	7	17	6:00	180	2
132	2022	7	17	9:00	45	1
133	2022	7	17	12:00	337.5	3
134	2022	7	17	15:00	315	3
135	2022	7	17	18:00	292.5	2
136	2022	7	17	21:00	225	1

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
137	2022	7	18	0:00	180	2
138	2022	7	18	3:00	180	2
139	2022	7	18	6:00	180	2
140	2022	7	18	9:00	315	1
141	2022	7	18	12:00	337.5	3
142	2022	7	18	15:00	337.5	3
143	2022	7	18	18:00	360	1
144	2022	7	18	21:00	202.5	2
145	2022	7	19	0:00	202.5	2
146	2022	7	19	3:00	205.5	2
147	2022	7	19	6:00	202.5	1
148	2022	7	19	9:00	315	1
149	2022	7	19	12:00	45	3
150	2022	7	19	15:00	360	2
151	2022	7	19	18:00	135	1
152	2022	7	19	21:00	180	2
153	2022	7	20	0:00	180	2
154	2022	7	20	3:00	180	3
155	2022	7	20	6:00	180	2
156	2022	7	20	9:00	292.5	0
157	2022	7	20	12:00	292.5	2
158	2022	7	20	15:00	315	3
159	2022	7	20	18:00	315	1
160	2022	7	20	21:00	180	0
161	2022	7	21	0:00	180	3
162	2022	7	21	3:00	157.5	3
163	2022	7	21	6:00	157.5	2
164	2022	7	21	9:00	315	3
165	2022	7	21	12:00	135	3
166	2022	7	21	15:00	67.5	3
167	2022	7	21	18:00	180	4
168	2022	7	21	21:00	157.5	4
169	2022	7	22	0:00	202.5	1
170	2022	7	22	3:00	202.5	1
171	2022	7	22	6:00	135	0
172	2022	7	22	9:00	360	2
173	2022	7	22	12:00	337.5	2
174	2022	7	22	15:00	337.5	3
175	2022	7	22	18:00	337.5	2
176	2022	7	22	21:00	225	1
177	2022	7	23	0:00	225	1
178	2022	7	23	3:00	225	1
179	2022	7	23	6:00	225	1
180	2022	7	23	9:00	315	1
181	2022	7	23	12:00	315	2
182	2022	7	23	15:00	315	2
183	2022	7	23	18:00	337.5	1
184	2022	7	23	21:00	247.5	1
185	2022	7	24	0:00	202.5	1
186	2022	7	24	3:00	202.5	1

Wind Rose Data

Annexure-IIIb

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
187	2022	7	24	6:00	180	1
188	2022	7	24	9:00	315	2
189	2022	7	24	12:00	315	3
190	2022	7	24	15:00	315	3
191	2022	7	24	18:00	315	2
192	2022	7	24	21:00	180	1
193	2022	7	28	0:00	202.5	1
194	2022	7	28	3:00	180	2
195	2022	7	28	6:00	225	1
196	2022	7	28	9:00	315	2
197	2022	7	28	12:00	315	3
198	2022	7	28	15:00	292.5	2
199	2022	7	28	18:00	202.5	1
200	2022	7	28	21:00	135	2
201	2022	7	26	0:00	225	1
202	2022	7	26	3:00	180	2
203	2022	7	26	6:00	202.5	1
204	2022	7	26	9:00	270	1
205	2022	7	26	12:00	315	2
206	2022	7	26	15:00	315	2
207	2022	7	26	18:00	225	0
208	2022	7	26	21:00	180	2
209	2022	7	27	0:00	180	1
210	2022	7	27	3:00	180	2
211	2022	7	27	6:00	180	1
212	2022	7	27	9:00	22.5	1
213	2022	7	27	12:00	315	3
214	2022	7	27	15:00	315	3
215	2022	7	27	18:00	292.5	1
216	2022	7	27	21:00	225	2
217	2022	7	28	0:00	157.5	1

S. No.	YYYY	MM	DD	HH	W_dir	W_Sp
218	2022	7	28	3:00	225	1
219	2022	7	28	6:00	180	0
220	2022	7	28	9:00	315	2
221	2022	7	28	12:00	315	3
222	2022	7	28	15:00	315	3
223	2022	7	28	18:00	135	2
224	2022	7	28	21:00	202.5	1
225	2022	7	29	0:00	180	1
226	2022	7	29	3:00	157.5	0
227	2022	7	29	6:00	225	1
228	2022	7	29	9:00	360	0
229	2022	7	29	12:00	315	3
230	2022	7	29	15:00	315	3
231	2022	7	29	18:00	292.5	1
232	2022	7	29	21:00	225	2
233	2022	7	30	0:00	202.5	2
234	2022	7	30	3:00	180	1
235	2022	7	30	6:00	270	1
236	2022	7	30	9:00	315	1
237	2022	7	30	12:00	315	2
238	2022	7	30	15:00	315	3
239	2022	7	30	18:00	315	2
240	2022	7	30	21:00	225	2
241	2022	7	31	0:00	202.5	1
242	2022	7	31	3:00	202.5	1
243	2022	7	31	6:00	202.5	1
244	2022	7	31	9:00	315	1
245	2022	7	31	12:00	315	3
246	2022	7	31	15:00	315	3
247	2022	7	31	18:00	315	1
248	2022	7	31	21:00	225	1

YYYY-Year; MM-Month; DD-Date; HH-Hour; W_dir-Wind Direction (Degree); W_Sp-Wind Speed (m/s).

Table 24: Frequency Distribution (Period 01/07/2022 to 31/07/2022)

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
1	North	0.4	2.82	0	0	0	0	0	3.22
2	NNE	0	0.4	0	0	0	0	0	0.4
3	NE	0	0.4	0.4	0	0	0	0	0.8
4	ENE	0	0	0.4	0	0	0	0	0.4
5	East	0.4	0	0	0	0	0	0	0.4
6	ESE	0	0	0	0	0	0	0	0
7	SE	0.4	3.23	0.4	0	0	0	0	4.03
8	SSE	0.4	3.23	0.81	0	0	0	0	4.44
9	South	0.81	15.32	1.61	0	0	0	0	17.74
10	SSW	0	13.71	0.4	0	0	0	0	14.11
11	SW	0.4	12.1	0	0	0	0	0	12.5
12	WSW	0	2.02	0	0	0	0	0	2.02

Wind Rose Data**Annexure-IIIb**

S. No.	Directions	0-0.5	0.5-2	2-4	4-6	6-8	8-10	10-25	Total
13	West	0.4	3.23	0	0	0	0	0	3.63
14	WNW	0.4	2.82	0.4	0	0	0	0	3.62
15	NW	0.4	14.11	13.31	0	0	0	0	27.82
16	NNW	0	2.02	2.82	0	0	0	0	4.84
Total		4.01	75.41	20.55	0	0	0	0	100



Sheikhbagh Forest Complex, Lal Chowk, Srinagar - 190001
Ph 0194-2455114 Fax 0194-2455366 email cc/kashmir@gmail.com

GOVERNMENT OF JAMMU & KASHMIR
OFFICE OF THE CHIEF CONSERVATOR OF FORESTS, KASHMIR

Addl. Pr, Chief Conservator of Forests/Nodal Officer,
FCA, Jammu & Kashmir Government,
Kashmir.

No.: 421/CCF(K)/Plg/2023-24/871-72

Dated: 19 - 07 - 2023

**Subject: Catchment Area Treatment Plan of Uri I Stage II HE Project-
Approval thereof.**

Ref: Conservator of Forests, North Circle's letter No.: FD/CFN2023
24/FCA/320-22 dated: 19-05-2023.

Sir,

Kindly refer the CAT plan of Uri I Phase-II HE Project submitted by the project proponent recommended by Conservator of Forest, North Circle, vide the above reference, a copy of which is endorsed to you as well (copy enclosed).

The project report has been prepared as per the forest schedule of rates 2017. The CAT plan needs revision on account of the following:

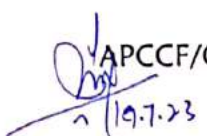
1. The PWD schedule of rates have also been revised in 2022 and hence the fencing work and civil work would involve enhancement of rates also.
2. The minimum wages of the labours have considerably increased during the time and is likely to increase during the period of implementation of the plan as well.
3. The fencing given in the CAT Plan is using PCC posts, however in Kashmir, angle iron fence posts are used for creating fencing of plantation sites.

In light of the above, it is proposed to revise the cost estimation given in para 10.2.6 as per extant schedule of rates and minimum wages. The cost of planting component is proposed to be enhanced by a factor of 1.36 considering the CPI (IW) of 2017 and 2023. The revised cost estimates now works out to be Rs. 12.97 Crores (details enclosed).

The plan could be revised at the time of the implementation of CAT Plan by PCCF (HOFF) J&K. Approval may be accorded to the CAT Plan so that the case may be processed on PARVISH under CAT for diversion of forest land for non-forestry purpose.

Yours faithfully,

Encl: 4 leaves


APCCF/Chief Conservator of Forests
Kashmir

Copy to:

1. Conservator of Forests, North Circle for information. This is with reference to letter No. cited above. He is requested to work out a detailed works programme with the extant rate norms.
2. File.

soplanning888@gmail.com

Annexre II of CAT Plan Revised

S.No		Unit	Unit Cost (Rs)	Qty	Total Cost (Rs)
1	ADVANCE WORK				
	a) Fencing with Angle Iron Posts	Rft	250	300	75000
2	CREATION				
	A. PLANTATION				
	a) Pit Plantation (PB)	No.	40.081374	330	13226.85342
	a) Pit Plantation (NR)	No.	31.652537	770	24372.45349
	B. SOWING				
	a). Patching Sowing	No.	9.549039	370	3533.14443
	b). Dibbling	No.	9.808598	370	3629.18126
					13721.75
3	SMC WORKS*	Cum	2744.35	5	133483
	Sub Total I				133480
	Or Say				
4	MAINTENANCE				
	(BUS) 1st year @ 25% of last year plantation				
	a) PB Plantation	No.	40.081374	83	3326.754042
	b) NR plantation	No.	31.652537	193	6108.939641
	(BUS) 2nd year @ 15% of last year plantation				
	a) PB Plantation	No.	40.081374	50	2004.0687
	b) NR plantation	No.	31.652537	116	3671.694292
	(BUS) 3rd year @ 5% of last year plantation				
	a) PB Plantation	No.	40.081374	17	681.383358
	b) NR plantation	No.	31.652537	39	1234.448943
	Sub Total II				17027
	Or Say				17030
	Grand Total (Sub Total I+II)				150511
	OR SAY				150510

* Rate as per PWD Schedule of Rates 2022, Code 7.3 (Page 111)

2. Per Hectare Norm for Enrichment

S.No		Unit	Unit Cost (Rs)	Qty	Total Cost (Rs)
1	ADVANCE WORK				
	a) Fencing with Angle Iron Posts	Rft	250	300	75000
2	CREATION				
	A. PLANTATION				
	a) Pit Plantation (PB)	No.	40.081374	240	9619.52976
	a) Pit Plantation (NR)	No.	31.652537	560	17725.42072
	B. SOWING				
	a). Patching Sowing	No.	9.549039	270	2578.24053
	b). Dibbling	No.	9.808598	270	2648.32146
					13721.75
3	SMC WORKS*	Cum	2744.35	5	133483
	Sub Total I				121293
	Or Say				121300
4	MAINTENANCE				
	(BUS) 1st year @ 25% of last year plantation				
	a) PB Plantation	No.	40.081374	60	2404.88244
	b) NR plantation	No.	31.652537	140	4431.35518

b) 2nd year @ 15% of last year plantation				
PB Plantation	No.	40.081374	36	1442.929464
b) NR plantation	No.	31.652537	84	2658.813108
(BUS) 3rd year @ 5% of last year plantation				
a) PB Plantation	No.	40.081374	12	480.976488
b) NR plantation	No.	31.652537	28	886.271036
Sub Total II				12305.23
Or Say				12300
Grand Total (Sub Total I+II)				133598
OR SAY				133600

* Rate as per PWD Schedule of Rates 2022, Code 7.3 (Page 111)

3. Per Hectare Norm for Pasture Development

S.No		Unit	Unit Cost (Rs)	Qty	Total Cost (Rs)
1	ADVANCE WORK				
	a) Fencing with Angle Iron Posts	RFt	250	300	75000
2	CREATION				
	A. PLANTATION				
	a) Pit Plantation (PB)	No.	40.081374	330	13226.85342
	a) Pit Plantation (NR)	No.	31.652537	770	24372.45349
	B. SOWING				
	a). Patching Sowing	No.	9.549039	370	3533.14443
	b). Dibbling	No.	9.808598	370	3629.18126
3	SMC WORKS*	Cum	2744.35	5	13721.75
	Sub Total I				133483.38
	Or Say				133480
4	MAINTENANCE				
	(BUS) 1st year @ 25% of last year plantation				
	a) PB Plantation	No.	40.081374	83	3326.754042
	b) NR plantation	No.	31.652537	193	6108.939641
	(BUS) 2nd year @ 15% of last year plantation				
	a) PB Plantation	No.	40.081374	50	2004.0687
	b) NR plantation	No.	31.652537	116	3671.694292
	(BUS) 3rd year @ 5% of last year plantation				
	a) PB Plantation	No.	40.081374	17	681.383358
	b) NR plantation	No.	31.652537	39	1234.448943
	Sub Total II				17027.29
	Or Say				17030
	Grand Total (Sub Total I+II)				150510.67
	OR SAY				150510

* Rate as per PWD Schedule of Rates 2022, Code 7.3 (Page 111)

4. Per Hectare Norm for Assisted Natural Regeneration

S.No		Unit	Unit Cost (Rs)	Qty	Total Cost (Rs)
1	ADVANCE WORK				
	a) Fencing with Angle Iron Posts	RFt	250	300	75000
2	CREATION				
	A. PLANTATION				
	a) Pit Plantation (PB)	No.	40.081374	120	4809.76488

	Plantation (NR)	No.	31.652537	280	8862.71036
	SOWING				
	a). Patching Sowing	No.	9.549039	135	1289.120265
	b). Dibbling	No.	9.808598	135	1324.16073
3	SMC WORKS*	Cum	2744.35	5	13721.75
	Sub Total I				105007.51
	Or Say				105010
4	MAINTENANCE				
	(BUS) 1st year @ 25% of last year plantation				
	a) PB Plantation	No.	40.081374	30	1202.44122
	b) NR plantation	No.	31.652537	70	2215.67759
	(BUS) 2nd year @ 15% of last year plantation				
	a) PB Plantation	No.	40.081374	18	721.464732
	b) NR plantation	No.	31.652537	42	1329.406554
	(BUS) 3rd year @ 5% of last year plantation				
	a) PB Plantation	No.	40.081374	6	240.488244
	b) NR plantation	No.	31.652537	14	443.135518
	Sub Total II				6152.61
	Or Say				6150
	Grand Total (Sub Total I+II)				111160.12
	OR SAY				111160
	* Rate as per PWD Schedule of Rates 2022, Code 7.3 (Page 111)				

10.13: Cost Estimate for Catchment Area Treatment of Uri-I Phase-II HEP.....Revised

S.No.	Item	Rate (Rs)	Unit	Target	
				Physical	Financial (Rs in Lakh)
A	Biological Measures				
1	Normal Afforestation including maintenance	125346.51	Ha	119.00	149.16
2	Enrichment Plantations including maintenance	104588.62	Ha	40.00	41.84
3	Pasture Development including maintenance	80053.46	Ha	84.00	67.24
4	Assisted Natural Renegeneration maintenance	77375.90	Ha	59.00	45.65
5	Plant Production				
a	Formation of New Permanent Nursery	413305.36	Ha	1	4.13
b	Raising of sapling of PB of size (9" x 6")				
c	Raising of sapling of NR sapling	10.97	/plant	73200	8.03
6	Maintenance of PB raised conifer saplings in nurseries of size (9" x 6")	10.16	/plant	170800	17.36
a	During 1st year of raising of plants	3.63	/plant	18300	0.66
b	During 2nd year of raising of plants	3.63	/plant	10980	0.40
c	During 3rd year of raising of plants	5.23	/plant	36600	1.91
d	During 4th year of raising of plants	5.23	/plant	36600	1.91
e	During 5th year of raising of plants	5.23	/plant	36600	1.91
f	During 6th year of raising of plants	5.23	/plant	36600	1.91
g	During 7th year of raising of plants	5.23	/plant	36600	1.91
h	During 8th year of raising of plants	5.23	/plant	36600	1.91
i	During 9th year of raising of plants	5.23	/plant	36600	1.91
j	During 10th year of raising of plants	5.23	/plant	36600	1.91
7	Maintenance of NR saplings				
a	During 1st year of raising of plants	3.39	/plant	42700	1.45
8	Engagement of Labours as Watch and Ward				
a	During Planting Year	330	/day	3	3.61
b	During 1st year of raising of plants	355	/day	3	3.89
c	During 2nd year of raising of plants	385	/day	3	4.22
d	During 3rd year of raising of plants	415	/day	3	4.54
e	During 4th year of raising of plants	450	/day	3	4.93
f	During 5th year of raising of plants	485	/day	3	5.31
g	During 6th year of raising of plants	525	/day	3	5.75
h	During 7th year of raising of plants	565	/day	3	6.19
i	During 8th year of raising of plants	610	/day	3	6.68
j	During 9th year of raising of plants	660	/day	3	7.23
k	During 10th year of raising of plants	710	/day	3	7.77
	Sub Total A				411.36
B	Engineering Measures				
9	DRSM Structures	2744.35	Cum.	7800.00	214.06
a	Maintenance cost @ 25%				53.51
10	Gabion Structures	4716.85	Cum.	2030.00	95.75
a	Maintenance cost @ 25%				23.94
11	Silt Observation Points		No.s	2	130.51



CRISIS & DISASTER MANAGEMENT PLAN



URI POWER STATION (4 x 120 MW)

DISTT. BARAMULLA (JAMMU & KASHMIR)

EFF. FROM: 01.01.2020

Edition- II (Revision-3)



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URI POWER STATION-I
**CRISIS & DISASTER
MANAGEMENT PLAN**

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NHPC Limited
(A Govt. of India Enterprise)
URI POWER STATION-I
**CRISIS & DISASTER
MANAGEMENT PLAN**

Doc. No.: UPS DMP-01

Edition No. : 02

Rev. No. : 03

Eff. Date : 1st Jan 2020

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DISTRIBUTION LIST

INTERNAL (NHPC)

Sl. No.	Authority	Address
1	Executive Director (RO-Jammu)	NHPC Limited, Regional Office, Jammu (J&K)
2	General Manager (In charge)	Uri Power Station, Gingle, Distt. Baramulla (J&K)
3	General Manager (Safety)	Safety Division, NHPC Limited, Corporate Office, Sec. 33, Faridabad(Haryana)
4	Dy .General Manager (Elect.)	Uri Power Station, Gingle, Distt. Baramulla (J&K)
5	General Manager, PCS & TEM	Uri Power Station, Gingle, Distt. Baramulla (J&K)
6	Sr. Manager (E&C), PH	Uri Power Station, Gingle, Distt. Baramulla (J&K)
7	Sr. Manager (HR)	Uri Power Station, Gingle, Distt. Baramulla (J&K)
8	Sr.Manager (M), Barrage Civil / E&M	Uri Power Station, Gingle, Distt. Baramulla (J&K)
9	Sr.Manager (Elect.), STD	Uri Power Station, Gingle, Distt. Baramulla (J&K)
10	Sr.Manager (Civil), T/Ship & PH	Uri Power Station, Gingle, Distt. Baramulla (J&K)
11	Sr.Manager (IT&C)	Uri Power Station, Gingle, Distt. Baramulla (J&K)
12	Library	Uri Power Station, Gingle, Distt. Baramulla (J&K)

EXTERNAL

1	Deputy, Commissioner	District Baramulla, Jammu & Kashmir
2	Commandant, CISF	Uri-I Unit, Gingle, Distt. Baramulla (J&K)



NHPC Limited

(A Govt. of India Enterprise)

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**CRISIS & DISASTER MANAGEMENT PLAN
URI POWER STATION**

REVISION STATUS

Rev. No.	Date	Document No.
00	01.04.2005	Edition-I
01	25.10.2016	Edition-II
02	01.08.2017	Edition-II (Revision- I)
03	01.01.2020	Edition-II (Revision- 3)

APPROVAL AND IMPLEMENTATION

Prepared by:

(Anand Ram)
Sr. Manager (E)
Uri Power Station
Date: 01.01.2020

This Disaster Management Plan is hereby approved. This plan is effective immediately and supersedes all previous editions.

(Khalid Umar)
General Manager
Uri Power Station
Date: 01.01.2020



एनएचपीसी लिमिटेड
(भारत सरकार का उद्योग)
NHPC Limited
(A Govt. of India Enterprise)



Uri 1 Power Station,
Gingle, Baramulla (J&K)
Phone: 01956-253211
CIN No.: L4010HR1975GOI032564

NH/UPS/GM-61/EIA EMP/2022/95

Dated: 05.10.2023

APPENDIX-I

UNDERTAKING

This is to certify that the contents (information and data) of Environment Impact Assessment/Environment Management Plan (EIA/EMP report) in respect of Uri-I Stage-II HE Project Uri Baramulla JK (240 MW) which is a Run-of-the river (RoR) Project, are correct and are based upon data of primary works carried out by QCI/NABET accredited consultant, M/s R S Envirolink Technologies Pvt. Ltd. Gurgaon, Haryana.

It is also certified that the primary work has not been copied from any EIA report. The secondary data information used in the report is well referred.


Naseer S Bhat 5/10/23

(Naseer S Bhat)

Senior Manager (Env)

Uri- Stage-II HE Project

Uri Baramulla JK

वरिष्ठ प्रबंधक (परि-
उद्देश्य पावर स्टेशन, Uri प्रकल्प, Stage-II
एन. एच. पी. सी. लि. लि. NHPC Ltd Gingle
बारामुला (ज. क.) Baramulla (J&K) 193122

Counter Signed


(Pradip Kumar Ray)

Head of the Project

उद्देश्य पावर स्टेशन
General Manager (in-charge)

Uri-I Stage-II HE Project

Uri Baramulla JK

General Manager (in-charge)

Uri



GOVERNMENT OF JAMMU AND KASHMIR
OFFICE OF THE JOINT DIRECTOR, KASHMIR
DIRECTORATE OF GEOLOGY AND MINING, J&K UT.
4th Floor, Sanat Ghar Bemina, Srinagar.

The General Manager
NHPC Limited
Uri Power Station
District Baramulla, J&K.

No: JDK/DGM/SGR/F-4306-08 Dated: 28.07.2021
Sub: No Objection Certificate in favour of NHPC Limited for the proposed Uri I
Stage II, Hydropower Project at Uri, District Baramulla, J&K UT.
Ref: i) NHPC letter no. NH/UPS/GM/21/14 dated: 17.05.2021
ii) DMO/Bla/DGM/4512-13 dated: 20.05.2021

Sir,

Kindly refer your office letter no. NH/UPS/GM/21/14 dated: 17.05.2021 regarding issuance of No Objection Certificate (NOC) for the proposed Uri-I Stage II Hydropower Project at Uri, District Baramulla. A committee of experts constituted vide this office order no. JDK/CGK/DGM/F-266/3489-92 dated 29.05.2021 submitted in their report vide no. MYB/DGM/SGR/F-3/111 dated: 23.06.2021 that the proposed Uri I Stage II H.E. Project does not encompass any prospected/established economic mineral deposit by the Department and shall not interfere the prospected/ leased out Gypsum Deposits in the area as per the DPR/layout of the project.

Accordingly this Department has No Objection for the proposed Uri I Stage II H.E. Project at Uri, District Baramulla subject to the following conditions:

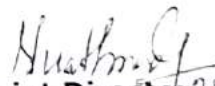
- i) The NHPC shall share with the Department the final DPR of the project and exploratory borehole data of the proposed additional structures i.e., Head Race Tunnel (HRT), observational Adits and Power House.
- ii) The material like overburden and litho units excavated during the execution of the project shall be stocked at the designated dumpyard under proper permission from the concerned District Mineral Office, Geology & Mining Department.



- iii) The excavated/stocked material shall be utilized for the proposed project only under proper disposal permits from Geology & Mining Department with advance payment of royalty and other dues.
- iv) The raw material (minor mineral) for the proposed project should be obtained from the legal source/mineral concessionaire under SRO 105, i.e, The Jammu and Kashmir Minor Mineral Concession, Storage, Transportation of Minerals and Prevention of Illegal Mining Rules 2016.
- v) The NOC issued shall be deemed cancelled ab initio in case any of the conditions envisaged above are violated.

The NoC is issued with the approval of Director, Geology & Mining Department, J&K.

Yours faithfully


Joint Director 28.07.21
✓ Geology & Mining Deptt
Kashmir

Copy to:

1. Director, Geology & Mining Department, J&K, Jammu for kind information please.
2. District Mineral officer, Baramulla for information and necessary action.

Government of Jammu and Kashmir,
Directorate of Archives, Archaeology and Museums,
Srinagar/Jammu

No: DOAAM-AMA/1/2021-02/ 918-19

Dated: - 20 -07 2022

The General Manger(Civil)
Uri Power Station, Gingle
Distt-Baramulla, J&K

Subject:- Uri-I stage-II HE Project information regarding important
Archaeological site present in reserve area and in the
catchment area.... NOC thereof.

Sir,

Kindly refer your office letter No. GGM/22/204, dated 19-07-2022 and in continuation to this office letter No. DAMA-2283-84/AMA-203, dated: 04-04-2022 and refer your letter No. NH/UPS/GM/21/76 dated 29-06-2021 on the subject cited above. In this regard, I am directed to request that as reported by Dy. Director, Archives, Archaeology & Museums, Srinagar vide letter DDAAMK/810/ADD-29, dated:- 18-09-2021, it is informed that no archaeological site/ Monument falls in the vicinity in the provided coordinates (as illustrated on site plan/ Map) of the project, is under the jurisdiction of this department as well as under the jurisdiction of ASI, Circle Srinagar. The NOC in this regard is conveyed, subject to following conditions:-

1. That the NOC is subject to obtaining other required clearances/ NOC's from relevant agencies.
2. That construction is carried out strictly as per the approved area marked in Red outline.
3. That during the digging/construction, if any archaeological finds come across, the work should be stopped immediately, and this department should be informed immediately.
4. The NOC is not transferable, and it shall be valid for a period of three years or till any Archaeological evidence come across whichever is earlier.

Yours faithfully


Deputy Director

Copy to the;

01. Deputy Director, Archives, Archaeology & Museums, Kashmir for information.
This has reference to his letter referred to above.