Environmental Impact Assessment

September 2019

PAK: Balakot Hydropower Development Project

Volume A – Main Report

Prepared by Pakhtunkhwa Energy Development Organization (PEDO), with support from Hagler Bailly Pakistan for the Asian Development Bank. This is an updated version of the draft originally posted in December 2018 available on https://www.adb.org/projects/documents/pak-49055-003-eia.

Hagler Bailly Pakistan

Balakot Hydropower Development Project

Environmental Impact Assessment

Volume I – Main Report
Final

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1. Introduction

The Pakhtunkhwa Energy Development Organization (PEDO) intends to construct a 300 megawatt (MW) run-of-river hydropower plant (referred to as "Project" in this report) at Balakot, in Mansehra District of Khyber Pakhtunkhwa (KP), Pakistan. The Project called Balakot Hydropower Development Project (BHDP) will be located on the Kunhar River about 18.6 kilometer (km) upstream of the town of Balakot. **Exhibit 1.1** shows the location of the Project.

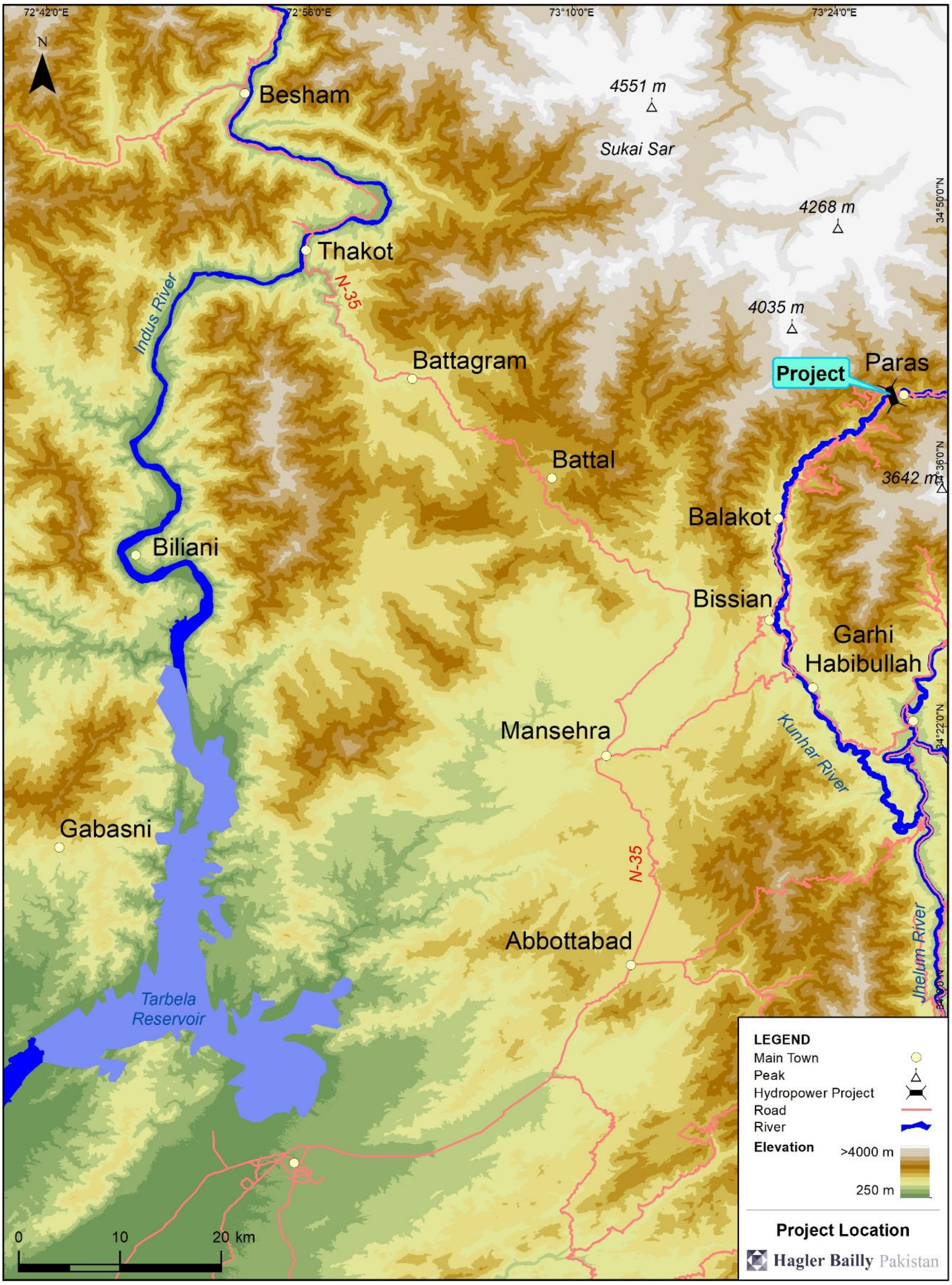
A feasibility study of the Project was prepared in 2013 (the "FS 2013").[1] The Asian Development Bank ("ADB" or the "Lenders") is evaluating the Project for financing under its Hydropower Investment Development Program. As part of the evaluation of the Project, ADB, on advice of technical consultants, deemed the design proposed in 2013 as unfeasible and had it modified by Aqualogus. Aqualogos proposed and assessed dam site and powerhouse option alternatives and released a draft report of their findings in May 2018. Hagler Bailly Pakistan (Private) Limited (HBP) contributed to the environmental and social assessment of options. ADB has now acquired the services of HBP as Safeguard Consultants to prepare the documents required for ensuring that the project meets the environmental and social safeguards of the ADB, and also conforms to environmental legislation of KP.

The complete package of the environmental and social safeguard documents comprises the following:

1. Knowledge Summary (A brief summary of the entire report)
2. The Environment Impact Assessment (EIA) in three volumes:
    a. The Main EIA Report (**this Report**)
    b. Appendices to the Main Report
    c. Supporting Studies including Environmental flow Assessment Report and Biodiversity Action Plan
3. Poverty, Social and Gender Analysis Report (PSGA)
4. Summary of Poverty Reduction and Social Strategy (SPRSS)
5. Land Acquisition and Resettlement Plan (LARP)

[1] Mirza Associates Engineering Services (Pvt.) Ltd., Feasibility Study of Balakot Hydropower Project, for Pakhtunkhwa Energy Development Organization (PEDO), December 2013

Exhibit 1.1: Project Location



1.1 Project Proponents

PEDO was established by the Government of KP in 1986 as the Small Hydel Development Organization. Its objectives included the following:

- To identify and develop hydel potential up to 5 MW.
- To construct small hydel stations for isolated load centers.
- To operate and maintain off grid small hydel stations.

In 1993, it was converted to an autonomous body and renamed the Sarhad Hydel Development Organization which was renamed Pakhtunkhwa Hydel Development Organization (PHYDO) in 2013 following change of the provinces name from Northwest Frontier Province to Khyber Pakhtunkhwa. The 18^{th} Amendment to the Constitution of Pakistan vested full authority to the provinces to develop power projects of any capacity through the public or private sector. Consequently, the provincial assembly of Khyber Pakhtunkhwa through the Pakhtunkhwa Energy Development Organization (Amendment) Act 2014 renamed PHYDO to Pakhtunkhwa Energy Development Organization and expanded its mandate to include all types of power generation sources. The key powers and duties of PEDO under the amended Act includes:[2]

1. Prepare a comprehensive plan for the development and utilization of the power and energy resources of the KP.
2. Frame a scheme, or schemes, for the KP providing for the generation, transmission and distribution of power; and the construction, maintenance and operation of power houses, grids and microgrids, transmission and distribution lines specially in the remote mountainous areas of KP.
3. Act as adviser to the Government on all matters regarding issuance of licenses and joint ventures in the power sector.
4. Have control over the operation of all power houses, grids, transmission and distribution lines in KP constructed by, or transferred to, PEDO
5. Make recommendations to Government for prescribing standards for the maintenance of power houses, grids, microgrids and transmission and distribution lines of the Organization
6. Restrict or prohibit by general or special order, the clearing and breaking up of land in the catchment area of any river;
7. Establish thermal, solar, wind or other alternate renewable energy based power houses, erect test masts, collect wind and solar data for power generation, lay or cause to be laid, pipelines for supply of fuel, establish fuel supply means, engage in transmission, trading, distribution and sale of energy to industries and domestic consumers, manage demand discipline, cause setting of tariff, recover and collect charges, fees and tariffs and do all other

[2] The Pakhtunkhwa Energy Development Organization Act, 1993. Khyber Pakhtunkhwa Act No. I of 1993. http://kpcode.kp.gov.pk/homepage/lawDetails/30.

things necessary and incidental with power produced or generated by or through the Organization;

1.2 Project Overview

The Project is a run-of-river hydropower project (**Exhibit 1.2**). The proposed site of the dam is 18.6 km upstream of Balakot town, whereas the underground powerhouse will be located in near the village of Barkot, 8.0 km upstream of Balakot town.

The dam will be a concrete gravity dam with a maximum height of 35 meters (m) from the river bed and dam crest length of 130 m. The dam top elevation will be 1,292 m above mean sea level (amsl). The dam will create a reservoir that will operate between the maximum operating level of 1,288 m and the minimum operating water level of 1,283 m. The reservoir volumes corresponding to the maximum and minimum operating levels are 3.6 million cubic meter (m^3) and 2.4 million m^3, respectively. The surface area of the reservoir will be approximately 28 hectares (ha) and it will extend 2.2 km upstream of the dam.

A headrace tunnels extending 9.1 km will divert water from the reservoir created by the dam to the powerhouse.

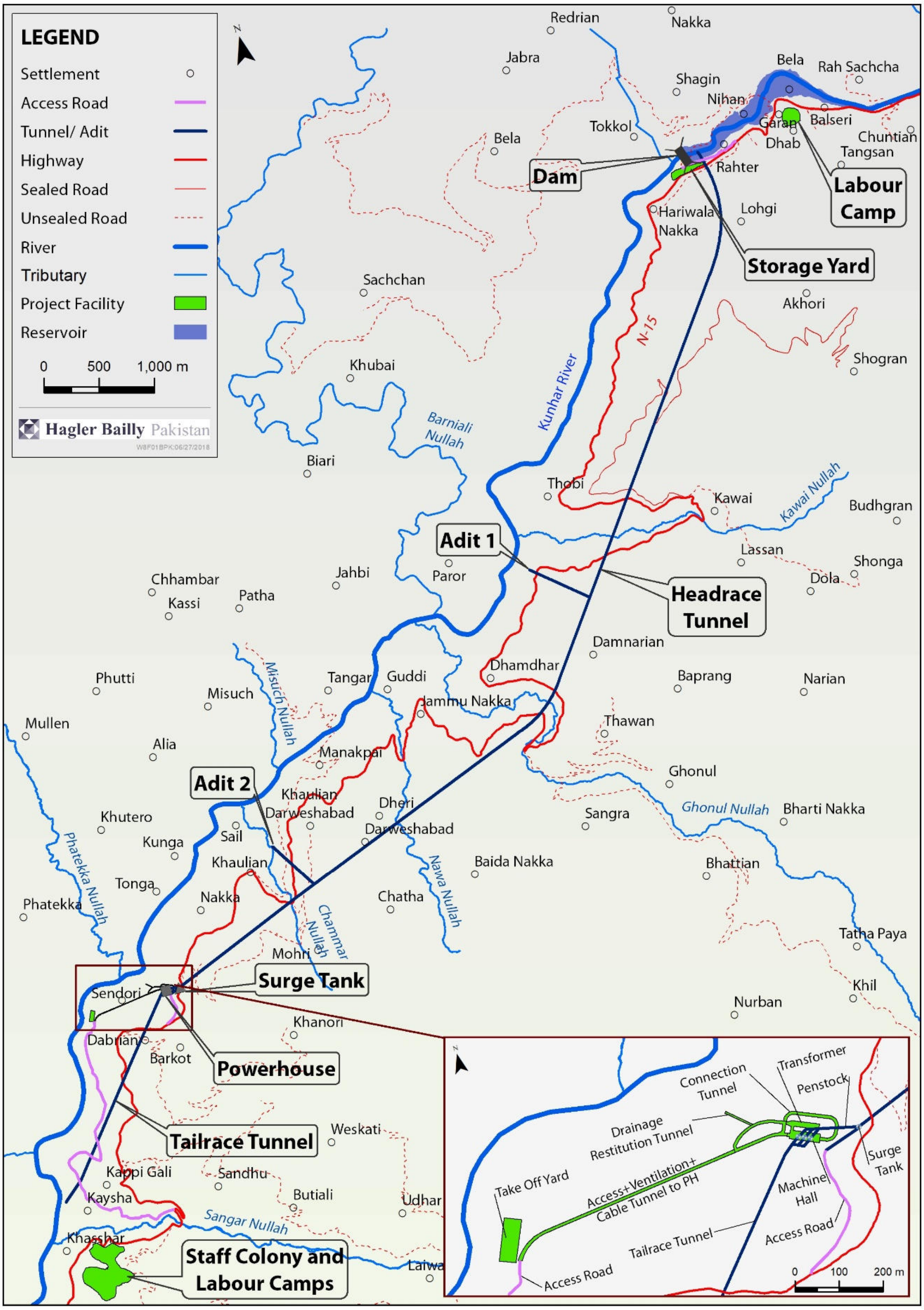
The powerhouse will be underground cavern-type powerhouse. A 1.565-km long tailrace tunnel will discharge the water back to the Kunhar River. The total distance between the dam and the outfall of the tailrace tunnel will be about 13.4 km.

A circular surge tank, having a 14.5 m diameter, is proposed at the end of the low pressure headrace tunnel with a surge height of 122m.

The total installed capacity will be 300 MW. The average annual energy generation will be 1,143 Gigawatt-hour (GWh).

The Modular flow at the intake is 87 m^3/s. The design discharge is 154 m^3/s.

Exhibit 1.2: Project Facilities Layout



1.3 Objectives and Scope of the EIA

The overall purpose of the EIA is to identify the potential environmental and social impacts of the proposed Project and evaluate them following the process which is acceptable to regulatory authorities in Pakistan and the Project lenders. In this process, the EIA identified measures to minimize any anticipated adverse impact of the proposed Project, at least to the level that it meet the national and good international industry practice (GIIP) criteria for evaluation of environmental and social impacts.

The specific objectives of this EIA is to:

- Assess the existing environmental conditions in the Project area, including the identification of environmentally sensitive areas.
- Assess the proposed activities to identify their potential impacts, evaluate the impacts, and determine their significance.
- Propose appropriate mitigation measures that can be incorporated into the design of the proposed Project, or how it is constructed or operated, to ensure that the potential impacts of the Project are within the acceptable limits—as defined by environmental laws, ADB safeguard policies, and GIIP—and where feasible the impacts are further minimized.
- Assess cumulative impacts of proposed hydropower projects on Kunhar River and provide recommendations to the concerned regulators to undertake measures for protection of the environment.
- Prepare an EIA report for submittal to the KP Environmental Protection Agency (KP-EPA) and the lenders.

The scope of the EIA includes the assessment environmental and social impacts of all activities during construction and operation stages that will be undertaken to make the Project a reality. However, the scope does not include the manufacturing of the hydropower plant equipment, its transportation from the place of manufacture through ships on international water and the unloading of the same on the Karachi ports.

To evacuate power from the proposed Project, a 500 kV transmission line to be constructed by National Transmission and Despatch Company (NTDC) falls in the category of associated project.[3] The length of the transmission line is not known at this stage as the interconnection point is not yet finalized.

To achieve environmental or social outcomes consistent with the KP regulatory requirements and the ADB safeguards policies, it is essential that NTDC undertake the EIA of the transmission line following the requirements stated in **Section 2** of this report and develop a sound Environmental Management Plan (EMP). The scope of this EIA does not include the design, construction, and operation of the transmission line for evacuation of the power produced by the Balakot HPP, however, recognizing the potential impacts and risks associated with the transmission line, measures to ensure that

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3 IFC defines associated facilities as “facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable”

a full EIA of the transmission line is undertaken, the EMP identifies and defines a set of management measures to be taken in the contractual arrangement with NTDC.

1.4 Study Areas

The spatial boundaries of the Study Areas for the EIA were selected to cover all areas where any measureable change to any component of the environment is likely to take place, directly or indirectly, due to any activity directly associated with the proposed Project. The selection of the Study Areas took into account the environmentally sensitive receptors[4] that are most likely to be impacted by the Project's development activities. It also took into account the different stages of the Project specifically construction and operation. To ensure assessment of cumulative impacts, the Study Areas were selected to be large enough to allow the assessment of the Valued Ecosystem Components (VECs) that may be affected by the Project activities.

The permanent footprint of the proposed Project includes the area that will be acquired for the dam, reservoir, powerhouse, and other facilities. Temporary footprint includes the land that will be required or disturbed due to the facilities that will be developed during the construction phase in the dam, powerhouse and other infrastructure components.

The Study Areas are considerably larger than the Project footprint. The proposed Project has different types of impacts spread over relatively large area. Therefore, a single study area for all types of impacts is difficult to define.

The ecological Study Area was defined as follows:

- **Aquatic Study Area**: The part of the Kunhar River starting from Faridabad upstream of the Project to Bissian downstream of the Project. It includes tributaries in this stretch but only those with a significant perennial flow that support breeding of fish.
- **Terrestrial Study Area**: This was defined as a 1 km buffer around locations where Project-related facilities are to be located.

The socioeconomic Study Area:

- **500 m buffer on each side of river**: along reaches that may be impacted due to the Project, and the zone where there is river dependence (either through use of drift wood, use of sediment as building materials) is a zone of 500 m of the river.
  - All settlements with a center within the 500 m buffer is included.
  - All settlements with more than 50% of their land area within the 500 m buffer are also included.
- **1 km buffer around Project facilities:** for coverage of communities that will be directly impacted through either resettlement, or construction related impacts.

[4] Sensitive receptors include, for example, residential areas, schools, places of worship, habitat of threatened or vulnerable flora and fauna species, drinking water sources, wetlands, and cultural heritage sites.

- **Upstream Extent:** selected as tailrace tunnel of Sukki Kinari HPP, upstream of the dam, as the dam as a barrier may affect communities reliant on ecological resources (such as fish).
- **Downstream Extent:** The downstream extent of the Study Area is at the start of reservoir of the Patrind HPP.

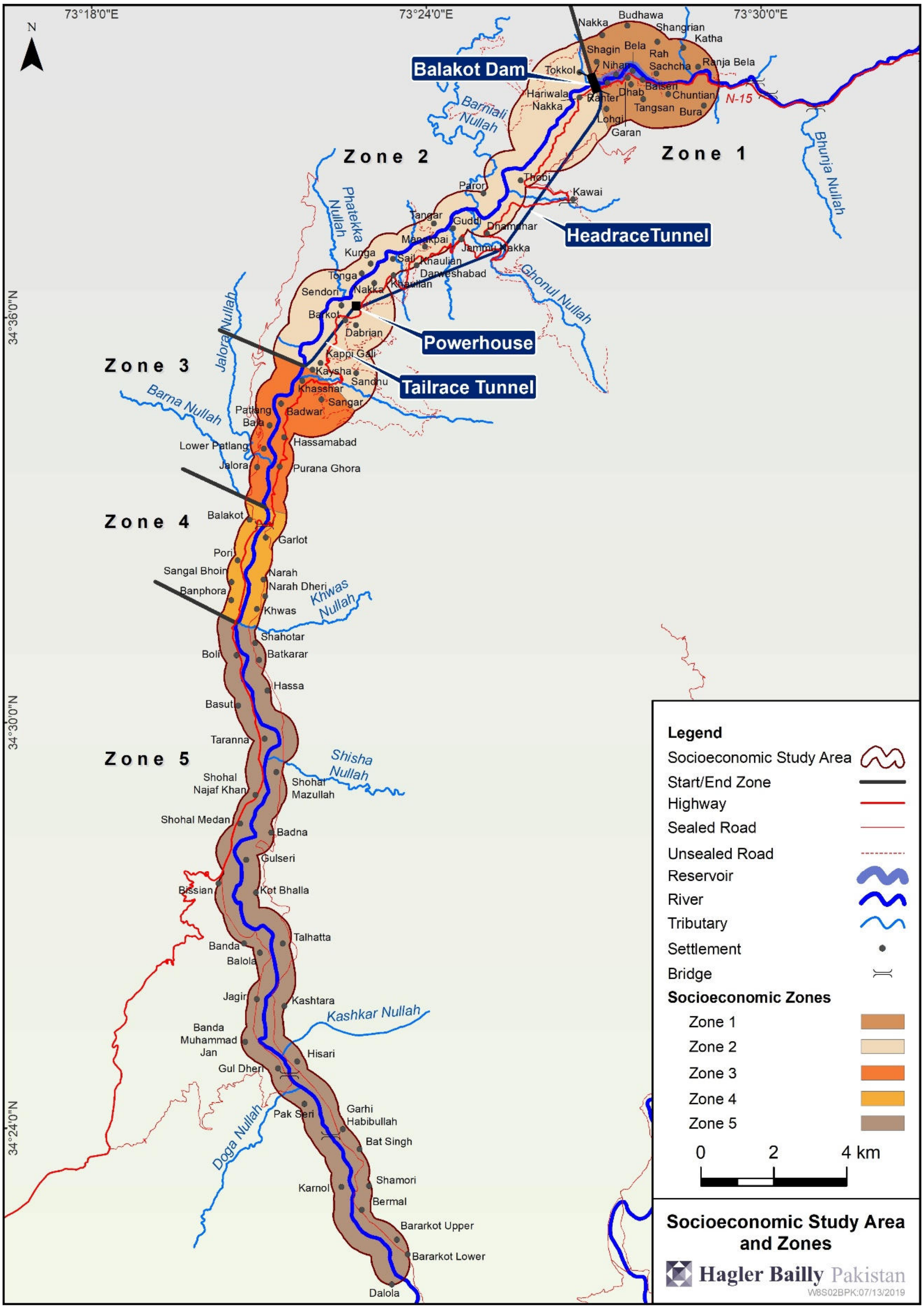
Keeping in view expected variations between rural and urban areas, impact due to the Project, flow variations along different reaches of the Kunhar River due to tributaries, as well as changes due to other hydropower projects, the Study Area is divided into different zones along the Kunhar River:

- **Zone 1:** Upstream of Balakot Dam (including Balakot Reservoir Area)
- **Zone 2:** Downstream of Balakot Dam up to Upstream of Balakot Tailrace Outlet
- **Zone 3:** Downstream of Balakot Tailrace Outlet up to Upstream of Balakot City
- **Zone 4:** Balakot City along Kunhar River
- **Zone 5:** Downstream of Balakot City up to the reservoir of Patrind Hydropower Project
- **Zone 6:** 1 km buffer around Project facilities

The Study Area used for the physical environment was the same as that for the socioeconomic environment

Exhibit 1.3 shows the Study Areas defined for this baseline study.

Exhibit 1.3: Study Areas



1.5 Study Team

The EIA has been developed by a team of professionals working with HBP or are associated with HBP, who are the leading experts in their respective fields in the country. In addition to HBP, a senior consultant from Southern Waters Ecological Research and Consulting (South Africa) as well as Engititan (Pvt.) Ltd. contributed to the EFlow assessment. **Exhibit 1.4** shows the names of the study team members and their roles.

Exhibit 1.4: Study Team

Name	*Education and Experience*	*Role and Main Activities*
HBP		
Hidayat Hasan	▶ PhD Coursework, Atmospheric Physics ▶ MSc Physics ▶ BSc Physics, Chemistry, Mathematics ▶ 23 years of experience in environmental and social impact assessment	▶ Project Team Leader ▶ Supervision of Compilation and standardization of the Project reports ▶ Technical support to the socioeconomic and LARP team
Vaqar Zakaria	▶ BS and MS in Chemical Engineering, MIT, USA ▶ 26 years of experience in environmental assessment and monitoring	▶ Project Supervision ▶ Technical Team Leader (EFlow Assessment) ▶ Supervision of the Biodiversity Action Plan ▶ Supervision of the Cumulative Impact Assessment
Anwar Fazal Ahmed	▶ MSc (Hons) Rural Development ▶ MA Economics ▶ 16 years of experience in resettlement planning and implementation	▶ Social Safeguards Expert (Land Acquisition and Resettlement) ▶ Household socioeconomic data collection, analysis and reporting.
Aziz Karim	▶ MSc Biochemistry ▶ BSc Biochemistry, Microbiology, Chemistry ▶ Over 10 years of experience in environmental assessment	▶ Technical Team Leader (Physical Environment) ▶ Coordination of Physical Environment field teams ▶ Supervision of physical data collection (noise, air quality, traffic and visual) ▶ Water quality, visual and traffic analysis and reporting

Name	Education and Experience	Role and Main Activities
Hassan Bukhari	▶ MS Natural Resources and Environment ▶ BS Physics ▶ 2 years of experience in environmental assessment	▶ Water quality, noise, traffic and air quality data analysis and reporting ▶ Physical impact assessment ▶ Inputs to aquatic ecology impact assessment ▶ Environmental Flow (EFlow) Assessment support
Saeed Nawaz	▶ BA Journalism and Education ▶ FSc Physics, Chemistry, Biology ▶ 19 years of experience in water, wastewater and soil sample analysis	▶ Hydrocensus and water sample data collection ▶ Water physical parameters laboratory analysis
Sadia Asghar	▶ BSc Environmental Engineering ▶ FSc Pre-Engineering ▶ 2 years of experience in environmental assessment	▶ Climate data review, analysis and reporting ▶ Physical baseline reporting ▶ Air quality, traffic and visual impact assessment
Kamran Minai	▶ MSc Environmental Science and Management ▶ BSc Biology ▶ 2 years of experience in environmental assessments	▶ Project management activities ▶ Compilation and standardization of the Project reports ▶ Quality assurance checks ▶ Coordination of Terrestrial Ecology field teams ▶ Compilation of Ecological Baseline ▶ Terrestrial ecology desktop research, data collection, analysis and reporting ▶ Terrestrial ecology impact assessment ▶ Aquatic ecology impact assessment
Ahmad Shoaib	▶ M.Phil. Fisheries and Aquaculture ▶ B.S (Hons.) Applied Zoology ▶ B.S (Hons.) Fisheries and Aquaculture ▶ 3 years of experience in aquaculture and 1 year of experience in fish surveys for environmental assessments	▶ Aquatic ecology field investigation, data analysis and reporting ▶ Development of Monitoring and Evaluation Plan for the BAP.
Muhammad Usman Berches Niazi	▶ M.Sc. Geography ▶ B.A. Geography and Economics ▶ 4 years of experience in Geographic Information Systems (GIS)	▶ Socioeconomic data collection (settlement and ecosystem services), community consultations, and compilation ▶ Socioeconomic, physical and ecological report maps

Name	*Education and Experience*	*Role and Main Activities*
Jan Muhammad	▶ MS Economics ▶ 8 years of experience in social development	▶ Translation of the Background Information Document (BID) into Urdu
Ghulam Murtaza	▶ MSc Sociology (in progress) ▶ BA Sociology ▶ FSc Pre-Engineering ▶ 7 years of experience in geographic information systems (GIS) and 8 years of experience in ecology field surveys	▶ Socioeconomic, physical and ecological report maps
Khalil Ejaz Awan	▶ MBA Business Administration ▶ Over 11 years of experience in administration and 2 years of experience in socioeconomic data collection.	▶ Administrative and logistic support
Imran Khalid	▶ Certification in MS Office and Hardware ▶ Graduation ▶ 12 years of experience in formatting and designing of technical documents	▶ Document formatting services
Umer Jahangir	▶ Graduation ▶ 7 years of experience in formatting and designing of technical documents	▶ Document formatting services
HBP Associates		
Dr Mohammad Rafique	▶ PhD Zoology ▶ MPhil Genetics ▶ MSc Zoology ▶ BSc ▶ 27 years of experience in fisheries assessments	▶ Biodiversity expert and lead aquatic ecologist ▶ Aquatic ecology field investigation, data analysis and reporting
Dr. Jamil Ahmad	▶ PhD Sociology ▶ Masters Anthropology ▶ Bachelor of Arts History ▶ 20 years of experience in socioeconomic studies and data collection	▶ Social Development Specialist ▶ Socioeconomic data collection ▶ Socioeconomic baseline reporting ▶ Socioeconomic impact assessment
Muhammad Munir Sheikh	▶ MS Hydrology ▶ MSc. Mathematics ▶ 30 years of experience in climate studies, assessments and authorship	▶ Climate change expert ▶ Climate change risk and vulnerability assessment

Name	*Education and Experience*	*Role and Main Activities*
Rizwana Waraich	▶ Master in English Literature ▶ Master in Business Administration (Human Resource Management) ▶ Bachelor of Arts in Economics and Statistics ▶ More than 15 years of experience in socioeconomic data collection, analysis and reporting with a focus on gender issues	▶ Gender Expert ▶ Socioeconomic data collection with a focus on gender-related data ▶ Gender analysis and reporting
Mishkatullah	▶ MSc (Hons) Agriculture and Entomology ▶ BSc (Hons) Agricultural Entomology ▶ FSc Pre-Engineering ▶ 12 years of experience in entomological studies	▶ Aquatic ecology field investigation (macroinvertebrates), data analysis and reporting
Rafaqat Masroor	▶ PhD Zoology (Herpetology) ▶ MSc Zoology ▶ BSc Zoology, Botany, Geography ▶ 14 years of experience in wildlife studies and conservation assessments	▶ Terrestrial ecology field investigation and data collection
Wajid Saghir	▶ MSc Botany ▶ BSc Botany, Zoology and Psychology ▶ 5 years of experience in plant studies for environmental assessments	▶ Terrestrial and riparian vegetation data collection and reporting
Buland Akhtar Siddiqui	▶ Certification in Project Management Professional (PMP) ▶ MS Computer Science ▶ Diploma in Computer Applications ▶ BSc Mathematics and Physics ▶ 20 years of experience in data analysis and management, more than 10 years of experience in project management	▶ Ecological and socioeconomic data analysis
Mohammad Arshad	▶ MSc Forestry ▶ Over 7 years of experience in social development including Resettlement Action Plans	▶ Household socioeconomic data collection
Muhammad Yasir Asad	▶ MS Sociology ▶ 6 years of experience in social development	▶ Household socioeconomic data collection
Arslan Tariq	▶ MS (M. Phil) Environmental Science	▶ Household socioeconomic data collection

Name	Education and Experience	Role and Main Activities
Madeha Aslam	▶ MA. Anthropology	▶ Household socioeconomic data collection
Sadaf Rani	▶ Master in Commerce – Finance	▶ Household socioeconomic data collection
HBP Consultants		
Bilal Khan	▶ BSc Geology ▶ BEng Environmental Engineering ▶ Over 10 years of experience in hydrology, geology and environmental impact assessment	▶ Hydrology modeling ▶ Climate Change Risk Assessment
Cate Brown	▶ PhD Zoology ▶ MSc Zoology ▶ BSc (Hons), Zoology ▶ BSc Zoology, Biochemistry ▶ 26 years of experience in aquatic ecology and integrated environmental flow assessment	▶ EFlow Expert ▶ Support for EFlow Assessment
Hussain Ali	▶ MEng Civil and Environmental Engineering ▶ 10 years of experience in environmental engineering	▶ Organization and supervision of river cross-section surveys

1.6 Organization of the Report

The EIA is organized in 10 chapters. Following this chapter, **Section 1** (*Introduction*), there are two chapters that provide the information that put the Project into context. These are

- **Section 2** (*Policy Legal and Administrative Framework*) describes the legal, policy, and requirements lenders applicable on the EIA process and the project design.
- **Section 3** (*Project Description*) describes the Project facilities, its main components, the construction activities, transport route, land requirement and the technical design summary.

The impact of the Project is assessed on the existing environment. The current status of environmental conditions are discussed in the following three chapters:

- **Section 4** (Description of the Environment) is divided into three parts:
  - **Section 4.1** (Physical Baseline) describes the geology, soils, hazards, topography, land use, climate, air quality, sound levels, visual character, and the water resources of the Study Area.

  - **Section 4.2** (Ecology Baseline) describes the fish, macro-invertebrates, riparian vegetation, terrestrial flora, mammals, avifauna, and herpetofauna of the Study Area.
  - **Section 4.3** (Socioeconomic Baseline) provides a narrative description of the socioeconomic zones, a description of the demographics, ethnicity, religion, governance, and administrative setup, social service infrastructure, physical infrastructure, local economy household socioeconomic conditions, indigenous people, and cultural heritage of the Study Area.
- **Section 5** (*Analysis of Alternatives*) identifies and the analyzes various alternatives to the Project and its design, this includes 'no project' option, alternative technology and scale of power generation, alternative Project location and layout, peaking and non-peaking operation, environmental flow and management option, and options for equipment and supplies transportation.
- **Section 6** (*Information Disclosure, Consultation, and Participation*) describes the scoping consultations undertaken for the Project and the results of consultations.

The impact assessment is organized in three chapters:

- **Section 7** (*Anticipated Environmental Impacts and Mitigation Measures*) is the main assessment chapter that assesses the impact of the proposed Project design, construction and operation on the physical, ecological and socioeconomic environment of the area. The aspects that are covered include aquatic ecology, terrestrial ecology, air quality, hydrology and water quality, noise, soil, topography, land stability, land acquisition, livelihood and well-being, macroeconomic impacts, aesthetics and tourism, climate change, cumulative impacts, traffic and road.
- **Section 8** (Grievance Redress Mechanism) that provides the framework for reporting, recording, and taking actions on complaints of the community.
- **Section 9** (*Environmental Management Plan*) provides details on management and mitigation measures to be carried out during the design, construction and operation phases of the Project. It also categorizes these measures based on the responsibilities of various members of the Project execution team and lays out the main aspects for monitoring of the implementation of management and mitigation measures.

Finally, the outcome of the impact assessment is combined to produce the following chapter:

- **Section 10** (*Conclusions and Recommendations*). It brings together the salient findings of the assessment.

2. Policy, Legal, and Administrative Framework

This section provides a summary of the national and international legislation and guidelines that are relevant to the assessment of the Project's environmental components. The review of the legal and institutional framework and relevant laws help identify the policy directives and required procedures to investigate social responsibility, environmental accountability and financial soundness of the Project.

2.1 Provincial Legislative and Regulatory Framework

The development of statutory and other instruments for environmental protection and management has steadily gained priority in Pakistan since the late 1970s. The Pakistan Environmental Protection Ordinance 1983 was the first piece of legislation designed specifically for protection of the environment. The promulgation of this ordinance was followed in 1984 by the establishment of the Pakistan Environmental Protection Agency, the primary government institution dealing with environmental issues. Significant work on developing environmental policy was carried out in the late 1980s, which culminated in the drafting of the Pakistan National Conservation Strategy. Provincial environmental protection agencies were also established at about the same time. The National Environmental Quality Standards (NEQS) (**Appendix A**) were established in 1993. The enactment of the Pakistan Environmental Protection Act 1997 (PEPA 1997) conferred broad-based enforcement powers to the environmental protection agencies. Publication of the Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations 2000 (IEE-EIA Regulations 2000) provided the necessary details on the preparation, submission, and review of an IEE and EIA. In addition to the PEPA 1997, Pakistan's statute books contain a number of other laws that have clauses concerning regulation and protection of the environment.

One of the key components of the 18th Amendment to the Constitution, passed by the parliament in 2010, was devolution of power from the federal to provincial governments. Through this amendment, the concurrent legislative list of the constitution was abolished, and all legislative powers on subjects included in the concurrent legislative list, which included environmental protection, were transferred to the provinces. Thus, after the passage of the 18th amendment, the federal government lost its power to legislate on environmental protection, and only provincial governments could make laws regarding protection of the environment.

2.1.1 Statutory Framework for Environment

The key national environmental legislation was the Pakistan Environmental Protection Act (PEPA 1997). After devolution through the 18th Constitutional Amendment 2010 the provinces have sole authority and responsibility to legislate on 'environment and ecology'. In this respect Khyber Pakhtunkhwa Environmental Protection Act 2014 (KP Act 2014), promulgated in 2014, is the relevant environmental act that will apply to this Project. This Act is largely based on PEPA 1997, with minor changes. Under the Act, all decisions made under PEPA 1997 are protected and applicable (Section 40(2)). Hence the environmental approval and conditions of approval, which were conferred before the enforcement of this act, are fully valid and applicable.

2.1.2 Khyber Pakhtunkhwa Environmental Protection Act 2014

The KP Environmental Protection Act 2014 is applicable to a broad range of issues and extends to air, water, industrial liquid effluent, and noise pollution, as well as to the handling of hazardous wastes. The articles of KP Act 2014 that have a direct bearing on the proposed Project are listed below.

The details are discussed in the following sections:

- Article 11 that deals with the KP environmental quality standards (KPEQS) and its application.
- Article 12 that deals with discharges, emissions and waste disposal.
- Article 13 that deals with IEE and EIA with review and approval process.
- Article 14 that prohibits import of hazardous waste.
- Article 15 that provides rules on handling of hazardous substances.
- Article 16 that provides regulations on motor vehicles.
- Article 17 that prohibits various acts detrimental to the environment.

The main features of the KP Act 2014 are discussed in **Exhibit 2.1**.

Exhibit 2.1: Khyber Pakhtunkhwa Environmental Protection Act 2014

Purpose	To provide for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution, and promotion of sustainable development
Definition of *Adverse Environmental Effect*	pollution or impairment of, or damage to, the environment, and includes,--- i. impairment of, or damage to, human health and safety or to property or biodiversity; ii. pollution to physical, biological, social, economic environment or to geological, hydrological resources or various land forms; iii. damage to public comfort, aesthetic conditions, ecological balance and meteorological conditions; iv. damage to aquifers, vegetal canopy, cultural heritage or archeological sites; and v. any other adverse environmental effect as may be specified in the rules
Definition of *Air Pollutant*	Any substance that causes pollution of air and includes soot, smoke, dust particles, odor, light, electro-magnetic radiation, heat, fumes, combustion exhaust, exhaust gases, noxious gases, hazardous substances and radioactive substances;
Definition of *Biodiversity Or Biological Diversity*	The variability among living organisms from all sources, including inter-alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, includes diversity within species, between species and of eco-systems;
Definition of *Environment*	i. air, water and land; ii. all layers of the atmosphere; iii. all organic and inorganic matter and living organisms; iv. the ecosystem or flora and fauna, and ecological relationships; v. buildings, structure's, roads, facilities, installations and works; vi. all social or cultural and economic conditions and activities affecting community life; and vii. the inter-relationships between any of the factors specified in sub-clauses (i) to (vi)
Definition of *Hazardous Waste*	The waste which contains hazardous substances or as may be prescribed and includes healthcare risk wastes and radioactive waste
Definition of *Hazardous Substance*	viii. a substance or mixture of substances, except the pesticide as defined in the Agricultural Pesticides Ordinance, 1971 (II of 1971), which, by reason of its physical, chemical or biological properties or toxic, explosive, flammable, corrosive, infectious, radioactive, persistent or having any other characteristics as may be prescribed, or is likely to cause, directly or in combination with other substances, an adverse environmental effect; and ix. any substance which may be prescribed as a hazardous substance;

Definition of *Discharge*	Spilling, leaking, pumping, depositing, seeping, releasing, flowing out, pouring, emitting, emptying or dumping;
Definition of *Ecosystem*	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit;
Definition of *Effluent*	Any material in solid, liquid or gaseous form or combination thereof being discharged from industrial activity or any other source and includes a slurry, suspension or vapour;
Definition of *Industrial Activity*	Any operation or process for manufacturing, making, formulating, synthesizing, altering, repairing, crushing, grinding, cleaning ornamenting, finishing, packing or otherwise treating any article or substance with a view to its use, sale, transport, delivery or disposal, or for mining, for oil and gas exploration and development, or for pumping water or sewage, or for generating, transforming or transmitting power or for any other industrial or commercial purposes;
Definition of *Industrial Waste*	Waste resulting from an industrial activity;
Definition of *Pollution*	The contamination of air, land or water by the discharge of emission of effluent or wastes or air pollutants or noise or other matter which either directly or indirectly or in combination with other discharges or substances alters unfavorably the chemical, physical, biological, radiational, thermal or radiological or aesthetic properties of the air, land or water or which may, or is likely to make the air, land or water unclean, noxious or impure or injurious, disagreeable or detrimental to the health, safety, welfare or property of persons or harmful to biodiversity;
Definition of *Noise*	The intensity, duration and character of sound from all sources, and includes vibration;
Definition of *Sewage*	Liquid or semi-solid wastes and sludge from sanitary conveniences, kitchens, laundries, washing and similar activities and from any sewerage system or sewage disposal works;
Definition of *Waste*	Substance or object or material which has been, is being or is intended to be, discarded or disposed of, and includes liquid waste, solid waste, waste gases, suspended waste, industrial waste, agricultural waste, radioactive and nuclear waste, mist, animal waste, electronic waste, municipal waste, hospital waste, pharmaceutical waste, plastic and polythene waste and residues from the incineration of all types of waste.
Definition of *Climate Change*	A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods;
Definition of *Emission*	The extent of pollutant's discharges per unit time or the extent of pollutant per unit volume of gas, liquid or vapor emitted
Definition of *Factory*	Any premises in which industrial activity is being undertaken;
Functions of the Agency	Administer and implement the provisions of this Act and the rules made there under;
	Prepare, in coordination with the appropriate Government Agency or local council and in consultation with the concerned sectoral Advisory Committees where established, environmental policies for the approval of the Council

	Prepare, revise and establish the Khyber Pakhtunkhwa Environmental Quality Standards with the approval of the Council: Provided that before seeking approval of the Council, the Agency shall publish the proposed Khyber Pakhtunkhwa Environmental Quality Standards for public opinion in accordance with the prescribed procedure;
	Ensure enforcement of the Khyber Pakhtunkhwa Environmental Quality Standards; resources, solid waste management and water sanitation
	Establish standards for the quality of the ambient air, water and land, by notification establish different standards for discharge or emission from different sources and for different areas and conditions as may be necessary: Provided that- (a) where these standards are less stringent than the Khyber Pakhtunkhwa Environmental Quality Standards prior approval of the Council shall be obtained; and (b) list of areas, with the approval of the Council, in which any class of activities or projects shall not be carried out or shall only be carried out subject to certain specified safeguards;
	Co-ordinate with other Provinces, Federal Government, National and International Organizations for the implementation of environmental policies, issues concerns and programs as may be prescribed
	Co-ordinate and facilitate the Government departments, agencies, organizations and institutions in the Khyber Pakhtunkhwa in adaptation to address the impacts of climate change;
	Establish systems and procedures for surveys, surveillance, monitoring, measurement, examination, investigation, research, inspection and audit to prevent and control pollution, and to estimate the costs of cleaning up pollution and rehabilitating the environment in various sectors
	Carry out and conduct environmental monitoring and implementation of environmental approvals provided in this Act;
	Carry out and conduct environmental audits of old industrial units in accordance with rules(Old industrial units means those established before the commencement of this Act)
	Issue licenses for the consignment, handling, transport, treatment, disposal, storage, handling or otherwise dealing with hazardous substances;
	Assist Government Agencies, local councils, local authorities and other persons to implement schemes for the proper disposal of wastes so as to ensure compliance with the Khyber Pakhtunkhwa Environmental Quality Standards
	Provide information and guidance to the public on environmental matters

	Specify safeguards for the prevention of accidents and disasters which may cause pollution, collaborate with the concerned persons in the preparation of contingency plans for control of such accidents and disasters, and co-ordinate implementation of such plans;
	Review and approve mitigation plans and give guidance and directions, where necessary, for cleanup operations ordered under this Act
Prohibition of certain discharges or emissions	(1) Subject to the provisions of this Act, rules, notifications and guidelines made thereunder i. no person shall discharge or emit or allow the discharge or emission of any effluent or wastes or air pollutant or noise, load, concentration or level which is in excess of the Khyber Pakhtunkhwa Environmental Quality Standards or, where applicable, the standards established under sub clause (vii) and (viii) of sub-section (1) of section 6; and ii. No person shall discharge effluents, emissions or wastes in excess of load permitted in the conditions of environmental permit or environmental approval or license. (2) The Agency, with the approval of Government, may levy a pollution charge on any person who contravenes or fails to comply with the provisions of sub-section (1), to be calculated at such rate, and collected in accordance with such procedure as may be prescribed. (3) Any person who pays the pollution charge levied under sub-section (2), shall not be charged with an offence with respect to that contravention or failure.
Initial Environmental Examination and Environmental Impact Assessment	1) No proponent of a project shall commence construction and operation unless he has filed with the Agency an initial environmental examination or where the project is likely to cause an adverse environmental effect, an environmental impact assessment, and has obtained from the Agency, environmental approval in respect thereof. (2) The Agency shall (a) review the initial environmental examination and accord its approval or require submission of an environmental impact assessment by the proponent; or (b) review the environmental impact assessment and accord its approval subject to such conditions as it may deem fit to impose, require that the environmental impact assessment be resubmitted after such modifications as may be stipulated, or reject the project as being contrary to environmental objectives. (3) Every review of an environmental impact assessment shall be carried out with public participation and no information will be disclosed during the course of such public participation which relates to: (a) trade, manufacturing or business activities, processes or techniques of a proprietary nature, or financial, commercial, scientific or technical matters which the proponent has requested should remain confidential, unless for reasons to be recorded in writing, the Director-General of the Agency is of the opinion that the request for confidentiality is not well-founded or the public interest in the disclosure outweighs the possible prejudice to the competitive position of the project or its proponent; or

	(b) International relations, national security or maintenance of law and order, except with the consent of Government; or (c) Matters covered by legal professional privilege. (4) The Agency shall communicate its approval or otherwise within a period of four months from the date of the initial environmental examination or environmental impact assessment is filed complete in all respects in accordance with the prescribed procedure, failing which the initial environmental examination or, as the case may be, the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules, provided that delay is not on part of the proponent for the provision of additional information asked for during the review process or conductance of public hearing of the project. (5) Subject to sub-section (4), Government may in a particular case extend the aforementioned period of four months if the nature of the project so warrants. (6) The provisions of sub-sections (1), (2), (3), (4) and (5) shall apply to such categories of projects and in such manner as may be prescribed. (7) The projects or any activity of a proponent not covered under sub-section (6), specified in guidelines shall obtain a general environmental approval in a manner prescribed in guidelines in respect thereof. (8) The Agency shall maintain separate Registers for initial environmental examination and environmental impact assessment projects, which shall contain brief particulars of each project and a summary of decisions taken thereon, and which shall be open to inspection by the public at all reasonable hours and the disclosure of information in such Registers shall be subject to the restrictions specified in sub-section (3).
Handling of Hazardous Substances	Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose of, store, handle, deal in and use or import any hazardous substance except--- (a) under a license issued by the Agency and in such manner as may be prescribed; or (b) in accordance with the provisions of any other law for the time being in force, or of any International Treaty, Convention, Protocol, Code, Standard, Agreement or other instrument to which Pakistan or the Province of the Khyber Pakhtunkhwa is a party.

Regulation of motor vehicles	(1) Subject to the provisions of this Act, and the rules, notification and guidelines made thereunder, no person shall operate a motor vehicle from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the Khyber Pakhtunkhwa Environmental Quality Standards or where applicable the standards established under clauses (vii) and (viii) of sub-section (1) of section 6. (2) For ensuring compliance with the standards mentioned in sub-section (1), the Agency may direct that any motor vehicle or class of vehicles or locomotive shall install such pollution control devices or other equipment or use such fuels or undergo such maintenance or testing as may be prescribed. (3) Where a direction has been issued by the Agency under sub-section (2) in respect of any motor vehicles or class of motor vehicles, or locomotives, no person shall operate any such vehicle till such direction has been complied with.

2.1.3 Preparation and Submission of EIA

Article 13 of KP Act states that "No proponent of a project shall commence construction and operation unless he has filed with the Agency an initial environmental examination (IEE) or where the project is likely to cause an adverse environmental effect, an environmental impact assessment (EIA), and has obtained from the Agency, environmental approval in respect thereof".

Hydroelectric power generation projects with capacities greater than 50 MW require an EIA as per the categorization of the IEE-EIA Regulations 2000. The law requires that the EIA must be submitted and approved by the provincial EPA before any construction activities can commence.

2.2 Environmental Standards

2.2.1 National Environmental Quality Standards

KP EPA is yet to formulate the *Khyber Pakhtunkhwa Environmental* Quality Standards (KPEQS) as per Article 6 (v) of the KP Act 2014. So, the National Environmental Quality Standards (NEQS) will be applicable to the Project. Article 11(1) of the PEPA 1997 states that
"Subject to the provisions of this Act and the rules and regulations made thereunder no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the National Environmental Quality Standards."

NEQS have been established for gaseous emission, liquid effluent, ambient air quality, noise and drinking water. From the date of enforcement of the NEQS, all projects, whether in operation on the date or constructed later, are required to comply with these standards.

The Project needs to comply with all applicable standards, and Project proponents and contractors should ensure that no activity will result in the emission of pollutants and effluents exceeding limits as prescribed in the NEQS. The applicability of the NEQS to the Project is described in **Exhibit 2.2**. The complete set of NEQS are included in **Appendix A**.

Exhibit 2.2: NEQS Applicable to the Project

NEQS	*Applicability During Construction*	*Applicability During Operation*
Gaseous Emission	All power generators	Any back-up generator
Noise emission	All noise sources	Not applicable
Emission from motor vehicles	All project vehicles	All project vehicles
Noise from motor vehicles	All project vehicles	All project vehicles

NEQS	Applicability During Construction	Applicability During Operation
Ambient air quality	Changes in air quality of the surrounding are due to construction activities	Not applicable
Liquid effluent	Sanitary waste and other liquid waste discharged to the environment	Sanitary waste and other liquid waste discharged to the environment
Drinking water	Water supplied by the owners and contractors to staff	Water supplied by the owners and contractors to staff

2.2.2 ADB's Guidelines for Project Emission

The ADB requires that "During the design, construction, and operation of the project the borrower/client will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from these levels and measures, the borrower/client will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/client will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in this document."

The IFC's EHS Guidelines[1] will be used as the basic criteria for evaluating the emissions (gaseous, effluent, noise, etc.) from the Project. Fundamentally, the NEQS as well as the IFC EHS Guidelines will be applicable following the guidelines cited above.

2.3 Other Environmental Laws

2.3.1 Land Acquisition Act 1894

The national law governing land acquisition is the Land Acquisition Act 1894 (LAA 1894) and successive amendments to it. The LAA 1894 regulates the land acquisition process and enables the government to acquire private land for public purposes through the exercise of the right of eminent domain. Land acquisition is a provincial responsibility in Pakistan and provinces also have their own province-specific implementation rules.

The LAA 1894 and its implementation rules require that, following an impact identification and valuation exercise, land and crops are compensated in cash at the current market rate to titled landowners. In past practice land acquisition was usually based on the last 3 to 5 years average registered land–sale rates. However, in several recent cases like Faisalabad Khanewal motorway project and the Expressway 35 project, the median rate over the past 1 year, or even the current rates have been applied. Under

1 Sustainability Overview webpage on the official website of the International Finance Corporation – World Bank Group, http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

section 23 of LAA 1894 and its amendments, in addition to the market–value of the land a sum of 15% of the amount as compulsory acquisition surcharge is also paid to the affected persons (APs), if the acquisition has been made for public purpose and a sum of 25% on such market–value if the acquisition has been made for a Company. The APs, if not satisfied, can go to the Court of Law to contest the compensation award of the LAC.

The various sections relating to the land acquisition are briefly discussed below and summarized in **Exhibit 2.3**.

Exhibit 2.3: Key Feature of the LAA 1894

Section	*Actions [Person Responsible]*	*Purpose and Effect*
4	▶ Publication in the official gazette of a notification that a “land in any locality is needed or is likely to be needed for any public purpose or for a Company” [Collector] ▶ Public notice of the substance of such notification at convenient places in the said locality [Collector]	Allows preliminary investigation. In affect it demonstrates the interest of the government that the “land in any locality is needed or is likely to be needed for any public purpose or for a Company” Allows the Collector to authorize persons to enter, and where necessary, clear the land to: survey the land; undertake soil and other studies for determining the suitability of the land; measure land and demarcate boundaries by placing markers.
5 and 5A	▶ Publication in the official gazette by the government a) the intention of the government that any particular land included in Section 4 notification is needed for public purposes or for a Company, b) the administrative location of the land, c) the purpose of land acquisition, d) its approximate area, and e) location where the development plan for the land, if required, is available for public inspection, if required, [DC, if land required for public purposes or the provincial government if land required for a Company] ▶ Public notice of the substance of such notification at convenient places in the said locality Collector	Notifies the intention of the government to acquire land for the particular purpose in order to give opportunity to the interested persons (persons who would be entitled to claim an interest in compensation if the land were acquired) to file an objection to the land acquisition. The objection can be filed within 30 days.
6	▶ The Collector, if satisfied after reviewing the report made under section 5–A, subsection (2), will make a declaration in the official Gazette with conclusive evidence, stating that particular land is required for public/private purpose. The declaration will include the location of the land, the purpose and its approximate area. ▶ The declaration shall be made only after ensuring that the compensation is to be paid by the company.	Provides the declaration from the collector for the purchase of required land. Declaration is published and communicated to the public in large to notify the acquisition of land including its location, area and purpose.
7	▶ After declaration under Section 6 Collector, to take order for the acquisition of the land.	Official orders are given by the [Executive District Officer (Revenue)], directing the Collector, to initiate the formal land acquisition process.
8	▶ If the required land is not demarcated under section 4, the Collector, will give orders to mark, measure and plan out the required land.	Demarcation of required land as per the exact requirement of the project.

Section	Actions [Person Responsible]	Purpose and Effect
9	▶ The Collector to issue public notice at convenient places on or near the land to show intentions for acquiring required land and inviting to file claims for compensation, objections to measurements etc., indicating date, time and place for all the land owners, indicating such date not earlier than 15 days. ▶ The Collector also to serve notice, by post, to the occupier or to the known land owners (if any), residing within the revenue district or elsewhere. ▶ The Collector shall also serve notice, not less than 15 days prior to the date fixed under sub–section (2) of section 9, to the land owners about the inquiry to be held under section 11 for determination of claims and objections.	To inform the land owners and public at large, well ahead the time, about the acquisition of the demarcated land to ensure that interested persons are given sufficient time to object or claim.
10	▶ The collector will also require and send a notice to any other interested person (co–proprietor, sub–proprietor, mortgagee, tenant or otherwise) with interest/claim pertaining to the required land. ▶ Any person claiming any interest under this section or section 9 will be bound to do so within the meaning of section 175 and 176 of Pakistan Penal Code.	To ensure that there are no financial discrepancies left unaddressed during the process of land acquisition and every person associated with the land is duly informed and their objection/claims are appropriately addressed.
11	▶ On the fixed date, the Collector to enquire into the claims and objections of interested persons with regard to measurements made under section 8, value of the land (at the date of the publication of the notification under section 4, sub–section (1) and respective claims. The Collector can make an award (under his jurisdictions) of true area of the land, compensation which in his opinion should be allowed for the land and the distribution of the compensation among all the known or believed to be interested in the land, whether they have appeared before him or not.	To determine the actual land owners and precise measurements of the required land. This section also ensures that the compensation paid is true representation of the value of land. To ensure that the compensation is fairly distributed among all the owners of the land.
12	▶ The award filed in the Collector's office shall be deemed conclusive, whether the interested persons have appeared before the Collector or not. ▶ The Collector shall issue immediate notice of the award to the land owners whether they have appeared personally or by their representatives when the award is made.	To avoid potential future conflicts between the government and the owners of the land. This ensures that the decision made by the collector is final. To convey complete information in a timely manner to the land owners. This section ensures that the land owners have complete information on the award irrespective of their presence in Collector's office.

Section	*Actions [Person Responsible]*	*Purpose and Effect*
12 –A	▶ The Collector can rectify any mistake (typographical, arithmetical errors) in the award by his own motion or on the application of any of the parties.	To ensure that there are no errors or mistakes in the award or the assessment of the land. This ensures that the measurement and valuation of the land is done justly.
13	▶ The Collector may conduct or discontinue and reschedule the enquiry for any reason, any day/time fixed by him.	To implement check and balance on the system. This ensures sense of responsibility on the government officers.
14	▶ The Collector is empowered by this section to call, and enforce the attendance of witnesses, including the interested parties or any of them to produce the documents by the same means, and in the same manner as provided the case of a Civil Court under the Code of Civil Procedures.	To avoid future conflicts and increase transparency in the land acquisition process. To ensure that only the rightful legal owners who have proper documents are paid the award and no illegal claims are entertained.
15	▶ The Collector shall be guided by section 23 and 24 in determining compensation.	
16	▶ Under this section, the collector may take possession of the land, after the compensation paid to the owner of the land or deposited in the Civil Court in his name by the acquisitioning authority and the required land, shall then be granted to the government without any further claim.	To ensure smooth transfer of land rights from the owner to the acquisitioning authority. This gives security to the acquiring authority that once the award is paid in full, the Collector will take the possession of the land.

2.3.2 Key Biodiversity Laws

There are a number of other laws in the statute books of Pakistan which have a bearing on the environmental performance of the Project. The three primary laws are described in **Exhibit 2.4**.

Exhibit 2.4: Three Key Laws Relevant to the Project

Law	*Description*	*Applicability to the Project*
The Khyber Pakhtunkhwa Forest Ordinance, 2002	This Act authorizes provincial forest departments to establish forest reserves and protected forests. The Act prohibits any person from: setting fires in the forest; quarrying stone; removal of any forest produce; or causing any damage to the forest by cutting trees or clearing areas for cultivation or any other purpose without express permission of the relevant provincial forest department.	The Project area does not include any forest reserve or protected forests established by the provincial forest department. There is limited forest cover around the Project facilities locations. Therefore, this law is not applicable to the Project.
The Khyber Pakhtunkhwa Wildlife and Biodiversity (Protection, Preservation, Conservation and Management) Act, 2015	This law was enacted to protect the province's wildlife resources directly and other natural resources indirectly. It classifies wildlife by degree of protection, i.e., animals that may be hunted on a permit or special license, and species that are protected and cannot be hunted under any circumstances. The Act specifies restrictions on hunting and trade in animals, trophies, or meat. The Act also defines various categories of wildlife-protected areas, i.e., National Parks, Wildlife Sanctuaries, and Game Reserves.	Parts of the Kunhar River are protected due to the presence of trout species. Furthermore, there are protected areas within the Mansehra District. If the Project and related activities is found to impact Protected Areas, this law will be applicable.
NWFP Fisheries Rules 1976	This law prohibits destruction of fish by explosives, poisoning water and the hunting of protected fish species. The law also forbids the use of net or fixed engine traps without a permit or license. The law grants power to the Director General (DG) Fisheries to issue permits to catch fish. It protects fish against 1) Destruction of fish by explosives, and 2) Destruction of fish by poisoning water.	This law was applicable to the Project as there was a possibility of catching fish as sustenance by the Project staff and also makes it obligatory to obtain a license from the fisheries department before commencing any fishing activities.

2.3.3 Other Laws

In addition to the laws cited above, a number of other laws were reviewed for provisions that can affect the environmental and social performance of this Project. A list is provided in **Exhibit 2.5**. These were reviewed and the results of the review are provided in this section, in particular information about their potential to impact the Project.

Exhibit 2.5: Other Laws Reviewed

Antiquities Act, 2016	Industrial Relations Act, 2010
Delimitation of Local Councils Act, 2015	Forestry Commission Act, 1999
Environmental Protection Act, 2014	Irrigation and Drainage Authority Act, 1997
Factories Act, 2013	Kaghan Development Authority Act, 1996
Forest Ordinance, 2002	Minimum Wages Act, 2013
Industrial and Commercial Employment (Standing Orders) Act, 2013	Payment of Wages Act, 2013
Energy Development Organization Act, 1993	Rivers Protection Ordinance, 2002
Integrated Water Resources Management Board Ordinance, 2002	Worker’s Compensation Act, 2013
Prohibition of Employment of Children Act, 2015	The Khyber Pakhtunkhwa Local Government Act, 2013
Protection of Trees and Brushwood Act, 1949	The West Pakistan Firewood and Charcoal (Restriction) Act, 1964
Rural Drinking Water Supply Scheme Act, 1985.	Wildlife and Biodiversity (Protection, Preservation, Conservation and Management) Act, 2015
The Khyber Pakhtunkhwa Right to Information Act,2013	

Energy Development Organization Act, 1993

The Pakhtunkhwa Energy Development Organization (PEDO) is granted authority by this Act to develop the energy resources in KP. Under this Act, development of hydropower is transferred to PEDO.

The Project is being developed by PEDO, which is operating under this Act. It is necessary for PEDO to comply with all regulations under this Act.

Forest Ordinance, 2002

The Forest Ordinance, 2002 has been instated to protect, conserve, manage and sustainably develop forests and other renewable natural resources. The ordinance empowers the government to declare any forest land as reserved or no longer reserved, designate reserve forests for village communities to use, declare forest land or wasteland as Protected Forests or remove protected status, control Guzara Forests, Mazri and Mazri produce, as well as timber and timber produce. Under the ordinance the government is granted powers forest management, with authority given to forest officers. The government, through its officers, has the right to exercise penalties on violations on prohibitions as laid out in the ordinance.

Certain plant species are protected under the Act when found in reserved forests, protected forests and protected wastelands. A list of these species is provided in Schedule I of the Act.

The Project is not expected to impact Reserve Forests, Protected Forests, Village Forests or Guzara Forests. Reserved Forests are located around the Project facilities. The Project will have an impact on forested areas. It is important to ensure that Project-related activities do not encroach on any of the above-mentioned types of forests. It is also important that Project staff not engage in the collection or trade of forest produce.

Forest Development Corporation Ordinance, 1980

The Forest Development Corporation has been established under this ordinance. The corporation functions to “make suitable arrangements for the

(i) economic and scientific exploitation of forests;

(ii) sale of forest produce;

(iii) establishment of primary wood-processing units;

(iv) regeneration in areas to be specified by Government; and

(v) performance of such other functions as may be assigned to it by Government.”

The Project will not be impacted by this ordinance. It should be ensured that Project staff do not engage in activities that are under the jurisdiction of this corporation for example in the trade of forest products.

Forestry Commission Act, 1999

The Act is aimed at establishing a Forestry Commission to improve the protection, management sustainable development of forests in KP. Under this Act the Commission established is empowered and entrusted to further this aim by taking steps such as giving vision and a framework for the sustainable development of forests in KP, guiding and overseeing the process of institutional and legislative reforms in the Department, advocating policies for sustainable development of forests etc. The Project will not be impacted by this Act, however, any initiatives undertaken by the Commission may be of interest to the Project for biodiversity management and mitigation.

Protection of Trees and Brushwood Act, 1949

The Act provides protection for trees and brushwood. Under this Act it is illegal to clear trees and brushwood belonging to the local government. The Project is being developed by PEDO, therefore, it is owned by the local government. Project-related activities should only be undertaken on land acquired for the Project. They should not clear trees or brushwood outside the acquired area.

Wildlife and Biodiversity (Protection, Preservation, Conservation and Management) Act, 2015

The Act has been instated to consolidate the laws relating to protection, preservation, conservation and management of wildlife in KP. Its aims include the following:

> "(a) strengthening the administration of the organization[2] to effectively manage wild animals and their habitats;
>
> (b) to holistically manage Protected Areas in a sustainable manners for the best interest of the indigenous communities and local stakeholders;
>
> (c) securing appropriately the goods and services produced from wild animals and their habitats at the level of local communities;
>
> (d) fulfilling the obligations envisaged under the biodiversity related multilateral environmental agreements ratified by the Government of Pakistan;
>
> (e) promotion of public awareness and capacity building for proper appreciation of the environmental significance and socio-economic values of wildlife; and
>
> (f) conservation of biological diversity and realization of its intrinsic and extrinsic values through sustainable use and community participation."

The Act empowers Wildlife Officers to enforce the laws relating to wildlife conservation and management and to use reasonable force to do so, if necessary. It places restrictions on hunting, possession and display of wildlife, trade and trafficking of wildlife or wildlife products, and protected areas. Wildlife offences and penalties for those offences are provided in the Act.

The Project and Project-related activities will be affected by the Act if there is violation of the rules pertaining to wildlife. This will be the case if staff engage in activities prohibited under the Act such as hunting, possession and display of wildlife, trade in wildlife and wildlife products, introduction of alien invasive species and so on. To ensure compliance with law, staff should report any wildlife sightings to the concerned government department.

Rivers Protection Ordinance, 2002

The ordinance has been instated to provide for the protection of aquatic ecology, water quality, economic and environmental value of rivers and their tributaries in KP. The ordinance has been instated keeping in view the increasing developments along rivers in KP and the need to maintain the quality of the rivers for public use. The rules set out will be applicable on any length of a particular river or stream or any part of a river or its tributary that has been specified by the Government. The Project is a hydropower project being developed on the main Kunhar River. If the Government of KP has designated the Kunhar River or specifically a stretch of the Kunhar River which includes the stretch to be used by the Project, then the rules set out in this ordinance will be applicable.

The rules laid out in the ordinance relate mainly to encroachment onto the river and pollution of the river. It is important that Project-related activities do not pollute the river

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[2] Wildlife Department, KP

and that all construction activities along the river banks be carried out within the area designated for them.

Integrated Water Resources Management Board Ordinance, 2002

The Integrated Water Resources Management Board has been established to devise and oversee the implementation of an integrated water resources management strategy aimed at sustainable economic, social and environmental returns on water resource development. Under the ordinance a Board has been established, the functions of which include conducting studies to accurately assess the various demands of water for consumptive or non-consumptive use. This includes the use of water resources for hydropower itself, as well as areas that will potentially be affected by the Project such as fisheries, water-related sports, environmental sustainability, forestry, lakes and water bodies etc. The Managing Director of PEDO is a member of the Board established under this ordinance.

The Project will be affected by this ordinance as it is impacting the flow of the Kunhar River. Any policies, rules and procedures put in place by the Board need to be complied with. In addition to this studies conducted as part of this assessment should be shared with the Board.

Rural Drinking Water Supply Scheme Act, 1985

The Act has been instated to facilitate the execution of schemes for supply of drinking water in rural areas. Project-related activities should not disrupt any schemes established under this Act. As long as Project-related activities take place within the land acquired for the Project, this law will not affect the Project.

Irrigation and Drainage Authority Act, 1997

The Act addresses the irrigation and drainage system in KP by requiring the adoption of a strategy for streamlining it. It includes the implementation of policies in the water resources sector to improve and sustainably develop supply for irrigated agriculture along with operating and maintaining irrigation, drainage, storage reservoirs and flood control infrastructure in KP. The Project will not be affected by the Act if it does not affect the irrigation system in KP. Irrigation is not expected to be impacted by the Project.

The West Pakistan Firewood and Charcoal (Restriction) Act, 1964

The Act prohibits the burning of firewood and charcoal in factories, brick-kilns, limekilns and other specified places. The Project can be considered a factory under the definition provided in the Act. The Project owner and developer should ensure that no burning of firewood and charcoal is carried out in premises under its control.

Antiquities Act, 2016

The Antiquities Act, 2016 is applicable to the Project. Chapter IV, Clause 56 ‘Execution of mega project’ requires a clearance to be obtained from the Director (as defined in the Act) before construction of a dam. Chapter VI, Clause 70, ‘Regulation of mining, quarrying, etc.’ gives the Director authority to prohibit mining, quarrying, excavation, blasting and movement of heavy vehicles for the purpose of protecting or preserving any immovable antiquity.

Factories Act, 2013

The Factories Act, 2013 provides for the regulation of labor in KP. A factory is defined as "…any premises, including the precincts thereof, whereon ten or more workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on or is ordinarily carried on with or without the aid of power, but does not include a mine, subject to the operation of the Mines Act, 1923 (Act No. IV of 1923);" Based on this definition, the Act is applicable to the Project.

The Act regulates a range of conditions relating to labor. These include health and safety, restrictions on working hours of adults, holiday with pay, and special provisions for adolescents with children. It also provides for government inspection staff to function as directed by the government, penalties and procedures relating to violations of the Act as well as supplemental information for staff (such as display of factory notices, removal of difficulties, protection against discrimination etc.). The Project needs to comply with the requirements under these regulations.

Industrial and Commercial Employment (Standing Orders) Act, 2013

The Industrial and Commercial Employment (Standing Orders) Act, 2013 provides for the regulation of industrial and commercial employment in KP. It provides a list of standing orders for workers in the province. These include classification of workers based on types of contracts, identification of workers, the requirement for documenting terms and conditions, publications of working times, publication of wage rates, shift working, payment of wages, incentive schemes, insurance, bonuses, stoppage of work, closure of establishment, termination of employment, punishments, liability of the employer, amongst others.

The Project is required to comply with the clauses in this Act. The terms and conditions for the workers need to be published and all matters related to agreements between workers and the developer, outlined in the Act, need to be documented and adhered to.

Prohibition of Employment of Children Act, 2015

The Act has been instated to prohibit the employment of children and to regulate the employment of adolescents in KP. The Project will be impacted by the Act only if it employs children under the age of 14. The Project should not employ children or adolescents for any Project-related activities. Under the Act, staff designated by the government, can inspect the Project facilities to ensure compliance with its rules. The inspector may require the establishment to provide evidence of age of staff in case of dispute over age.

Industrial Relations Act, 2010

The Act has been instated to regulate relationships between workers and employers. It outlines the rights and responsibilities of the workers and the employer. For example, workers and employers can, without distinction, establish and join associations of their own choice. Every trade union and employer's association shall frame its own constitution and rules to elect its representatives.

The owners and developers of the Project need to ensure that no unfair conditions are placed on labor in terms of employment practices. The workers also must not partake in any unfair labor practices. Furthermore, under the Act, participation of workers in management is important. Under the Act the government can appoint an inspector to ensure compliance with provisions of the Act. The Act also provides for penalties in case of violations of provisions in the Act.

Minimum Wages Act, 2013

The Act provides for the regulation of minimum rates of wages and various allowances for different categories of workers employed in certain industrial and commercial undertakings and establishments. The Project needs to ensure that all workers are paid at least minimum wages. If this is ensured, the Act will not affect the Project.

Payment of Wages Act, 2013

The Act regulates the payment of wages to persons employed in factories, industrial establishments and commercial establishment in KP. The Project can be considered a factory under the definition in the Act. Therefore, it needs to comply with the provisions of the Act by ensuring payment of wages by all responsible people.

Worker's Compensation Act, 2013

The Act provides for workers or their legal heirs compensation for injury or death by accident. The Project owner will be liable to provide compensation if personal injury is caused to a worker by accident during the course of his employment.

Kaghan Development Authority Act, 1996

The Act instates the development of an authority to develop Kaghan and other regions of Hazara Division. The Kaghan Development Authority is empowered by the Act for environmental upgradation and uplift of the common. The Authority is involved in development of schemes in diverse types of scheme, examples of which include education, health, agriculture and industry, forest conservation, preservation of wildlife, promotion of tourism, improvement of water supply, land slide management, sewerage and drainage etc.

The Project will have an impact on the area under the jurisdiction of the Kaghan Development Authority. The Project is being developed by PEDO, therefore, it is owned by the Government of KP. Under the Act the Authority shall discharge its functions, guided by directions from the government. This highlights the importance of PEDO to coordinate with the Kaghan Development Authority, especially as Project-related activities will place added pressure on the service infrastructure in the area, which is under the Authority. However, the Act is not binding on the Project.

The Khyber Pakhtunkhwa Local Government Act, 2013

The Act has been instated to construct and regulate local government institutions in KP and to consolidate laws relating to these institutions. The Act defines the functions and powers of various heads of local government such as District Councils, Villages, City Districts etc.

The local government is a stakeholder with whom the Project needs to coordinate. Any changes in the organization, powers and functions of the local government, directed by the Act, can affect the Project.

Delimitation of Local Councils Act, 2015

The Act mainly concerns the defining of local councils by providing for the delimitation of village councils, neighborhood councils and territorial wards for general seats to tehsil councils, and district councils, for elections to local councils in KP. The Act may affect the Project if there is a change in the delimitation of local councils.

The Khyber Pakhtunkhwa Right to Information Act, 2013

The Act provides for ensuring transparency and access to information in KP. The Project is a public sector Project, therefore, it needs to provide information to the public and not compromise transparency under this Act.

2.4 Federal and Provincial Conservation Strategies

Pakistan National Conservation Strategy (PNCS) [3] was prepared jointly by the then federal Ministry of Environment with assistance from the International Union for the Conservation of Nature (IUCN). It was approved by the federal cabinet in 1992 as the basic policy document on environmental sustainability.

The Sarhad Provincial Conservation Strategy (SPCS)[4] was prepared by the Government of KP with assistance from IUCN. It was approved by the provincial cabinet in 1996 and was considered a sustainable development action plan for the KP.

Both these documents are no longer used for planning purposes and as such are obsolete as a policy document. However, they can be used where relevant as a guideline.

National Sustainable Development Strategy, 2012 (NSDS): The NSDS envisions the evolution of a just and harmonious society via the promotion of vibrant and equitable economic growth without the over-exploitation of natural resources and the fair distribution of development dividends to all, in particular marginalized, poor, and vulnerable in society and to future generations. The strategy is aligned with the emerging concept of 'green economy' as an alternate to the Framework for Economic Growth (2011), prepared by the Planning Commission of Pakistan.

National Climate Change Policy (2012): The National Climate Change Policy, approved by the Government in 2012 has the overall goal 'to ensure that climate change is mainstreamed in the economically and socially vulnerable sectors of the economy and to steer Pakistan towards climate resilient development'. One of the major objectives of this policy is conservation of natural resources and long term sustainability further elaborated through specific measures under forestry, biodiversity, and other vulnerable ecosystems. With respect to forestry, the National Climate Change Policy (NCCP) outlines the need to restore and enhance Pakistan's forest cover under sustainable forest management to 'withstand present and probable future impacts of climate change.'

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3 The Pakistan National Conservation Strategy, 1992.

4 The Sarhad Provincial Conservation Strategy, 1996, Government of North West Frontier Province in collaboration with IUCN–The World Conservation Union.

Biodiversity-related policy measures include setting national biodiversity indicators and provision of requisite financial resources for implementation of the BAP (2000).

To support the Climate Change Policy, in 2013 the Government prepared a Framework for Implementation of the Climate Change Policy (2014-2030) which lists priority, short-term, medium-term and long-term actions to be implemented in various sectors including forestry.

2.5 Institutional Framework

The success of environmental assessments as a means of ensuring that development projects are environmentally sound and sustainable depends in large measure on the capability of regulatory institutions for environmental management. The institutional framework for decision-making and policy formulation in environmental and conservation issues is briefly described below.

The Khyber Pakhtunkhwa Environmental Protection Agency (KP EPA) is primarily responsible for administering the provisions of the KP Environmental Protection Act, 2014. The institutional framework for decision-making and policy formulation in environmental and conservation issues is summarized in **Exhibit 2.6**.

Exhibit 2.6: Institutional Responsibilities

Agency	*Law*	*Functions*	*Relevance to the Project*
KP Environmental Protection Agency and KP Environmental Protection Council	KP Environmental Protection Act 2014	Enforcement of provisions of the KP Environmental Protection Act 2014 in KP	KP-EPA has the key jurisdiction in the context of environmental protection over the Project
Pakhtunkhwa Energy Development Organization (PEDO)	The Sarhad Hydel Development Organization Act, 1993	Preparation of a comprehensive plan for the development and utilization of the power and energy resources of KP, and framing of a scheme or schemes for the province for generation, transmission and distribution of power.	Being the developer, PEDO needs to ensure compliance with the requirements of the KP EPA and lender agencies.
National Electric Power Regulatory Authority (NEPRA)	Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997	Regulating the provision of electric power services, specifically grant licenses for generation, transmission and distribution of electric power. The Act requires the licensee to follow performance standards laid down by the Authority for distribution and transmission of electric power, including safety, health and environmental protection instructions issued by the Authority or any Governmental agency, with the least environmentally harmful supply of electricity.	The Authority requires preparation and approval of EIA from the respective EPA as a condition of grant of generation license. Beyond this the authority has no direct role in environmental management as per current practice.
Provincial Disaster Management Authority KP	National Disaster Management Act (Amended) 2012	The Authority may: lay down policies on disaster management; lay down guidelines to be followed by government; and take such measures for the prevention of disaster or the mitigation or for preparedness and capacity building for dealing with disaster situation as it may consider necessary.	Will be the key agency in case of any natural or human-made emergency and disaster in the Project area.
Fisheries Department, KP	NWFP Fisheries Rules 1976	The Fisheries Department has the authority to enforce the laws and regulations provided in the Fisheries Rules, 1976. This includes regulation of fishing methods using permits and licenses, the species that can be caught and associated penalties for violation of regulations pertaining to wild fish.	All wild fish fauna is under the jurisdiction of the Fisheries Department, therefore, they need to be informed about any impacts on fish fauna and related mitigation measures need to be agreed with them.

Agency	Law	Functions	Relevance to the Project
Forest Department, KP	The Khyber Pakhtunkhwa Forest Ordinance, 2002. Khyber Pakhtunkhwa Ordinance No. XIX of 2002.	The Forest Department enforces the provisions of the Forest Ordinance, 2002 to meet its objectives which include protection, conservation, management and sustainable development of forests by engaging the community and defining the role of the government.	All forest areas including reserved forests, village forests, protected forests, guzara forests and wastelands, and produce from forests is under the jurisdiction of this department. They need to be informed about impacts on forests and they need to agree with related mitigation measures.
Wildlife Department, KP	The Khyber Pakhtunkhwa Wildlife and Biodiversity (Protection, Preservation, Conservation and Management) Act, 2015	The Wildlife Department enforces the provisions of the Khyber Pakhtunkhwa Wildlife and Biodiversity Act, 2015 to meet its objectives which include strengthening the administration of the organization to effectively manage wild animals and their habitats, to fulfil the obligations of the government under its commitments to managing biodiversity, and promoting public awareness for the value of wildlife and conservation.	All wildlife is under the jurisdiction of this department. The department needs to be informed of impacts on wildlife and they need to agree to related mitigation measures.
Local Governments	The Khyber Pakhtunkhwa Local Government Act, 2013 Act No. XXVIII	Under this Act the local governments are established and function within the provincial framework. Local areas for local government include villages, neighborhoods, tehsils, towns, districts, and city districts. The Act foresees a role for the district government in environmental management.	The District Administration in Mansehra, if it has enacted any of the procedures for environmental management, will be involved in certain aspects of environmental management of the Project.

2.5.1 Environmental Protection Agency

The KP EPA was established in 1989. It is a monitoring and regulating agency with the following main functions:

- Administer and implement the KP Environmental Protection Act 2014, its rules and regulations.
- Review the IEE-EIA, including preparation of procedures and guidelines.
- Preparation, revision and enforcement of NEQS (industries, municipalities and vehicular emissions).
- Establish and maintain laboratories, certification of laboratories, for conducting tests and analysis.
- Assist local councils/authorities and government agencies in execution of projects.
- Establish a system for surveys, monitoring, examination and inspection to combat pollution.
- Conduct training for government functionaries and industrial management.
- Provide information and education to the public on environmental issues.
- Publish an annual state of the environment report. Survey qualitative and quantitative data on air, soil, water, industrial/municipal and traffic emissions.
- Take measures to promote environment related research and development activities.

2.5.2 Environmental Protection Council

The Pakistan Environmental Protection Council established in 1984 does not have regulatory power over KP. The KP environmental protection Act 2014 allows for a provincial level environmental protection council which has yet to be established. It will be the highest inter-ministerial statutory body in the province and will be responsible for:

- Formulating environmental policies.
- Overseeing enforcement of environmental law.
- Approval of the NEQS.
- Incorporation of environmental considerations into development plans and policies.

2.6 Asian Development Bank Policies and Guidelines

The Safeguard Policy Statement (SPS) builds upon the three previous safeguard policies on the environment, involuntary resettlement and indigenous peoples, and brings them into one single policy that enhances consistency and coherence, and more comprehensively addresses environmental and social impacts and risks. The SPS aims to promote sustainability of Project outcomes by protecting the environment and people from Project's potential adverse impacts by avoiding adverse impacts of projects on the environment and affected people, where possible; minimizing, mitigating, and/or compensating for adverse project impacts on the environment and affected people when avoidance is not possible; and helping borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

The following ADB policies and guidelines may be applicable to the proposed Project:

- ADB's 2009 Safeguard Policy Statement (SPS) – Safeguards Requirement (SR) 1 on Environment, SR2 on Involuntary Resettlement (IR), and SR 3 on Indigenous Peoples (IP);
- ADB Social Protection Strategy (2001);
- ADB Gender and Development Policy (1998);
- Access to Information Policy (2018);[5] and
- Relevant ADB Operations Manual (OM) such as OMF1 for Safeguards Policy Statement, OML3 for Access to Information Policy[6], OMD10 for Non-sovereign Operations, OMC3 for Incorporation of Social Dimensions into ADB Operations, OMC2 for Gender and Development;[7]
- ADB's Accountability Mechanism Policy (2012)[8]

The ADB's environmental policy is grounded in its Poverty Reduction Strategy and its Long-Terms Strategic Framework. To ensure the reduction of poverty through environmentally sustainable development, the ADB's Environment Policy contains five main elements: (i) promoting environment and natural resource management interventions to reduce poverty directly, (ii) assisting developing member countries to mainstream environmental considerations in economic growth, (iii) helping maintain global and regional life support systems that underpin future development prospects, (iv) building partnerships to maximize the impact of ADB lending and non-lending activities, and (v) integrating environmental considerations across all ADB operations.

Under the last element, the ADB pledges to address the environmental aspects of its operations through the systematic application of procedures for (i) environmental analysis for country strategy and programming; (ii) environmental assessment of project loans, program loans, sector loans, loans involving financial intermediaries, and private sector loans; (iii) monitoring and evaluation of compliance with environmental requirements of loans; and (iv) implementation of procedures for environmentally responsible procurement. In the context of policy-based lending and policy dialogue, the ADB will

5 Asian Development Bank (ADB), September 2018, Access to Information Policy, Available at https://www.adb.org/sites/default/files/institutional-document/450636/access-information-policy.pdf. Accessed on 18 June, 2019.

6 Asian Development Bank (ADB), Janaury 2019, Access to Information Policy Operations Manual, Available at https://www.adb.org/sites/default/files/institutional-document/31483/om-l3.pdf

7 Asian Development Bank (ADB), September 2016, Operations Manual, Institutional Document, ADB, Available at https://www.adb.org/documents/operations-manual

8 Asian Development Bank (ADB), 2012, Accountability Mechanism Policy, ADB Available at https://www.adb.org/sites/default/files/institutional-document/33440/files/accountability-mechanism-policy-2012.pdf

identify opportunities to introduce policy reforms that provide incentives to improve environmental quality and enhance the sustainability of natural resource management.

ADB classifies projects into category A (with potentially significant environmental impact); category B (with potentially less significant environmental impact); or, category C (unlikely to have significant environmental impact).[9] An IEE is required for category B projects and an EIA, requiring greater depth of analysis, for category A projects. No environmental assessment is required for category C projects although their environmental implications nevertheless need to be reviewed. The proposed Project has been classified as a category A project for environment.

The ADB requires public consultation and access to information in the environment assessment process. It specifies the need for meaningful consultation, which involves a two-way communication between the borrower/client and the affected communities and stakeholders. It also involves the active participation of affected communities and stakeholders in various stages in the project design and implementation. The following principles are applicable to meaningful consultations:[10]

1. begins early and is carried out on an ongoing basis throughout the project cycle,
2. ensures timely disclosure of relevant information,
3. is free of intimidation or coercion,
4. is gender-inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups, and
5. incorporates relevant views of affected people and other stakeholders into project design and decision-making.

The Environmental Management Plan (EMP) is a key component of the EIA. The ADB places strong emphasis on the preparation of EMPs during project processing. The EMP sets out conditions and targets to be met during project implementation. It is also required to develop procedures and plans to ensure that the mitigation measures and monitoring requirements approved during the environmental compliance review will actually be carried out in subsequent stages of the project.

The ADB, however, recognizes that the specific construction and operational activities may not be defined well enough at the feasibility stage of the project cycle to provide the details required for an effective EMP. The ADB therefore requires that the Borrower ensure that a revised EMP be prepared at the beginning of the implementation stage. The Company will be the project proponent and will be responsible for preparing the revised EMP.

[9] A fourth category, FI (credit line for subprojects through a financial intermediary, or equity investment in a financial intermediary), requires that an appropriate environmental management system should be developed and assessment carried out.

[10] Asian Development Bank (ADB), Environmental Safeguards: A Good Practice Sourcebook Draft Working Document, December 2012.

2.6.1 ADB's Safeguard Policy Statement 2009

Built upon the three previous safeguard policies on the Involuntary Resettlement Policy (1995), the Policy on Indigenous Peoples (1998) and the Environment Policy (2002), the Safeguard Policy Statement was approved in 2009. The safeguard policies are operational policies that seek to avoid, minimize or mitigate adverse environmental and social impacts including protecting the rights of those likely to be affected or marginalized by the developmental process.

According to **Section 8**, Biodiversity Conservation and Sustainable Natural Resource Management of ADB's Safeguard Policy Statement 2009, "the borrower/client will assess the significance of project impacts and risks on biodiversity and natural resources as an integral part of the environmental assessment process. The assessment will focus on the major threats to biodiversity, which include destruction of habitat and introduction of invasive alien species, and on the use of natural resources in an unsustainable manner. The borrower/client will need to identify measures to avoid, minimize, or mitigate potentially adverse impacts and risks and, as a last resort, propose compensatory measures, such as biodiversity offsets, to achieve no net loss or a net gain of the affected biodiversity."

Critical Habitat is defined by ADB's SPS 2009 as follows: Critical habitat is a subset of both natural and modified habitat that deserves particular attention. Critical habitat includes areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic, or cultural importance to local communities. Critical habitats include those areas either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites.

No project activity will be implemented in areas of critical habitat unless the following requirements are met:

- There are no measurable adverse impacts, or likelihood of such, on the critical habitat which could impair its high biodiversity value or the ability to function.
- The project is not anticipated to lead to a reduction in the population of any recognized endangered or critically endangered species or a loss in area of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised.
- Any lesser impacts are mitigated in accordance with para. 27 (Mitigation measures will be designed to achieve at least no net loss of biodiversity. They may include a combination of actions, such as post project restoration of habitats, offset of losses through the creation or effective conservation of ecologically comparable areas that are managed for biodiversity while respecting the ongoing

use of such biodiversity by Indigenous. Peoples or traditional communities, and compensation to direct users of biodiversity.

When the project involves activities in a critical habitat, the borrower/client will retain qualified and experienced external experts to assist in conducting the assessment.

ADB's safeguard policy framework consists of three operational policies on the environment, indigenous peoples and involuntary resettlement. A brief detail of all three operational policies has been mentioned below:

Environmental Safeguard: This safeguard is meant to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process. The requirements apply to all ADB-financed and/or ADB-administered sovereign and non-sovereign projects, and their components regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees (hereafter broadly referred to as projects). This policy and its requirements pertaining to environmental assessment, baseline, and impact assessment will apply to this project and the EIA will be undertaken to ensure that the Project is designed to comply with the policy.

Involuntary Resettlement Safeguard: This safeguard has been placed in order to avoid involuntary resettlement whenever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre- project levels; and to improve the standards of living of the displaced poor and other vulnerable groups. This policy and its requirements will apply to this project and the EIA and LARP will be undertaken to ensure that the Project is designed to comply with the policy.

Indigenous Peoples Safeguard: This safeguard looks at designing and implementing projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems and cultural uniqueness as defined by the Indigenous Peoples themselves so that they receive culturally appropriate social and economic benefits; do not suffer adverse impacts as a result of projects; and participate actively in projects that affect them. Based on the available information no indigenous people live in the project area. However, this will be further confirmed during the study.

Information, Consultation and Disclosure: Consultation and participation are essential in achieving the safeguard policy objectives. This implies that there is a need for prior and informed consultation with affected persons and communities in the context of safeguard planning and for continued consultation during project implementation to identify and help address safeguard issues that may arise. The consultation process begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle. It provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people and is undertaken in an atmosphere free of intimidation or coercion. In addition, it is gender inclusive and responsive and tailored to the needs of disadvantaged and vulnerable groups and enables the incorporation of all relevant views of affected people and other stakeholders into decision making. ADB requires the borrowers/clients to engage with communities, groups or people affected by proposed projects and with civil society through information disclosure, consultation and informed participation in a manner commensurate with the risks to and impacts on affected communities. For projects with significant adverse environmental, involuntary resettlement or Indigenous Peoples impacts, ADB project teams will participate in consultation activities to understand the concerns of affected people and ensure that such concerns are addressed in project design and safeguard plans.

2.6.2 Social Protection Requirements

ADB's Social Protection Strategy (2001 SPS) requires the Borrower to comply with applicable labor laws in relation to the Project, and take the following measures to comply with the core labor standards[11] for the ADB financed portion of the Project:

- carry out its activities consistent with the intent of ensuring legally permissible equal opportunity, fair treatment and non-discrimination in relation to recruitment and hiring, compensation, working conditions and terms of employment for its workers (including prohibiting any form of discrimination against women during hiring and providing equal work for equal pay for men and women engaged by the Borrower);
- not restrict its workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment;
- engage contractors and other providers of goods and services:
- who do not employ child labor[12] or forced labor[13];
- who have appropriate management systems that will allow them to operate in a manner which is consistent with the intent of (A) ensuring legally permissible equal opportunity and fair treatment and non-discrimination for their workers, and (B) not restricting their workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment; and
- whose subcontracts contain provisions which are consistent with paragraphs (i) and (ii) above.

2.6.3 Access to Information Policy (2018)

The objective of the The Access to Information Policy (2018) is to promote stakeholder trust in ADB and to increase the development impact of ADB activities. The policy reflects ADB’s commitment to transparency, accountability, and participation by stakeholders in ADB-supported development activities in Asia and the Pacific. It also recognizes the right of people to seek, receive, and impart information about ADB’s operations.

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[11] The core labor standards are the elimination of all forms of forced or compulsory labor; the abolition of child labor; elimination of discrimination in respect of employment and occupation; and freedom of association and the effective recognition of the right to collective bargaining, as per the relevant conventions of the International Labor Organization

[12] child labor means the employment of children whose age is below the statutory minimum age of employment in the relevant country, or employment of children in contravention of International Labor Organization Convention No. 138 'Minimum Age Convention" (www.ioo.org)

[13] forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty

The policy applies to documents and information that ADB produces, requires to be produced by its borrowers or clients, or are produced and provided to ADB by other parties in the course of ADB operations.

2.6.4 Gender and Development Policy 1998

ADB's Gender and Development Policy (1998) adopts gender mainstreaming as a key strategy for promoting gender equity, and for ensuring that women participate in and that their needs are explicitly addressed in the decision-making process for development activities. The key elements of ADBs gender policy are: (i) Gender sensitivity, to observe how the project affects women and men differently and to take account of their different needs and perspectives in resettlement planning; (ii) Gender analysis, which refers to the systematic assessment of the project impact on men and women and on the economic and social relationships between them; (iii) Gender planning, which refers to the formulation of specific strategies to bring about equal opportunities to men and women; and (iv) Mainstreaming, to consider gender issues in all aspects of ADB operations, accompanied by efforts to encourage women's participation in the decision-making process in development activities.

The SPS and safeguards requirements also reiterate the importance of including gender issues in the preparation of safeguards documents at all stages to ensure that gender concerns are incorporated, including gender-specific consultation and information disclosure. This includes special attention to guarantee women's assets, property, and land-use rights and restoration/improvement of their living standards; and to ensure that women will receive project benefits.

2.6.5 Climate Change Risk Management Framework

The climate risk management approach of the ADB aims to reduce risks resulting from climate change to investment projects in Asia and the Pacific. ADB’s framework identifies climate change risks to project performance in the early stages of project development, and incorporates adaptation measures in the design of projects at risk. ADB climate risk management framework comprises the following steps:

(i) context-sensitive climate risk screening at the concept development stage to identify projects that may be at medium or high risk;
(ii) climate change risk and vulnerability assessment during preparation of projects at risk;
(iii) technical and economic evaluation of adaptation options;
(i) identification of adaptation options in project design; and
(ii) monitoring and reporting of the level of risk and climate-proofing measures.

2.7 International Treaties and Agreements

Exhibit 2.7 lists important international environmental treaties that have been signed by Pakistan and may have relevance to the Project. They concern climate change and depletion of the ozone layer; biological diversity and trade in wild flora and fauna; desertification; waste and pollution; and cultural heritage.

Exhibit 2.7: International Environmental Treaties Endorsed by Pakistan

Topic	Convention	Date of Treaty	Entry into Force in Pakistan
Climate change and the ozone layer	United Nations Framework Convention on Climate Change - the primary objective is the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.	1992	1994
	Kyoto Protocol to the United Nations Framework Convention on Climate Change - enabled by the above Convention on Climate Change. It has more powerful and legally binding measures. It sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas emissions.	1997	2005
	Vienna Convention for the Protection of the Ozone Layer - acts as a framework for the international efforts to protect the ozone layer with a primary objective to protect human health and the environment against adverse effects resulting from human activities that modify or are likely to modify the ozone layer.	1985	1993
	The Montreal Protocol on Substances that Deplete Ozone Layer and associated amendments - enabled by the Vienna Convention, it is designed to protect the ozone layer by phasing out the production and consumption of a number of substances believed to be responsible for ozone depletion.	1987	1993
Waste and pollution	Basel Convention on the Control of Trans Boundary Movements of Hazardous Wastes and their Disposal - regulates the trans boundary movement of hazardous waste and other waste with a stated purpose to protect human health and the environment against the adverse effects from generation and management of hazardous waste and other waste. The Convention provides for three sets of measures with binding obligations. These are: Strict control of trans boundary movement of hazardous waste; Environmentally sound management of hazardous waste; and Enforcement and implementation of the provisions of the convention at international and national levels.	1989	1994
	International Convention on Oil Pollution Preparedness, Response and Co-operation	1990	1995
	Stockholm Convention on Persistent Organic Pollutants - seeks to protect human health and the environment from Persistent Organic Pollutants, which are chemicals that remain intact in the environment for long periods, become widely distributed geographically and accumulate in the fatty tissue of humans and wildlife.	2001	2008

Topic	Convention	Date of Treaty	Entry into Force in Pakistan
	International Convention for the Prevention of Pollution from Ships (MARPOL) – is the main international convention that's covers prevention of pollution of the marine environment by ships from operational or accidental causes. The Convention includes regulations aimed at preventing and minimizing pollution from ships, both accidental pollution and that from routine operations, and currently includes six technical Annexes.	1983	
Desertification	International Convention to Combat Desertification – with an objective to combat desertification and mitigate the effects of drought. It is supported by international cooperation and partnership arrangements, with the aim of achieving sustainable use of land and water resources and sustainable development in affected areas.	1994	1997
Biodiversity and the protection of plants and animals	Convention on Biological Diversity – covering ecosystems, species, and genetic resources and also the field of biotechnology. The objectives are: ▶ conserve of biological diversity; ▶ sustainable use of its components; and ▶ fair and equitable sharing of benefits arising from genetic resources.	1992	1994
	Cartagena Protocol on Biosafety to the Convention on Biological Diversity - addresses potential risks posed by living modified organisms resulting from modern biotechnology.	2000	2009
	Bonn Convention on the Conservation of Migratory Species of Wild Animals - aims to conserve terrestrial, marine and avian migratory species throughout their range. It is concerned with the conservation of wildlife and habitats on a global scale.	1979	1987
	Memorandum of Understanding concerning Conservation Measures for the Siberian Crane - parties undertakes to provide strict protection to Siberian Cranes, and identify and conserve wetland habitats essential for their survival.	1998	1999
	Convention on International Trade in Endangered Species of Wild Fauna and Flora - to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	1973	1976

Topic	*Convention*	*Date of Treaty*	*Entry into Force in Pakistan*
	International Plant Protection Convention (1997 Revised Text) - to prevent the international spread of pests and plant diseases. It requires maintenance of lists of plant pests, tracking of pest outbreaks, and coordination of technical assistance between member nations.	1951/52	1954
	Agreement for the Establishment of the Near East Plant Protection Organization - to establish the Near East Plant Protection Organization (NEPPO), which promotes international co-operation with a view to implementing International Plant Protection Convention.	1993	2009
	Plant Protection Agreement for the Asia and Pacific Region and amendments – establishes the Asia and Pacific Plant Protection Commission to review and promote the region's progress in the implementation of the Agreement. Trade in plants and plant products are regulated by certification, prohibition, inspection, disinfection, quarantine, destruction, etc., as necessary.	1955 (amendment 1967)	1958 (amendment 1969)
	Convention on Wetlands of International Importance especially as Waterfowl Habitat and associated protocols and amendments - to promote conservation and sustainable use of wetlands. The Ramsar List of Wetlands of International Importance now includes almost 1,800 sites (known as Ramsar Sites). There are currently 19 Ramsar sites in Pakistan.	1971 (amended 1987)	1976 (amended 1994)
Cultural heritage	Convention concerning the Protection of the World Cultural and Natural Heritage - requires parties to adapt a general policy on the protection of the natural and cultural heritage, to set up services for such protection, to develop scientific and technical studies, to take appropriate legal, technical, scientific and administrative measures and to foster training and education for such protection.	1972	1976

Pakistan is a party to a number of conventions in relation to biodiversity, including the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES), the Convention on Wetlands of International Importance (Ramsar Convention) and the United Nations Convention on Biological Diversity (CBD).

The CBD defines biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems". As a signatory country, Pakistan has a responsibility to:

- Safeguard its biodiversity.
- Introduce procedures requiring environmental impact assessment (EIA) for projects likely to have significant impacts on biological diversity.
- Introduce legislative provisions that ensure environmental policies and procedures are duly taken into account.

There are no direct bearing of these treaties on the Project. Wherever required, the federal or provincial governments have enacted laws to comply with the provisions of the treaties listed in this section. Thus the obligations of the Project are to comply with pertinent laws only.

2.8 Guidelines

2.8.1 World Bank Group

The ADB recognizes the environmental safeguards documents of the World Bank Group including the International Finance Corporation as an example of good international industry practice.

The specific requirements are as follows:

> Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. …. [Page 16 of SPS 2009]
>
> During the design, construction, and operation of the project the borrower/client will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from these levels and measures, the borrower/client will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/client will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in this document. [Page 36 of SPS 2009]

> The borrower/client will provide workers12 with a safe and healthy working environment, taking into account risks inherent to the particular sector and specific classes of hazards in the borrower's/client's work areas, including physical, chemical, biological, and radiological hazards. The borrower/client will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work by (i) identifying and minimizing, so far as reasonably practicable, the causes of potential hazards to workers; (ii) providing preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) providing appropriate equipment to minimize risks and requiring and enforcing its use; (iv) training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment; (v) documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place. The borrower/client will apply preventive and protective measures consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. [Page 38 of SPS 2009]

The ADB recommends using the IFC's Environmental Health and Safety (EHS) guidelines for emission and effluent.[14] It also refers to the IFC's Performance Standard 3: Resource Efficiency and Pollution Prevention, for assessment and compliance with greenhouse gas emission standards.[15] There are a total of eight IFC Performance Standards which were published in April 2006 and revised in 2012. In addition to this, the World Bank Group's Environmental and Social Framework includes ten Environmental and Social Standards (ESS). ESS4. Community Health and Safety addresses the health, safety, and security risks and impacts on project-affected communities. Annex 1 of ESS4 "Safety of Dams" applies to new, existing and under-construction dams.[16] For large dams the World Bank requires:

- reviews by an independent panel of experts (the Panel) of the investigation, design, and construction of the dam and the start of operations;
- preparation and implementation of detailed plans: a plan for construction supervision and quality assurance, an instrumentation plan, an operation and maintenance plan, and an emergency preparedness plan;
- prequalification of bidders during procurement and bid tendering,
- periodic safety inspections of the dam after completion.

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14 The International Finance Corporation, Environmental, Health, and Safety General Guidelines, The World Bank Group, April 2007.

15 Asian Development Bank (ADB), Environmental Safeguards: A Good Practice Sourcebook Draft Working Document, December 2012.

16 The World Bank Group, The Environmental and Social Framework, March 30, 2017, < http://www.worldbank.org/en/programs/environmental-and-social-policies-for-projects/brief/the-environmental-and-social-framework-esf>, accessed May 1, 2017

2.8.2 World Commission on Dams 2000

The World Commission on Dams (WCD) established the most comprehensive guidelines for dam building. It describes an innovative framework for planning water and energy projects that is intended to protect dam-affected people and the environment, and ensure that the benefits from dams are more equitably distributed. The WCD framework covers key areas for improved planning of dams, including the need to fully assess all available options for meeting water and energy needs; addressing outstanding social issues from existing dams before building new ones, gaining public acceptance for key decisions, and the importance of protecting healthy rivers.[17] The Project is being constructed in an area with natural resources of value both in terms of ecology and socioeconomics. It is being financed by an international funding body, the ADB, therefore, international standards, guidelines and best practices need to be considered.

2.8.3 Pakistan Environmental Protection Agency

Regulation 7 of the IEE-EIA Regulations 2000 pertains to the guidelines. It states that: '(1) The Agency may issue guidelines for preparation of an IEE or EIA or an environmental checklist, including guidelines of general applicability and sectoral guidelines indicating specific assessment requirements for planning, construction and operation of projects relating to a particular sector. (2) where guidelines have been issued under sub-regulation (1), an IEE or EIA shall be prepared, to the extent practicable, in accordance therewith and the proponent shall justify in the IEE or EIA or in environmental checklist any departure therefrom.'

The relevant guidelines are the follows:

- *Policy and Procedures for Filing, Review and Approval of Environmental Assessments*, Pakistan Environmental Protection Agency, September 1997

  These guidelines define the policy context and the administrative procedures that will govern the environmental assessment process, from the project pre-feasibility stage, to the approval of the environmental report. The section on administrative procedures has been superseded by the IEE-EIA Regulations, 2000.

- *Guidelines for the Preparation and Review of Environmental Reports*, Pakistan Environmental Protection Agency, 1997

  These guidelines target the project proponents and specify:

  - The nature of the information to be included in environmental reports
  - The minimum qualifications of the EIA conductors appointed
  - The need to incorporate suitable mitigation measures at every stage of project implementation
  - The need to specify monitoring procedures.

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17 International Rivers, The World Commission on Dams, Available at <https://www.internationalrivers.org/campaigns/the-world-commission-on-dams>, accessed April 18, 2017

The terms of reference for the reports are to be prepared by the project proponents themselves. The report must contain baseline data on the project area, detailed assessment thereof, and mitigation measures.

- *Guidelines for Public Consultation*, Pakistan Environmental Protection Agency, May, 1997

  These guidelines support the two guidelines mentioned earlier. It deals with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study.

- *Guidelines for Sensitive and Critical Areas*, Pakistan Environmental Protection Agency, October, 1997

  The guidelines on sensitive areas are more specific in that they identify the officially notified protected areas in Pakistan, including critical ecosystems, archeological sites, etc., and present checklists for environmental assessment procedures to be carried out inside or in the vicinity of such sites. Environmentally sensitive areas include, among others, archeological sites, biosphere reserves and natural parks, and wildlife sanctuaries and preserves. The guidelines state that the approach recommended in the document should extend to areas in the vicinity of such sensitive and critical sites, although the term 'vicinity' is not explicitly defined.

3. Project Description

This section provides a brief description of the Project. The description is based on the Feasibility Study carried out for the Project in June 2019.[1]

The Project is a run-of-river type, located on the Kunhar River in the Khyber Pakhtunkhwa (KP) province of Pakistan, in the 12 km stretch from Paras to Sangar Village. The hydel power potential available in the 20 km stretch of the river from Paras to Sangar tributary will be utilized for the Project.

The Kunhar River originates from the glaciers above Lulusar Lake in the Kaghan Valley of KP. Glaciers of Malka Parbat and Makra Peak and the waters of Saiful Muluk Lake feed the river. It passes through Jalkhand and meets Jhelum River at Rarra. The drainage area of the river is 2,535 km^2, with elevation ranging from 600 to 5,000 m.[2] It is one of the biggest tributaries of the Jhelum River Basin and the only main tributary situated entirely in Pakistan's territory. Snowmelt from the Kunhar Basin contributes 65% of the total discharge of the Kunhar River and 20-40% of the Jhelum River at Mangla.[3]

All parts of the Project are located on the left bank of the Kunhar River. The dam site (34° 39' 36.510" N, 73° 27' 1.340" E) is about 18.6 km upstream of the town of Balakot. The powerhouse (34° 36' 15.143" N, 73° 22' 49.943" E) is located 8 km upstream of Balakot, near Kappi Gali Village.

Exhibit 3.1 shows a map of the location of the Project. **Exhibit 3.2** provides the general layout of the Project.

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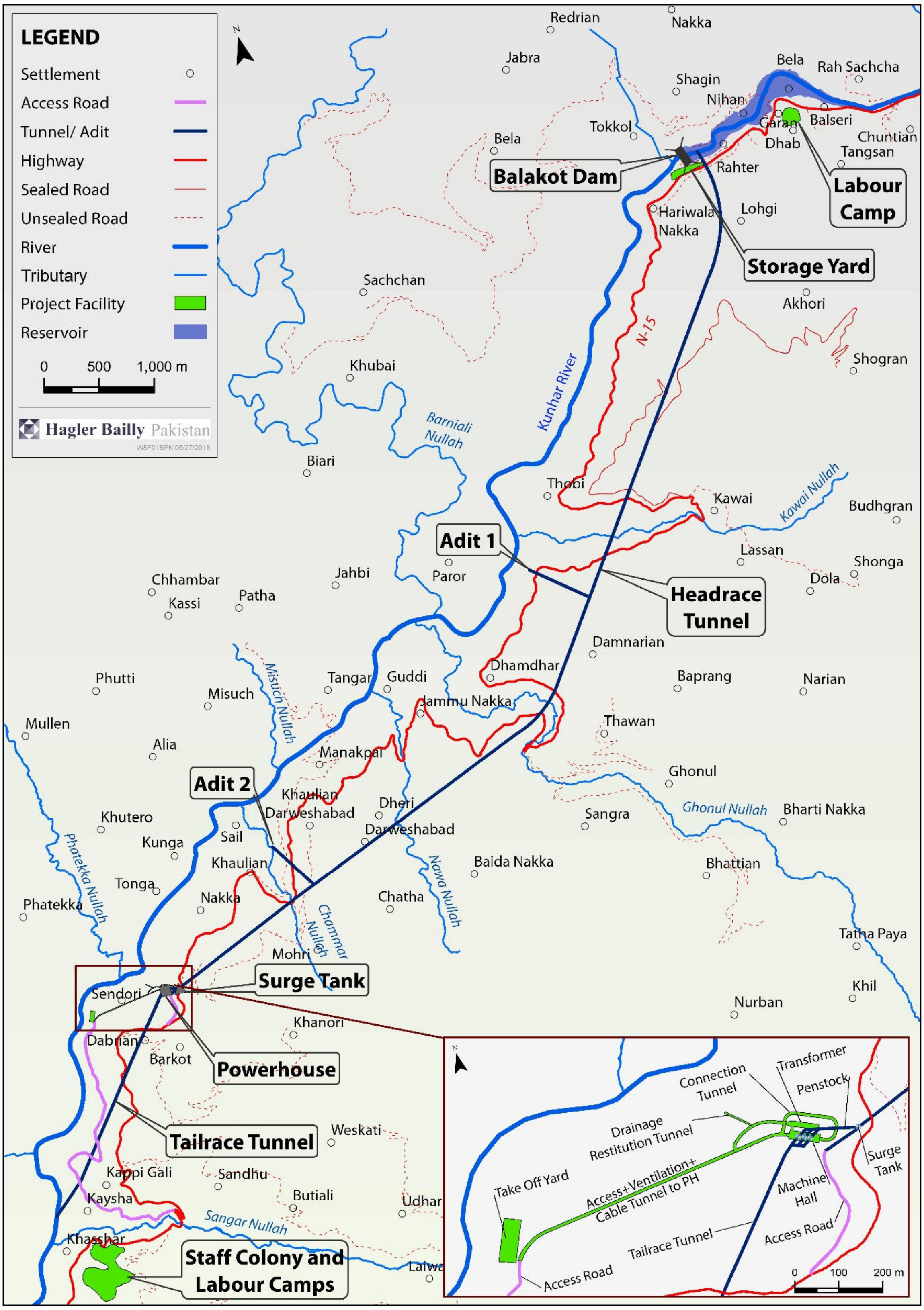
1 Aqualogus, June 2019, Draft Final Report D2.2B – Feasibility Study for the 300 MW Balakot Hydropwoer Project, for the Asian Development Bank and Pakhtunkhwa Energy Development Organization

2 Mahmood R, Jia S, Babel M. S., January 16, 2016, Potential Impacts of Climate Change on Water Resources in the Kunhar River Basin, *Water, Multidisciplinary Digital Publishing Institute*, Basel, Switzerland

3 Ibid

Exhibit 3.1: Project Location

Exhibit 3.2: Project Layout



3.1 Main Component of the Project

3.1.1 The Main Dam

The dam area layout is shown in **Exhibit 3.3**. The intake is shown in **Exhibit 3.4**. The sediment bypass tunnel is shown in **Exhibit 3.5**. The layout of the powerhouse is shown in **Exhibit 3.6**. The layout of the powerhouse accesses is shown in **Exhibit 3.7.**

The main dam will be a concrete gravity dam, with a height of 35 m from the river bed, comprising low level/flushing outlets and a gated spillway. It has been designed to pass floods of 3,500 cubic meter per second (m^3/s or cumecs), with an upper gated ogee crest spillway and a low level gated spillway. This layout consists of three radial upper spillway gates having an opening of 11 meter (m) height and 10 m width as and two low level spillway sluice gates of 8 meter (m) height and 6 meter (m) width. The gates are hydraulically operated for flood discharge and are set at the crest level of 1,258 meters above sea level (masl).

The river diversion scheme consists of a left bank diversion tunnel which will be further converted to a sediment by-pass tunnel as well as additional openings in the dam body for the low-level spillway. An upstream coffer dam is also deliberated and will compromise of a concrete gravity solution with a crest elevation of 1272m which will be further converted into a guiding structure for sediment management.

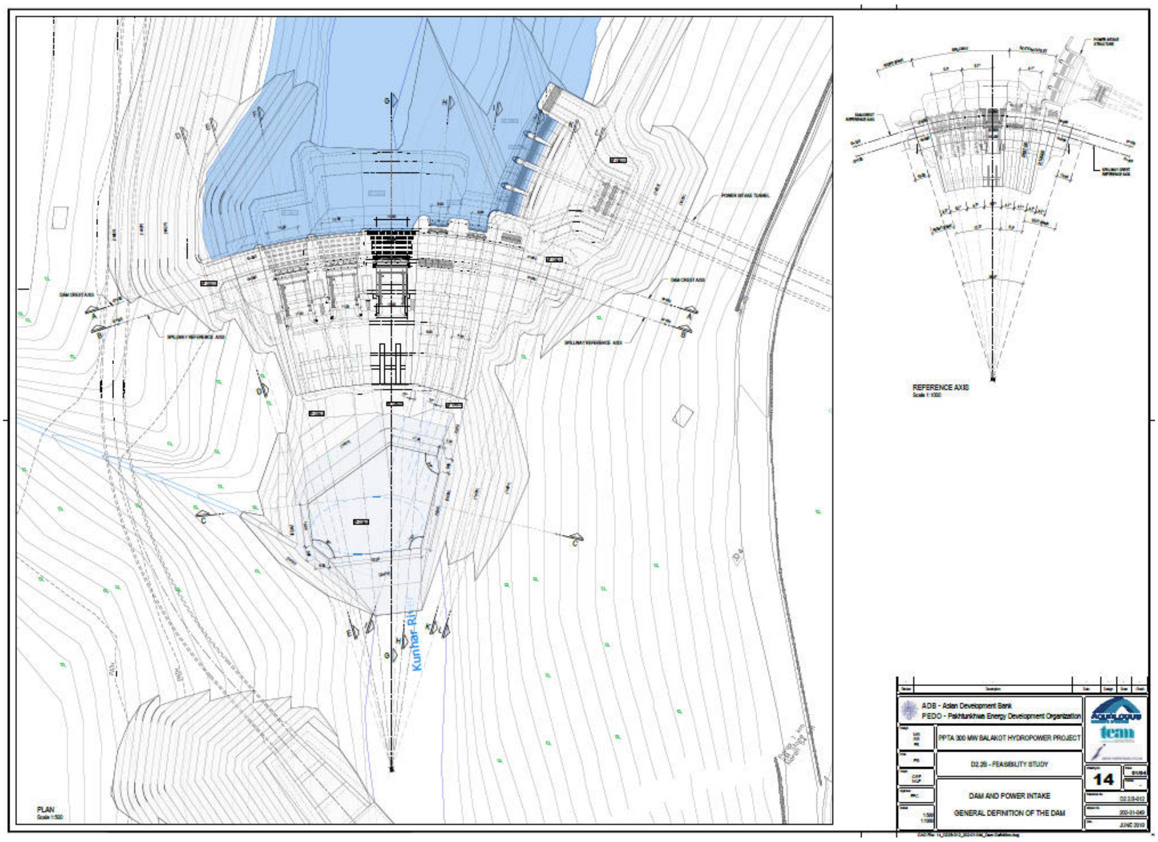
Lateral power intake structure: This will be located on the left bank of Kunhar river and will comprise 4 bays split by three vertical piers to provide a design discharge of 154 m^3/s. It will include trash racks for passing the design discharge. Two rectangular 4 m wide by 8 m high control gate equipped with upstream sealing will be provided.

Low pressure headrace tunnel: This will be a length of about 9.1 km and a diameter of 8 m.

3.1.2 Powerhouse

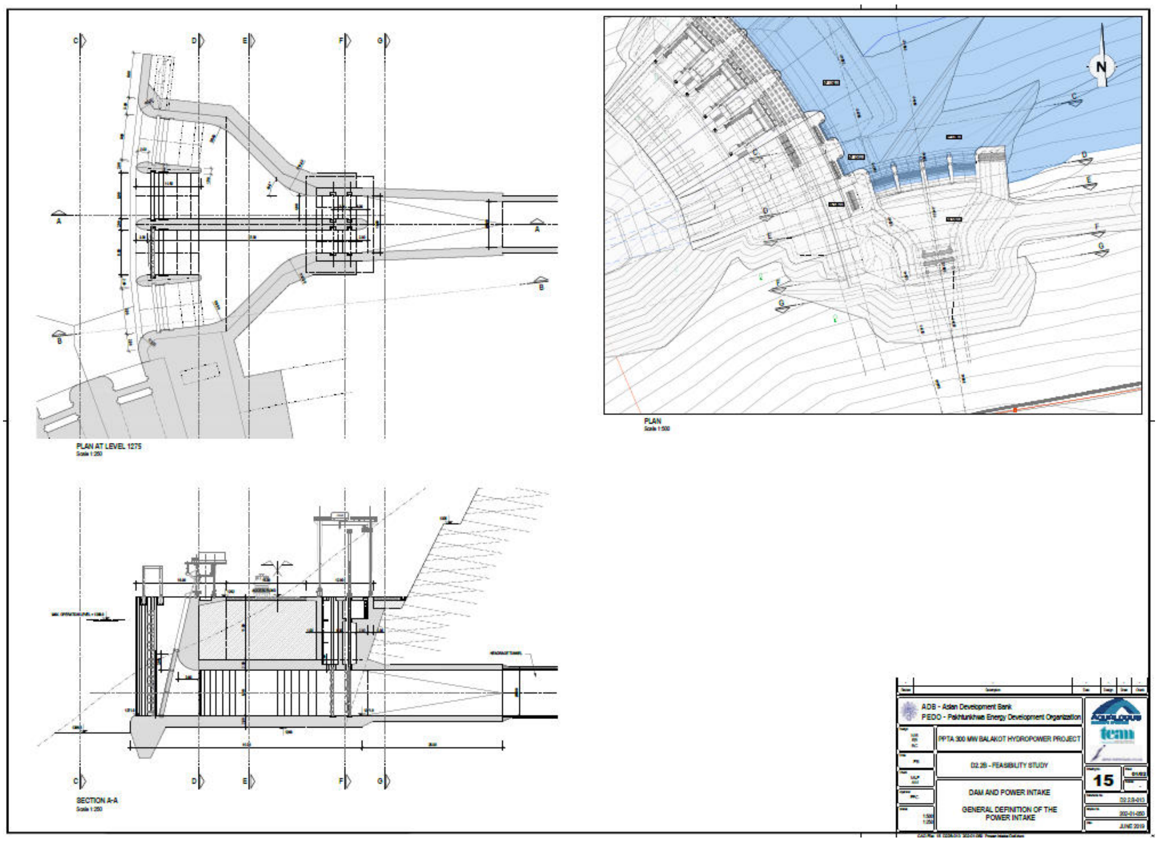
The layout of the powerhouse is shown in **Exhibit 3.6**. The transformer hall cavern will have dimensions of length 88 m, width 14 m and height 20 m. It will consist of single phase generator transformers (3 per unit, plus one spare) for a total of 10 which will be placed in a separate fire-protected enclosure. It will also consist of a transformer transfer facility through rails starting from the unloading bay to the powerhouse. Geographic Information Systems (GIS) equipment and the facility for transfer of the power cable to the cable tunnel will also be provided.

Exhibit 3.3: Dam Layout – Concrete Gravity



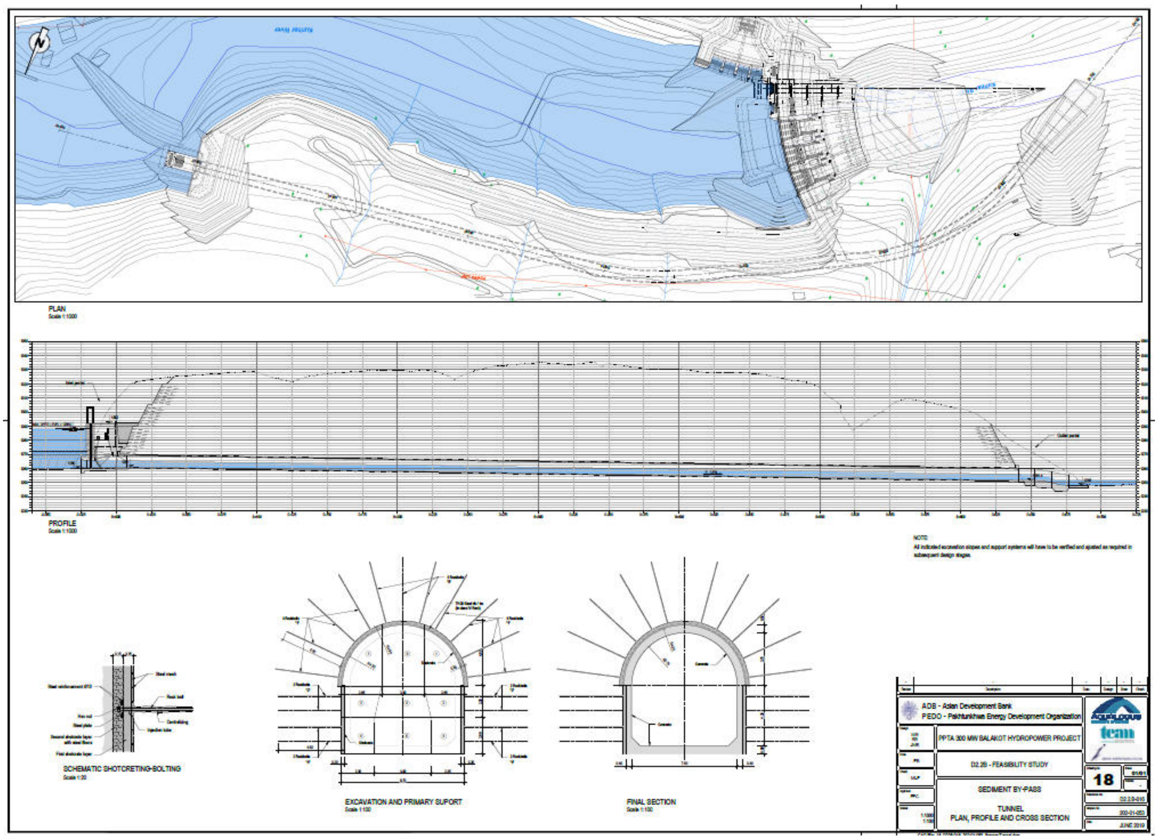
Source: Aqualogus, June 2019, Draft Final Report D2.2B – Feasibility Study for the 300 MW Balakot Hydropwoer Project, for the Asian Development Bank and Pakhtunkhwa Energy Development Organization

Exhibit 3.4: Concrete Dam – Intake



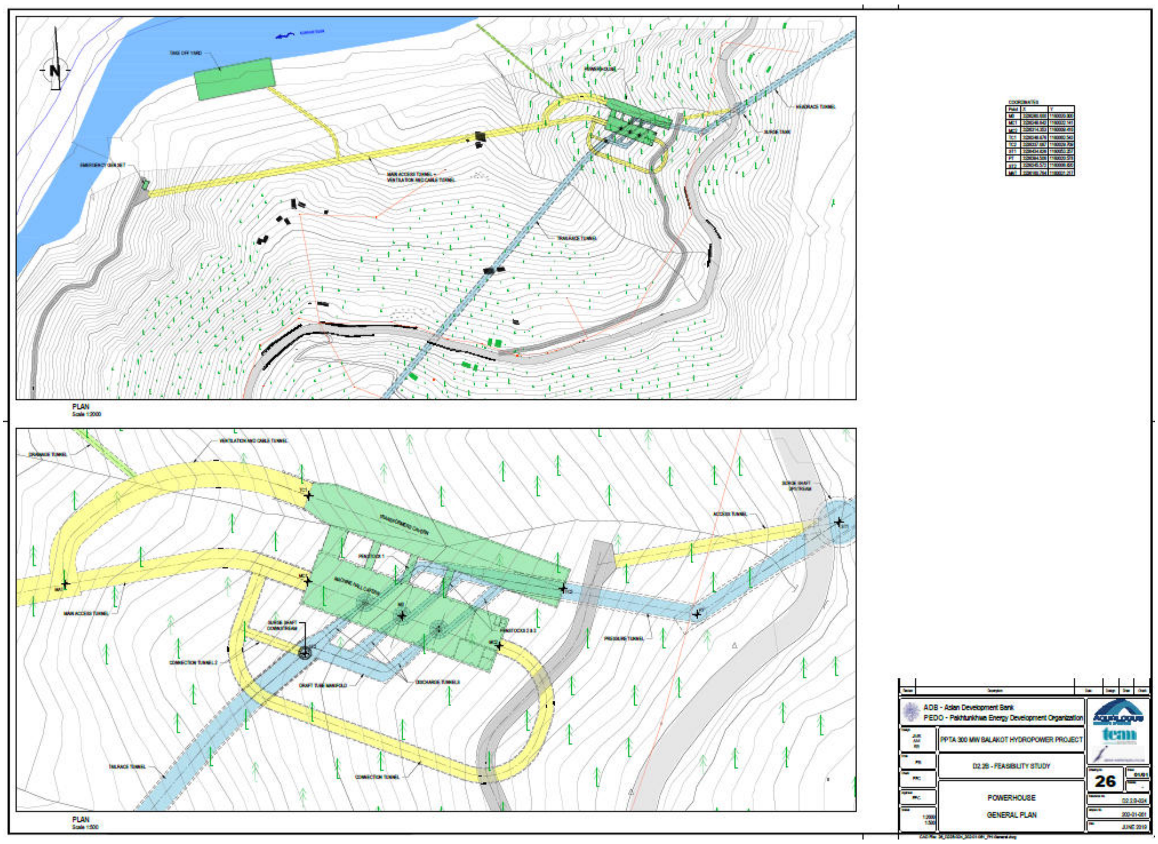
Source: Aqualogus June 2019, Draft Final Report D2.2B – Feasibility Study for the 300 MW Balakot Hydropwoer Project, for the Asian Development Bank and Pakhtunkhwa Energy Development Organization

Exhibit 3.5: Concrete Dam – Sediment Bypass Tunnel



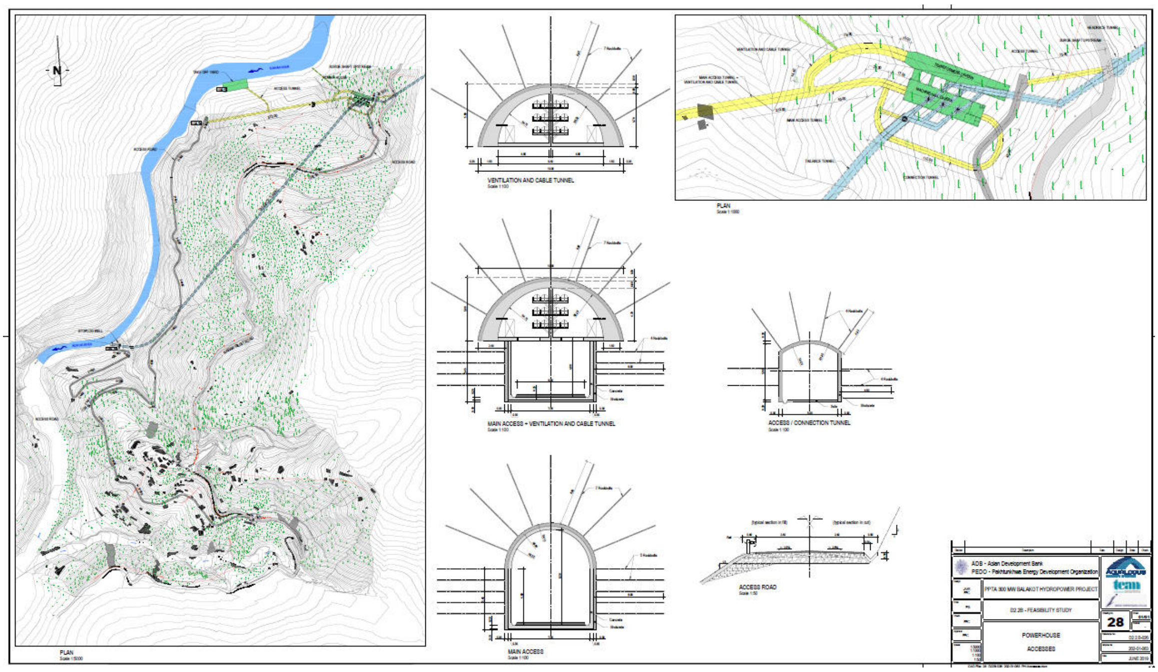
Source: Aqualogus, June 2019, Draft Final Report D2.2B – Feasibility Study for the 300 MW Balakot Hydropwoer Project, for the Asian Development Bank and Pakhtunkhwa Energy Development Organization

Exhibit 3.6: Powerhouse Area Layout



Source: Aqualogus, June 2019, Draft Final Report D2.2B – Feasibility Study for the 300 MW Balakot Hydropwoer Project, for the Asian Development Bank and Pakhtunkhwa Energy Development Organization

Exhibit 3.7: Powerhouse Accesses



An underground powerhouse has been proposed comprising the following structures:

- Underground Powerhouse Cavern
- Transformer/substation Cavern
- Single headrace tunnel
- Surge shaft, pressure shaft
- Manifolds
- Tailrace structure

The powerhouse cavern will be 71 m long, 20 m wide and 34 m high from the main inlet valve floor to the arch roof crown.

Free flow tailrace tunnel: Having a length of 1,565 m. It has a circular concrete lined tunnel with a diameter of 8 m.

Surge Tank: A circular surge tank, having a 14.5 m diameter, is proposed at the end of the low pressure headrace tunnel with a surge height of 122m.

Access Tunnel: The access tunnel is the main point of entry to the underground powerhouse complex. It is sized to accommodate two-way dump truck traffic during construction, and to provide the space needed to transport heavy equipment on low bay loaders or multi-wheeled transformers into the cavern.

3.2 Project Operation

The maximum and minimum reservoir operating levels will be 1,288 masl and 1,283 masl, respectively. The installed capacity will be 300 MW with mean annual energy output (average 55 years) of 1,143 GWh. Sediment flushing will be carried out when required with the discharge of about 100 cubic meter per second. During the low flow periods, the live storage will be used to store water during off peak hours to improve the flows for power generation in peak hours. It has been estimated that 1.2 million m^3 net storage would provide additional flows in four peak hours.

3.3 Technical Design Summary

Exhibit 3.8 provides the technical design summary. Several of these parameters are essential for the impact assessment. It is anticipated that any change in these by the Aqualogus during the updating of the FS will be communicated to HBP at the earliest. **Exhibit 3.9** shows the water levels at the dam site.

Exhibit 3.8: Salient Features of the Project Design

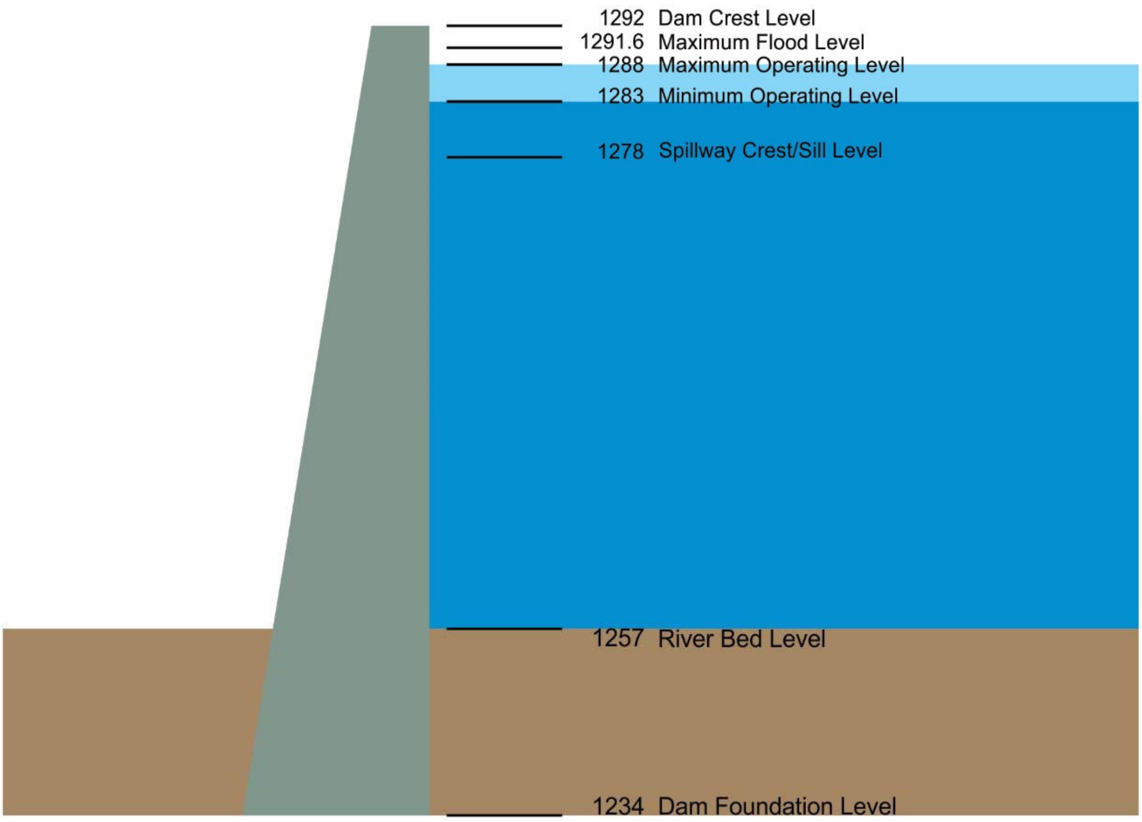
Design Aspect	*Value*
1. Hydrology and Design Flows	
River	Kunhar
Catchment area at dam site (km2)	1939
Modular flow at the intake (m3/s)	87
Design Discharge (m3/s)	154
Design Flood (m3/s) T= 10 000 years	3500
Probable Maximum Flood (m3/s)	5000
2. Reservoir	
Normal Operation Level (NOL)	1288.0
Minimum Operation Level (MinOL)	1283.0
Surface area (at NOL) (km2)	0.28
Length of Reservoir (at NOL) (km)	2.2
Gross storage capacity (at NOL) (x106 m3)	3.56
Live storage (at NOL) (x106 m3)	1.20
3. Dam Structure	
Type	Concrete Gravity Arch
Dam crest elevation (masl)	1292.0
Maximum height above river bed (m)	35.0
Maximum height above foundation (m)	58.0
Crest length (m)	130.0
4. Spillways and low-level outlets / flushing sluices	
Spillway type	Upper gated ogee crest spillway + low level gated spillway
Upper spillway crest elevation (masl)	1278.0

Design Aspect	*Value*
Upper spillway gates no. and type	3 (radial gates)
Upper spillway gates size (W x H) (m)	11 x 10
Low level spillway invert elevation (masl)	1258.0
Low level spillway gates no. and type	2 (sluice gates)
Low level spillway size (W x H) (m)	6 x 8
5. Sediment Management	
Solution	Sediment Bypass Tunnel (SBT) + flushing outlets
SBT type	Gated intake followed by archway tunnel
Intake size (W x H) (m)	7.5 x 4.5
Inlet invert elevation (masl)	1261.0
Tunnel cross section (W x H) (m)	archway (7.5 x 8.0)
Tunnel length (m)	650
Tunnel slope (%)	1.5
Outlet invert elevation (masl)	1248.0
Submerged guiding structure crest elevation (masl)	1272.0
Submerged weir/guiding structure height (m)	21 (estimated maximum above foundation)
6. River Diversion	
Construction Flood (m^3/s) (T= 20 years)	900
Diversion type	openings left in the dam body for the low-level spillway and a left bank diversion tunnel (which will be further converted to the sediment by-pass tunnel)
Upstream Coffer dam type	concrete gravity solution (which will be further converted to guiding structure)
Upstream Coffer dam crest elevation (masl)	1272.0
Downstream Coffer dam type	concrete gravity solution
Downstream Coffer dam crest elevation (masl)	1252.5
Diversion tunnel type	Archway (concrete lined)
Diversion tunnel no. (-)	1
Diversion tunnel size (W x H) (m)	archway (7.5 x 8.0)
Diversion tunnel length (m)	650
Diversion tunnel slope (%)	1.5
Diversion tunnel inlet invert El. (masl)	1261.0
Diversion tunnel outlet invert El. (masl)	1248.0

Design Aspect	Value
7. Power intake structure	
Intake type	Horizontal intake
Trash rack no.	4
Trash rack size (W x H) (m)	8 x 10
Service gates no.	2
Service gates size (W x H)	4 x 8 m
Intake crest elevation (masl).	1271.0
8. Headrace tunnel	
Tunnel section	Circular concrete lined (8.0 m inner diameter)
Length up to surge tank (m)	9137
Tunnel slope (%)	0.56%
9. Upstream surge shaft	
Type	concrete lined circular surge shaft
Internal diameter (m)	14.5
Surge shaft height (m)	122
Surge shaft bottom elevation (masl)	1220.0
10. Pressure tunnel/shaft and penstock	
Pressure tunnel/shaft main section type and size	Steel lined circular cross section (5.6 m internal diameter)
Pressure tunnel/shaft length (m)	152
Penstock length (m)	88
Branch Section Type	Manifold (3 branches)
Size of each branch (m)	3.2 m internal diameter conduits
Max. Length of branch (m)	□30
Pressure tunnel/shaft main section type and size	Steel lined circular cross section (5.6 m internal diameter)
11. Powerhouse and substation	
Powerhouse type	conventional underground cavern
Main cavern general dimensions (LxWxH) (m)	71 x 20 x 34
Turbine type	Francis
No. of units	3
Turbine axis elevation (masl)	1054.0
No. of generators	3
Transformer / Substation type	Underground cavern (adjacent to the main powerhouse cavern)

Design Aspect	*Value*
Transformer cavern general dimensions (LxWxH) (m)	88 x 14 x 20
12. Downstream surge shaft	
Type	concrete lined circular surge shaft
Internal diameter (m)	3.0
Surge shaft height (m)	244
Surge shaft bottom elevation (masl)	1055.0
13. Tailrace	
Type	Circular tunnel with transition to an archway section at the final length and Outlet portal
Tunnel section	Circular concrete lined (8.0 m diameter)
Length up to the final transition section (m)	1515
Tunnel slope up to the transition section (%)	0.23% (ascending slope)
Tunnel final section	Archway concrete lined section (8.0 W x 8.0 H)
Length from transition to outlet (m)	50
Tunnel slope up to the outlet portal (%)	15% (ascending slope)
14. Power and Energy	
Gross Head (m)	229.0
Design Net Head (m)	217.6
Installed plant capacity (MW)	300 (at the generator)
Average annual energy (GWh)	1143 (average of 55 years)
15. Project access facilities	
Access road to dam and related structures (length)	550 m (from Sharan Road, connection to National Highway N–15 at the left side of Kunhar River, nearby Paras village)
Access road to sediment by-pass tunnel (length)	440 m (from the dam bridge deck up to the sediment by-pass tunnel intake)

Exhibit 3.9: Water and Dam Levels of Project Dam



3.4 Project Requirements

3.4.1 Materials

Materials required to carry out the construction of civil works for the Project include concrete aggregate, cement, pozzolans, various types of fill materials, construction chemicals, steel products etc.

Borrow material is expected to be insignificant. The quanitity of quarry material is estimated at approximately 250,000 m^3. Sources of quarry material will be defined at a later stage, however, areas near Paras (for gravel), Naran, Kaghan and Garhi Habibullah (for sand) have been identified.

3.4.2 Water

A considerable quantity of water will be required during the construction of the Project for mixing/curing of concrete and for washing of aggregate etc. The Kunhar River at the dam site and powerhouse site will be the main sources of water that could be used during the construction of the Project. The water shall be readily available throughout the year. Other sources of water in the Project area are the perennial tributaries/nullahs and natural springs, which are mainly used for drinking and irrigation purposes.

3.4.3 Land Requirement

The total land requirement is 32.8 hectare (ha). Out of total 32.8 ha of required land 3.05 ha will be required for staff colony, 3.05 ha will be required for 2 construction camps, 1.32 ha will be required for access roads and 23.36 ha will be required for reservoir and dam.

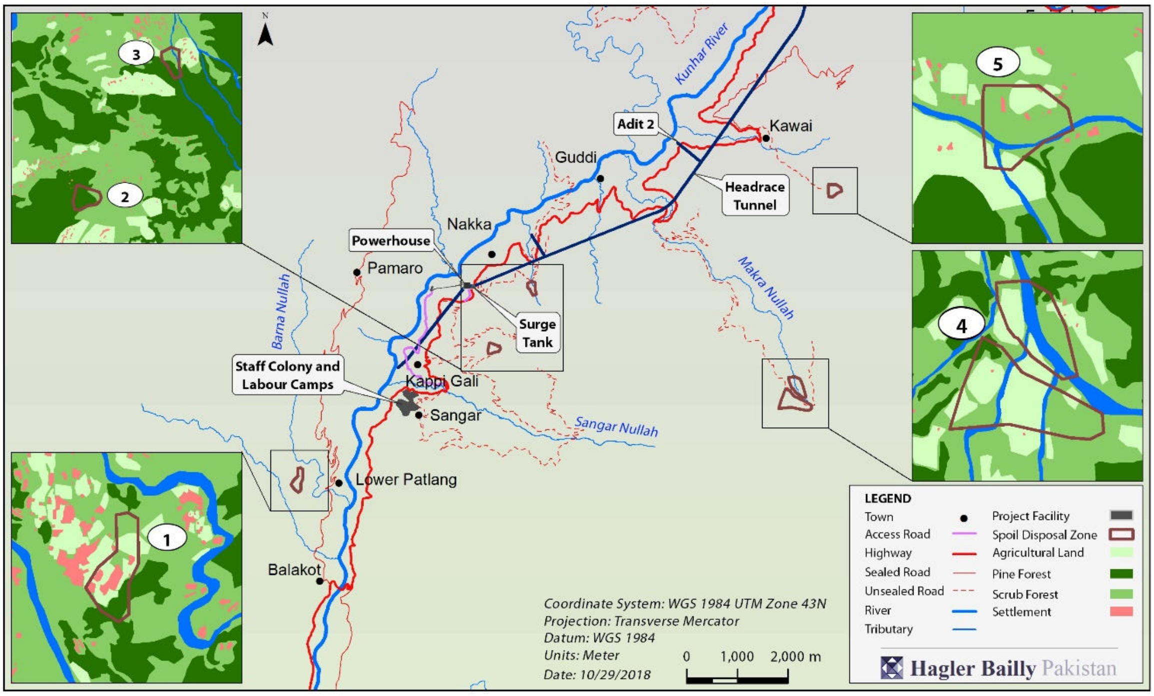
3.4.4 Spoil Disposal

Due to steep topography, exceeding excavation material will have to be placed in smaller kathas and high mountain areas. This will be a significant challenge, as the potential suitable zones are minimal. **Exhibit 3.10** provides a preliminary identification of possible zones which will be confirmed at a later stage.

Approximately 1.1 x 10^6 m^3 of spoil material will be generated. Based on current assessment this material cannot be used for construction.

Design of spoil areas will be done at a later stage as part of site specific conditions including orography, geology, permeability, hydrology etc.

Exhibit 3.10: Spoil Disposal Zones

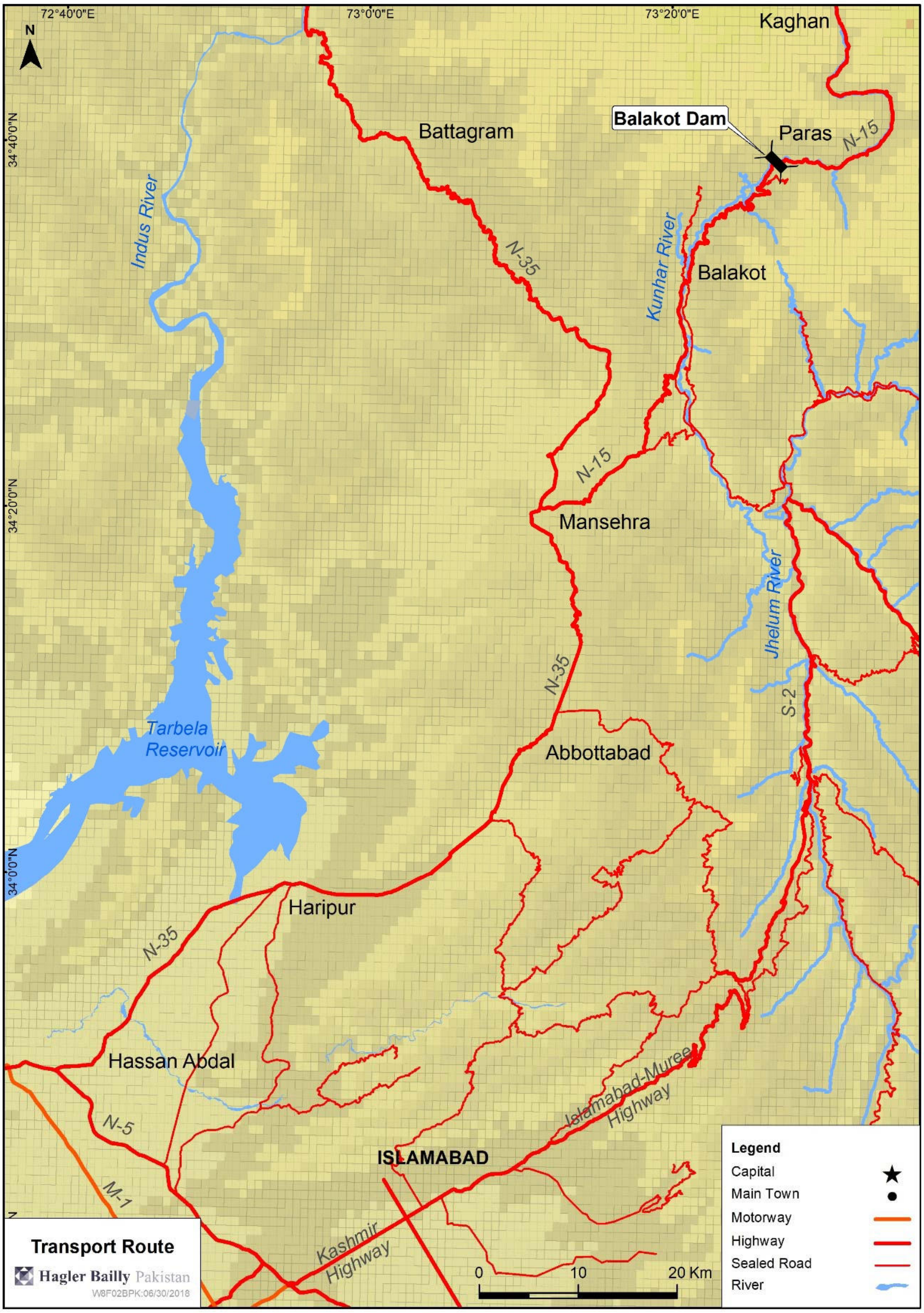


3.5 Access

The main access to the Kaghan Valley from areas south of Balakot is through Abbottabad and Mansehra. Dam and powerhouse sites are accessible from Balakot town from the Balakot-Jalkhad Road. The road is constructed at a gentle gradient and is metaled throughout the way up to Jalkhad.

Exhibit 3.11 shows the access route from the port city of Karachi to the Project Area.

Exhibit 3.11: Access Route



3.6 Regional Hydropower Developments

The Kunhar River is a tributary of the Jhelum River. A number of hydropower projects have been planned or are under construction in the Jhelum Basin, of which five are located on the Kunhar River. None of the projects are currently operational. **Exhibit 3.12** shows a list of these hydropower projects. **Exhibit 3.14** shows the cascade of projects on a map.

Exhibit 3.12: Hydropower Projects Planned or Under Construction on the Kunhar River

No.	*Project Name*	*Capacity (MW)*	*Dam Height (m)*	*Planned/Under Construction*
1.	Batakundi HPP	96	58	Planned
2.	Naran HPP	188	74	Planned
3.	Suki Kinari HPP	870	55	Under construction
4.	Balakot HPP or BHDP	310	45	Planned
5.	Patrind HPP	147	44	In operation
	Total	**1,601**		

3.7 Associated Facilities

The transmission line to be constructed by NTDC to evacuate power from the proposed Project falls in the category of associated facility. Total length of the transmission line will be 720 m and it will connect switch yard of BHDP to the Sukki Kinari – Maira transmission line.[4] **Exhibit 3.13** shows a schematic diagram of the proposed transmission line. To achieve environmental or social outcomes consistent with the ADB SPS, it is essential that NTDC undertake the environmental assessment of the transmission line and develop a sound ESMS consistent with the national and provincial legal environmental requirements as well as that of the ADB SPS. The scope of Consultant's assignment does not include the evaluation of the design, construction, and operation of the transmission line for evacuation of the power produced by the Project, however, recognizing the potential impacts and risks associated with the transmission line, measures to ensure that a full environmental and social assessment of the transmission line is undertaken, the EMP of this Project has identified and defined a set of management measures to be taken in the contractual arrangement with NTDC.

[4] Associated facilities are not funded as part of the project (funding may be provided separately by the borrower/client or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project.

Exhibit 3.13: Schematic of Transmission Line

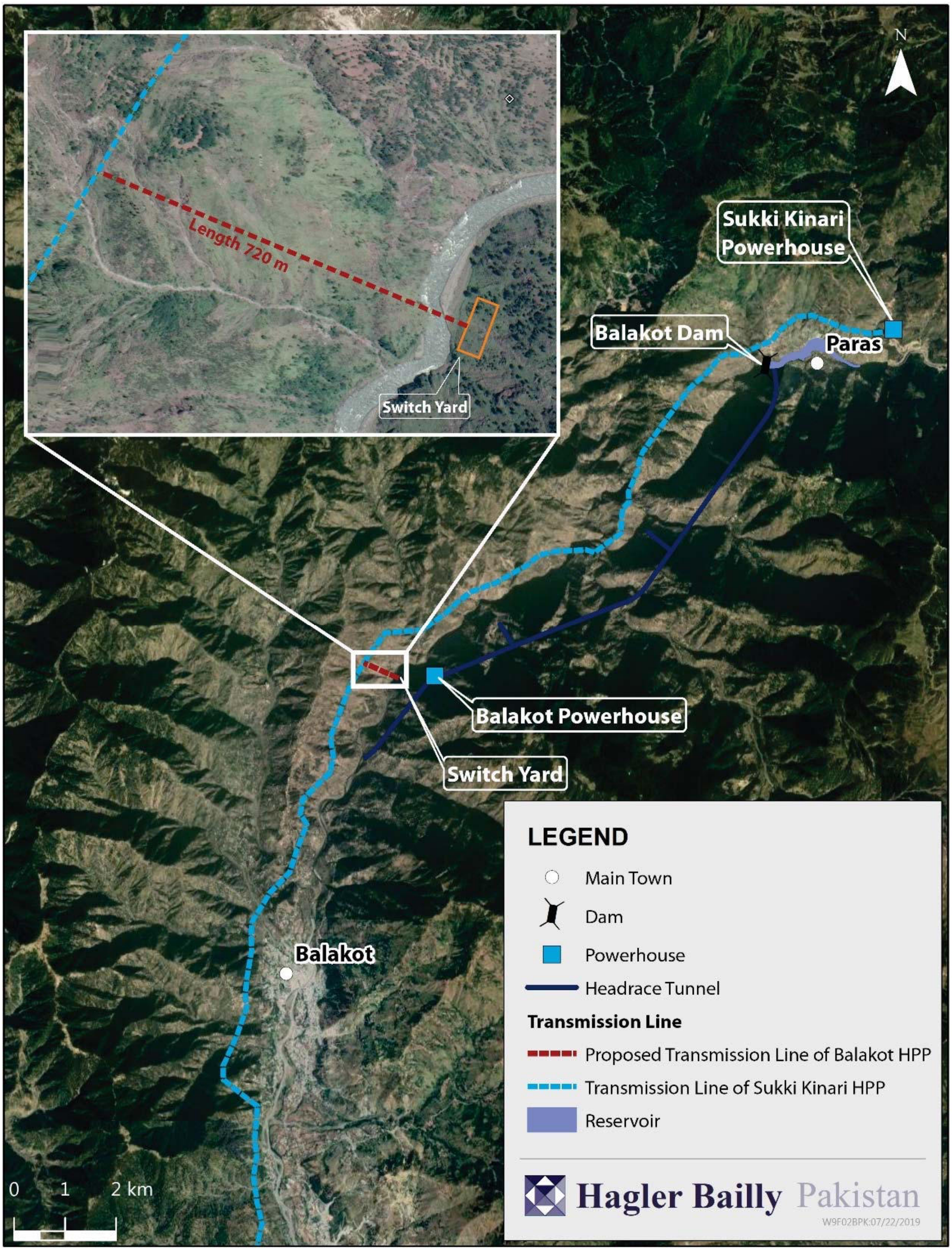
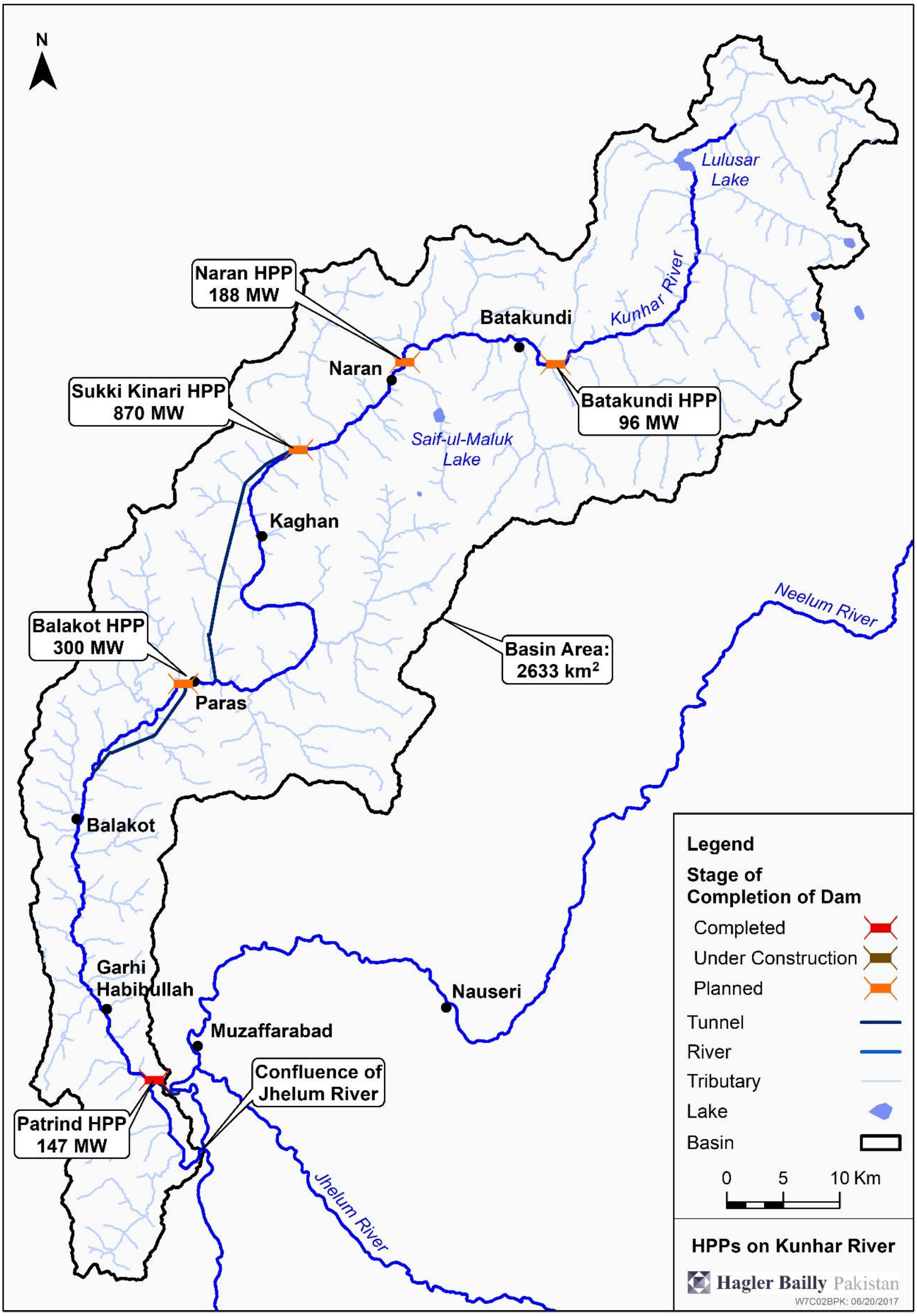


Exhibit 3.14: Hydropower Projects Planned or Under Construction on the Kunhar River



4. Description of the Environment

4.1 Physical Environment

The physical baseline includes a description of the topography, land use, geomorphology, visual character, climate, air quality, sound levels, and water resources of the Study Area.

4.1.1 Scope and Methodology

The specific tasks covered under the physical baseline study included:

- Review of the available literature on the physical environment of the Study Area.
- Analysis of secondary information to characterize baselines, particularly topography, land-use and climate.
- Field surveys for characterization of Study Area - specifically:
  - Soil quality
  - Visual character
  - Water resources (including water quality sampling and hydro census of community springs)
  - Air quality
  - Traffic levels
  - Noise levels

Where relevant baseline data is compared to the NEQS and where relevant, other standards, including the IFC-EHS Guidelines, that are applicable to the Project. The physical environment survey plan is included as **Appendix B**.

4.1.2 Topography

The Kunhar River flows at a high altitude, with most (59%) of its catchment above 3,000 meters above mean sea level (m amsl), through narrow steep gorges for much of its length. The relief in the catchment of the Project dam varies from 629 m amsl to 5,199 m amsl. The dam site is at an elevation of 1,257 m amsl and the powerhouse site at an elevation of 1,316 m amsl. A comparison of the distribution by elevation in the catchment of the Kunhar River and the catchment of the proposed Project dam is given in **Exhibit 4.1** and topography of the area mapped in **Exhibit 4.2.**

4.1.3 Land Use

Land use distribution is shown in **Exhibit 4.3**. Land use in the Study Area (see **Section 4.1.3**) is tabulated in **Exhibit 4.4** and graphed in **Exhibit 4.5**. Photographs of major land uses are given in **Exhibit 4.6**. An example of the classification method is shown in **Exhibit 4.7.** A brief discussion of the land use categories found in the Study Area is given below.

- Agricultural fields are mostly terraced, and used to grow crops such as wheat, maize and rice. Fruit trees are also common. It is the second most dominant land use covering 26% of the Study Area. The extent of agriculture expands downstream as the valley widens with 43% of Zone 5 under agriculture, compared to only 12% of Zone 2.
- Settlements include built-up area such as homes and shops. Homes are often in the middle of agricultural fields. Balakot town is the defining feature of Zone 4 where the settlement accounts for the largest land use category at 37%. Settlements make up 10% or less of the land use in the other zones.
- Water bodies such as rivers are used for fishing and for extraction of sand and gravel. The Kunhar River is very narrow in Zones 1 to 3 accounting for between 2% to 5% of the land cover. It widens in Zones 4 and 5 where its land cover increases to 11% and 14%, respectively.
- Pine forests make a significant portion of Zones 1 to 3 ranging from 22% to 29%. Pine forests account for only 6% and 8% of Zones 4 and 5, respectively.
- Scrub forests are is the most widely spread land use, covering 40% of the Study Area.

Exhibit 4.1: Catchment Elevation Distribution

Elevation Band (m amsl)	*Kunhar River Catchment*	*Project Dam Catchment*
<1000	3%	0%
1000-1999	16%	3%
2000 - 2999	21%	19%
3000 - 3999	34%	44%
4000 - 4999	25%	34%
5000+	0.02%	0.03%
Min	629	1,245
Max	5,199	5,199
Average	2,907	3,210

Exhibit 4.2: Topography of the Kunhar River Basin

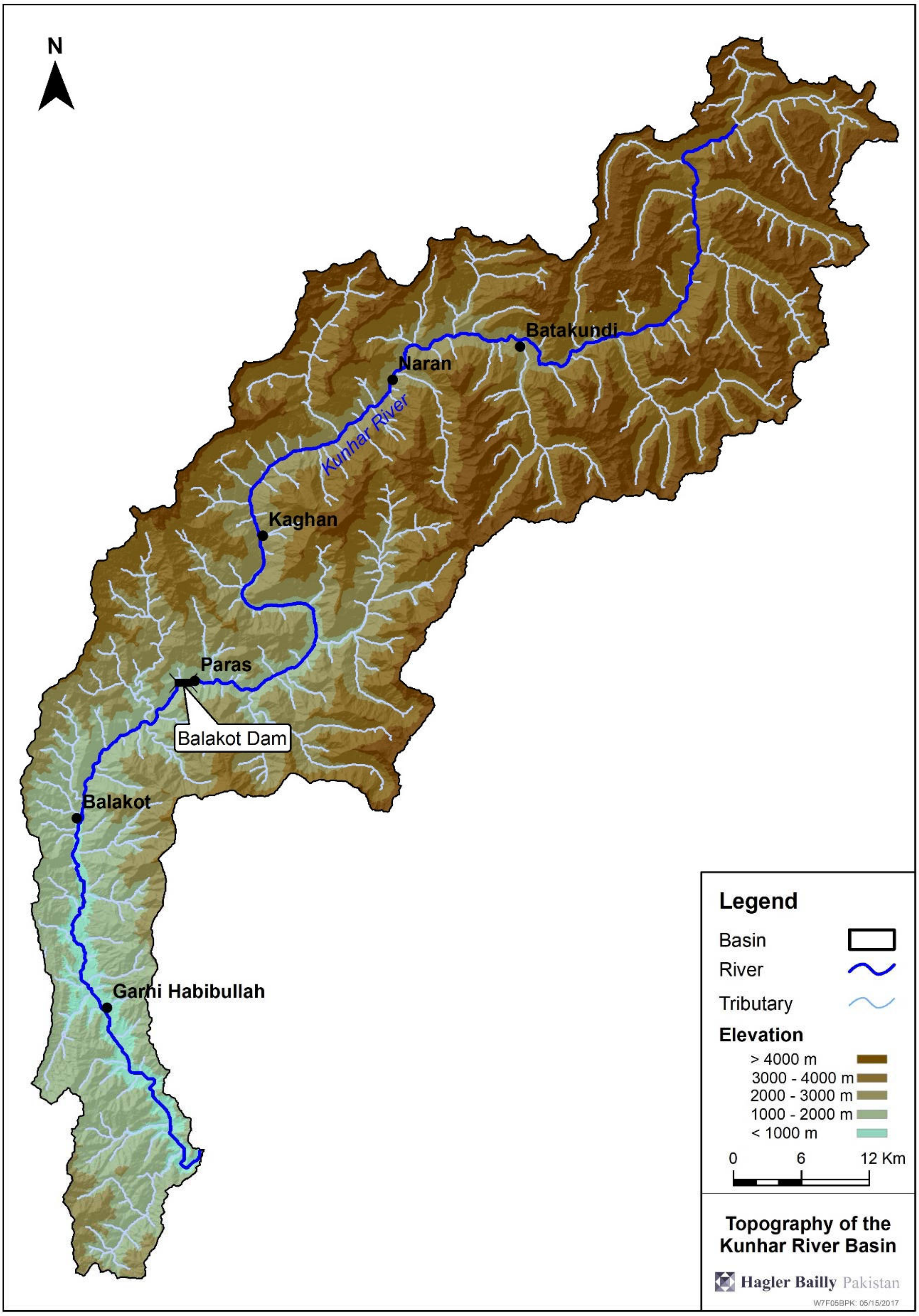


Exhibit 4.3: Land Use Distribution in the Study Area

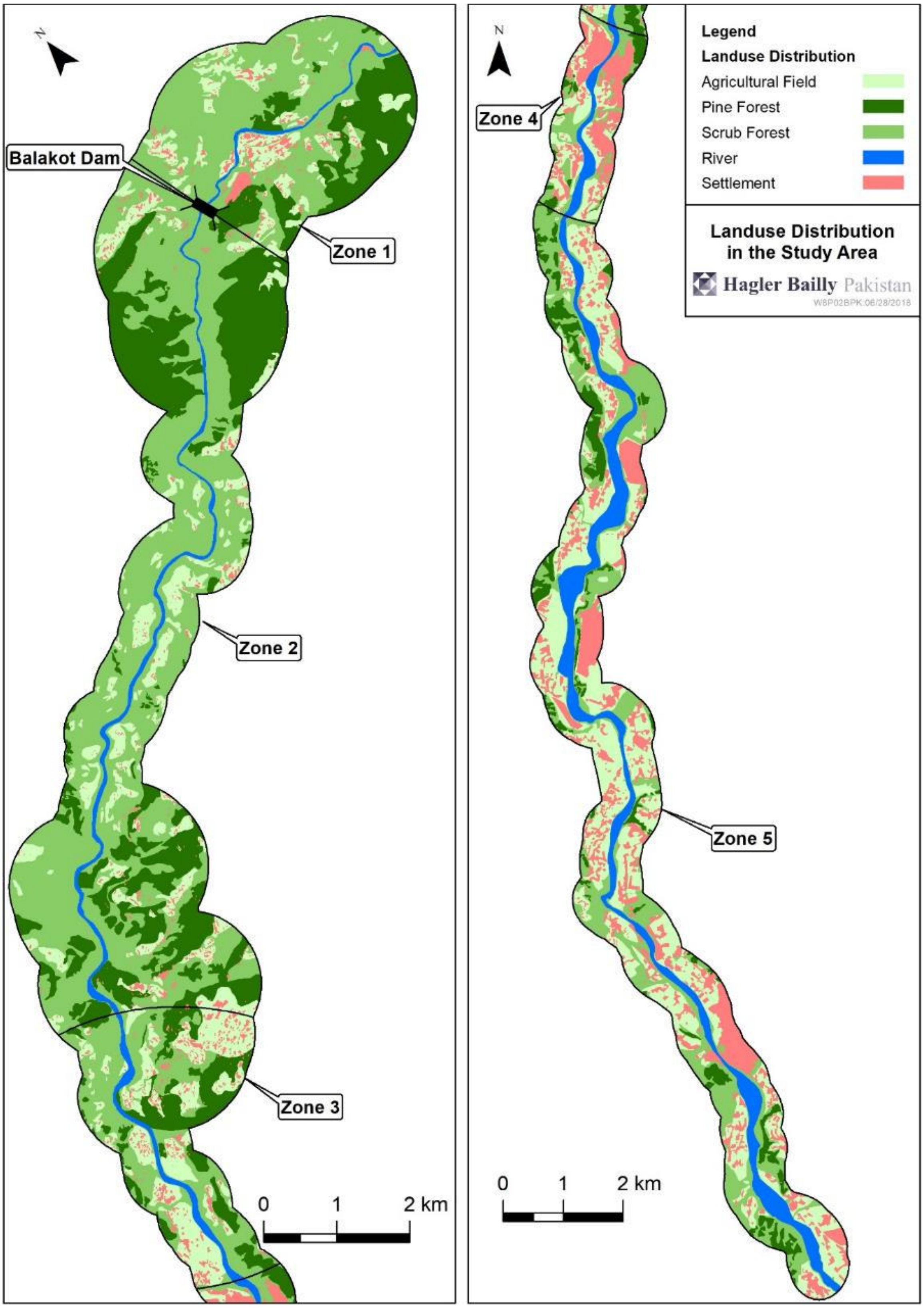


Exhibit 4.4: Land Use in the Study Area (km^2)

	Pine Forests	*Scrub Forests*	*Agricultural Fields*	*Settlements*	*Water Bodies*	***Total Area***
Zone 1	1.98	4.45	1.25	0.40	0.15	8.24
Zone 2	5.99	11.39	2.62	0.39	0.61	21.00
Zone 3	1.36	2.27	1.83	0.43	0.33	6.21
Zone 4	0.22	0.68	0.90	1.27	0.38	3.45
Zone 5	1.73	5.30	9.37	2.05	3.09	21.54
Study Area (Total)	**11.29**	**24.08**	**15.97**	**4.54**	**4.57**	**60.45**
Study Area (Percentage)	**19%**	**40%**	**26%**	**8%**	**8%**	**100%**

Exhibit 4.5: Land Use in the Study Area (%)

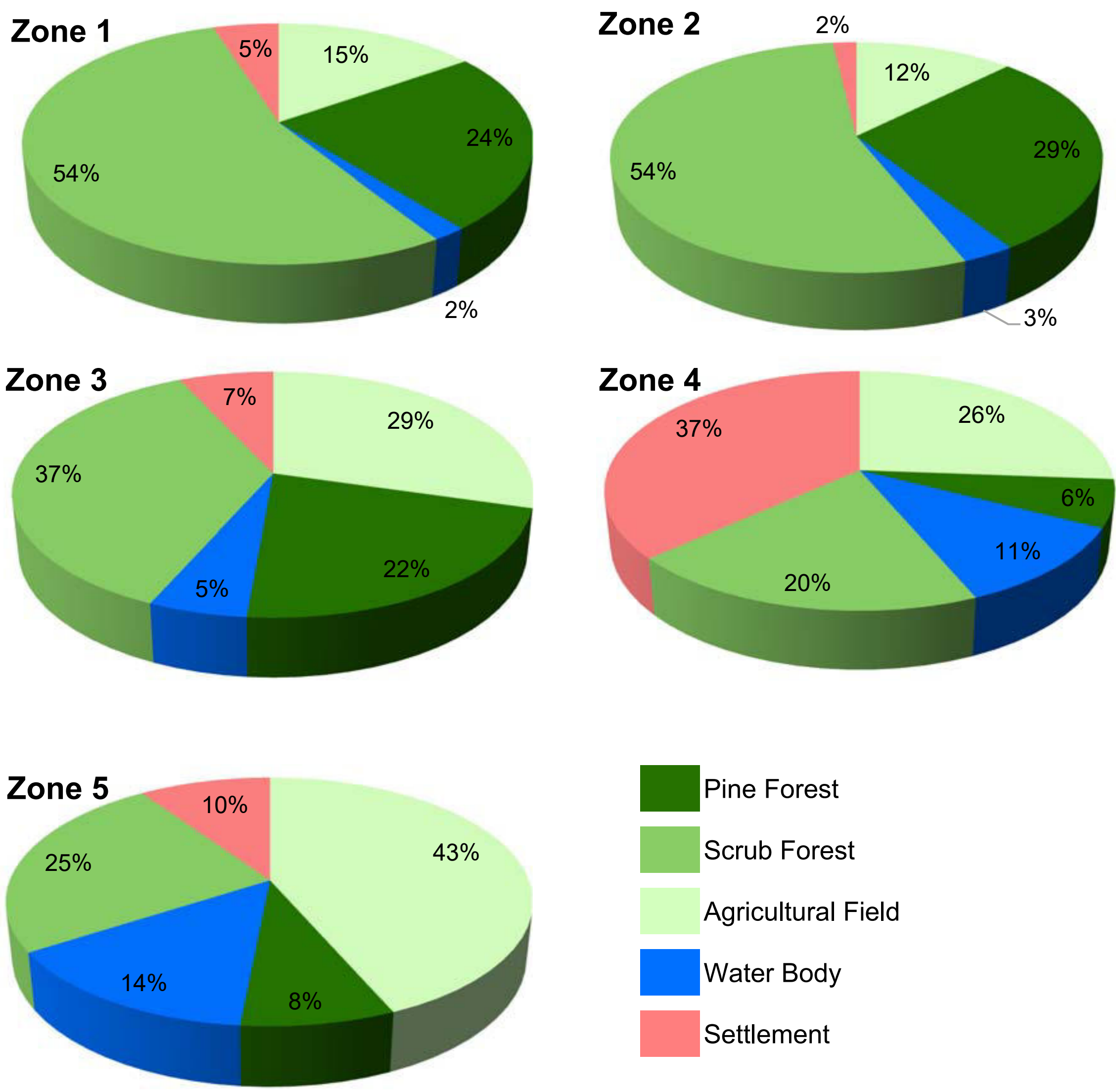


Exhibit 4.6: Photographs of Major Land Uses in the Study Area

Terraced agricultural fields at Dhamdar village

Terraced agricultural fields at Jalora village

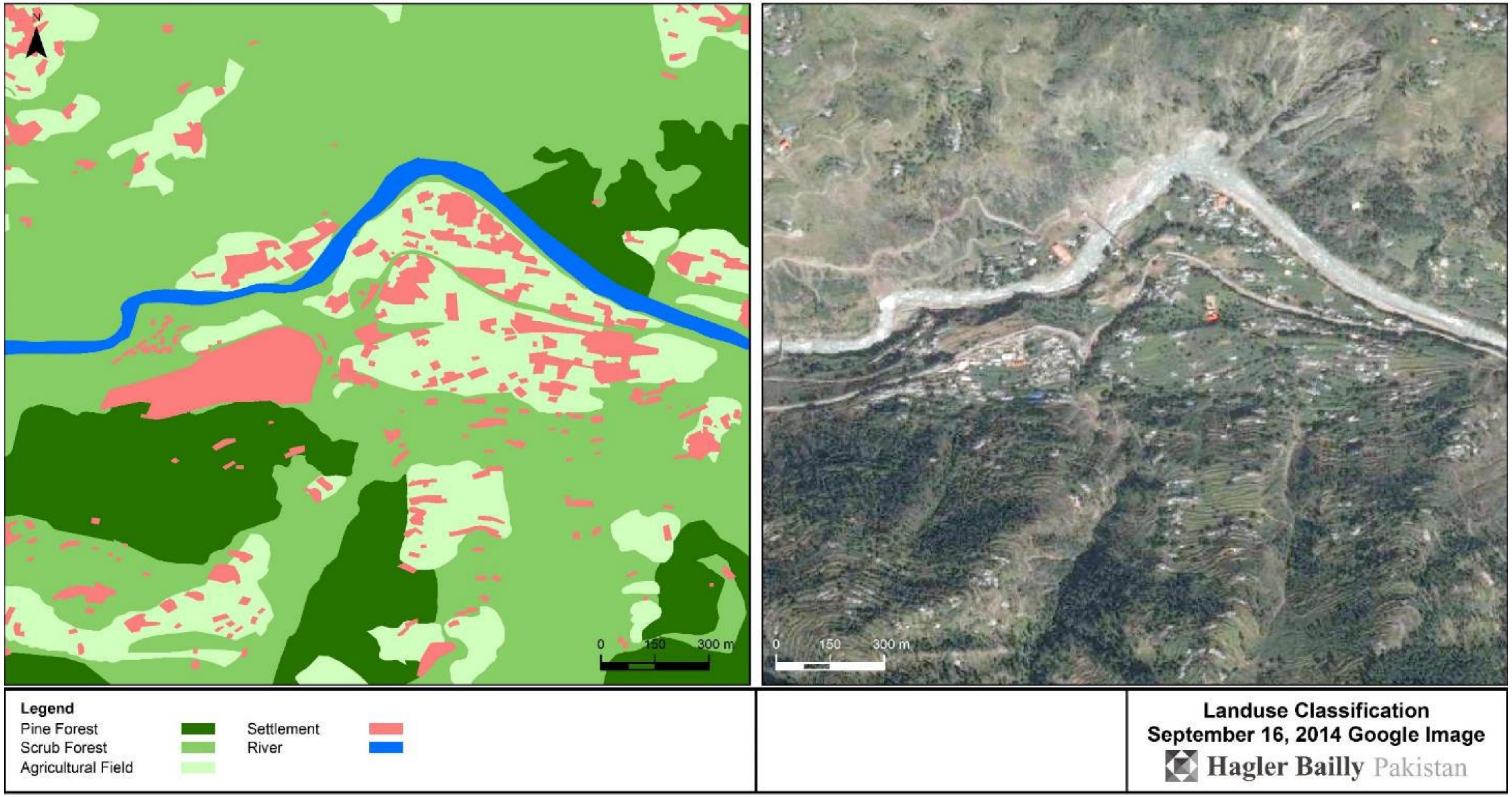
Built up area next to the Kunhar River

Kunhar River near Bissian village

Pine forest near Project dam site

Scrub forest near Project dam site

Exhibit 4.7: Land Use Classification Example



4.1.4 Geology, Soils and Seismic Hazards

This section largely summarizes information from the Feasibility Study, and supplemented with additional literature reviews.

Tectonics

The Project lies along a major and active continental margin, at the confluence of Eurasian and Indian Plates that has resulted in the Himalayan orogeny. The Project area has been affected considerably by tectonics which has produced some prominent faults like the Main Boundary Thrust (MBT), the Panjal Thrust[1], and the Himalayan Frontal Thrust[2] (HFT). MBT passes along the right bank of the Kunhar River, while the powerhouse area and headrace tunnel run parallel on the left bank. This fault is about 2.4 km west of Kunhar River at the dam site. The maximum distance of headrace tunnel from MBT is about 4.64 km. It continues in a southern direction through the rock formation some 2 km away from the powerhouse site. Major tectonic faults are shown in **Exhibit 4.8**.

Being part of the seismically active Himalayas, all the regional faults in the vicinity of the Project dam, have potential for generating future earthquakes at the Project site. However, the Muzaffarabad Thrust, of Holocene age, and its northwest continuation as Indus-Kohistan seismic zone is a proven active seismic zone, which not only generated 2005 earthquake (of magnitude 7.6), but also the 1974 Patan earthquake, 1906 Kangra earthquake, and 1555 Srinagar earthquake. Since this active fault is a northwest (NW) - southeast (SE) oriented thrust fault that dips at an angle of ~30º towards the NW, the epicenters of earthquakes associated with this fault are located along a linear belt extending from Allai-Kohistan through Paras (the Project reservoir site), and then further into Kashmir. This implies that regional geology and tectonics associated with this regional boundary fault is the controlling factor in seismic vulnerability of the any man-made structures in the Kaghan and Neelum Valleys.

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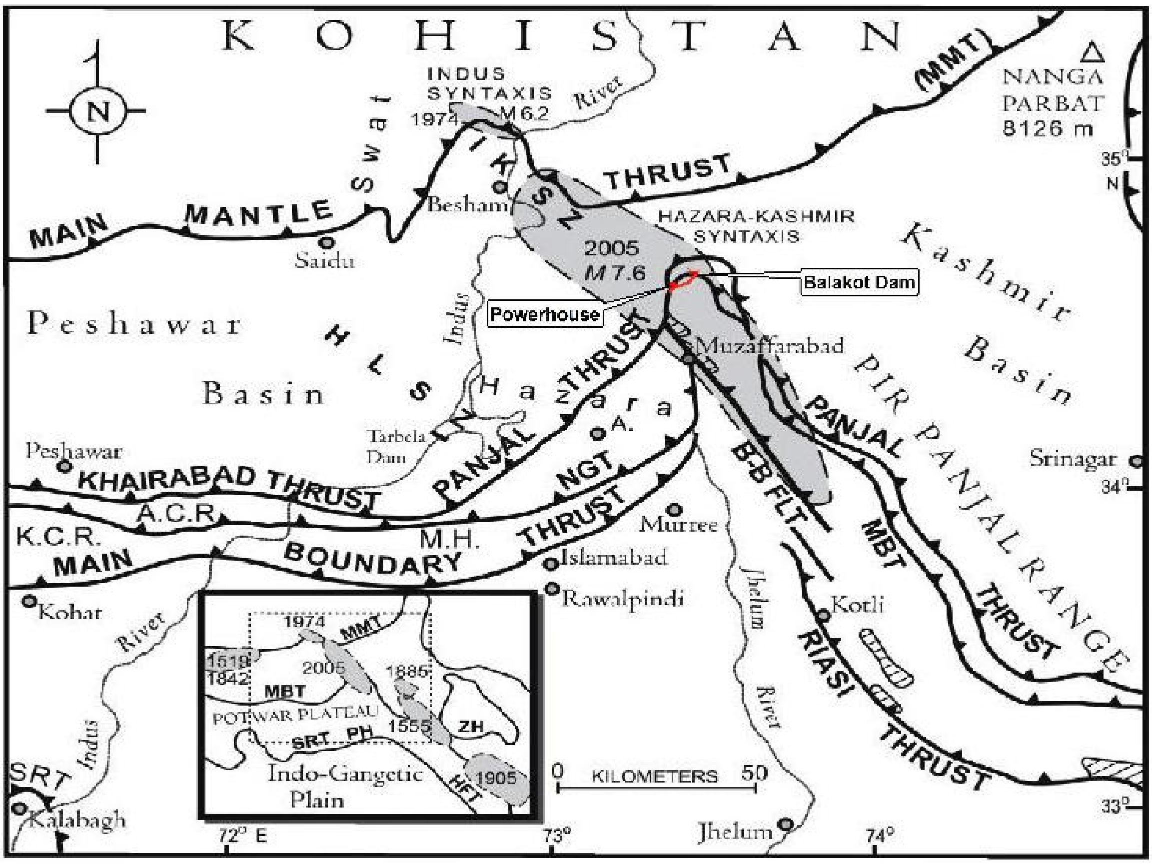
1 In some literature, sections of the Panjal Thrust are synonymous with the Main Central Thrust (e.g. see Robert Yeats, Active Faults of the World, 2012, Cambridge University Press)

2 This is considered part, or synonymous with the Muzaffarabad Thrust depending on the literature and synonymous with the Balakot-Bagh Frontal Thrust

Exhibit 4.8: Major Tectonic Faults in Relation to Dam and Powerhouse



Source: Hussain, Ahmad, Robert Yeats, and MonaLisa. "Geological setting of the 8 October 2005 earthquake." Journal of Seismology 13.3 (2009): 315-325; Notes: A.C.R., Attock–Cherat Range; K.C.R., Kala Chitta Range; M.H., Margalla Hills; B-B FLT, Balakot–Bagh fault; IKSZ, Indus Kohistan Seismic Zone; HLSZ, Hazara–Lower Seismic Zone; NGT, Nathia Gali thrust; HFT, Himalayan Front thrust; SRT, Salt Range thrust; PH, Pabbi Hills; A, Abbottabad; ZH, Zanskar Himalaya; diagonal pattern: Precambrian limestone inliers. Shaded pattern, meizoseismal zones of earthquakes with dates give; shading in main map shows the 2005 earthquake.

Earthquakes and Seismicity

Earthquakes occur very frequently in the Project area, which is within a highly seismically active area. Several regional faults, which are some of the most active faults in the Himalayas, pass through the close vicinity of the Project site. The area is known for recent seismic events including 2004 Paras Earthquake of magnitude 5.2 and 2005 Earthquake of magnitude 7.6, which is discussed further below.

In October 2005, an earthquake of magnitude 7.6 occurred along the Muzaffarabad Thrust. This formed a surface rupture zone approximately 80 km long with an average co-seismic vertical displacement of approximately 2.8 m.[3] The Riasi Thrust has been loaded due to the earthquake and possesses conditions for a strong earthquake of magnitude over 7 to occur, in addition to other faults including the Panjal Thrust, Nathia Gali Thrust, Murree Thrust and Jhelum Fault.

[3] Ibid.

Due to the complex seismotectonic setting described above, it was considered necessary in the Feasibility Study, 2013 to conduct a critical evaluation of seismic hazards to quantitatively determine the level of seismic hazards the proposed Project may exposed to. The guidelines of the International Commission on Large Dams [ICOLD, 1989; modified 2010] require both deterministic and probabilistic seismic hazard analyses, which result in characterization of the design ground motions for different elements of the hydropower project.

- **Deterministic Seismic Hazard Analysis (DSHA):** DSHA involves selection of a seismic source with maximum magnitude potential and minimum distance from the site of interest. Hazards are computed in terms of maximum horizontal peak-ground acceleration (PGA) using a set of selected ground-motion prediction equations. The Feasibility Study, 2013 used, two next generation attenuation equations (Boore and Atkinson, 2008 and Akkar and Bommer, 2010) for computation of seismic hazards**.**
- **Probabilistic Seismic Hazard Analysis (PSHA):** PSHA primarily refers to a model for seismic hazard computations originally developed by Cornell (1968) and McGuire (1976) popularly termed Cornell–McGuire model (Klügel, 2008). The goal of PSHA is to quantify the rate (or probability) of exceeding various ground-motion levels at a site (or a map of sites) given all possible earthquakes.

Exhibit 4.9 shows a summary of the results of the above studies and the reported values briefly described below:

- The controlling Maximum Credible Earthquake (MCE) is the largest reasonably conceivable earthquake that appears possible along a recognized fault or within a geographically defined tectonic province, under the specific tectonic framework governing the region of interest. Inelastic behavior with associated damages and cracking is permissible under the MCE provided the water retaining integrity of the main dam body is retained. According to ICOLD (2010), MCE is estimated based on DSHA earthquake scenarios. The ground motion parameters of the MCE are taken as the 84 percentile.
- The maximum design earthquake (MDE) is the maximum level of ground motion for which a structure is designed. According to ICOLD (2010) guidelines, the MDE ground motion parameters are estimated based on PSHA, using the mean values of the ground motion parameters.
- According to ICOLD (2010) guidelines, the dam shall be capable of resisting the controlling Operation Basis Earthquake (OBE) within the elastic range, remain operational, and not require extensive repairs. All structural components, which are part of or built within the main dam body, will be designed to remain functional during and after an OBE event. The OBE is best determined by using PSHA. OBE ground motions are significantly lower than those for MCE and MDE and has return periods between 145-275 years, depending upon the local seismic conditions.

Exhibit 4.9: Summary of Seismic Design Criteria (PGA in g)

Criteria	Return Period	Value (PGA in g)	
		Dam Site	Powerhouse Site
Operation Basis Earthquake (OBE)	150	0.26	0.27
	475	0.37	0.38
Maximum Design Earthquake (MDE)	1,000	0.45	0.46
	2,500	0.57	0.58
	10,000	0.79	0.81
Maximum Credible Earthquake (MCE)		0.71	0.79

According to the revised Building code of Pakistan with Seismic Provision (PBC, 2007) the Project location is classified under seismic Zone 4 (see **Exhibit 4.10**) for which the Project is required to withstand a PGA greater than 0.32g (3.2 m/s^2) (see **Exhibit 4.11**).

Exhibit 4.10: Seismic Zones, PBC 2007

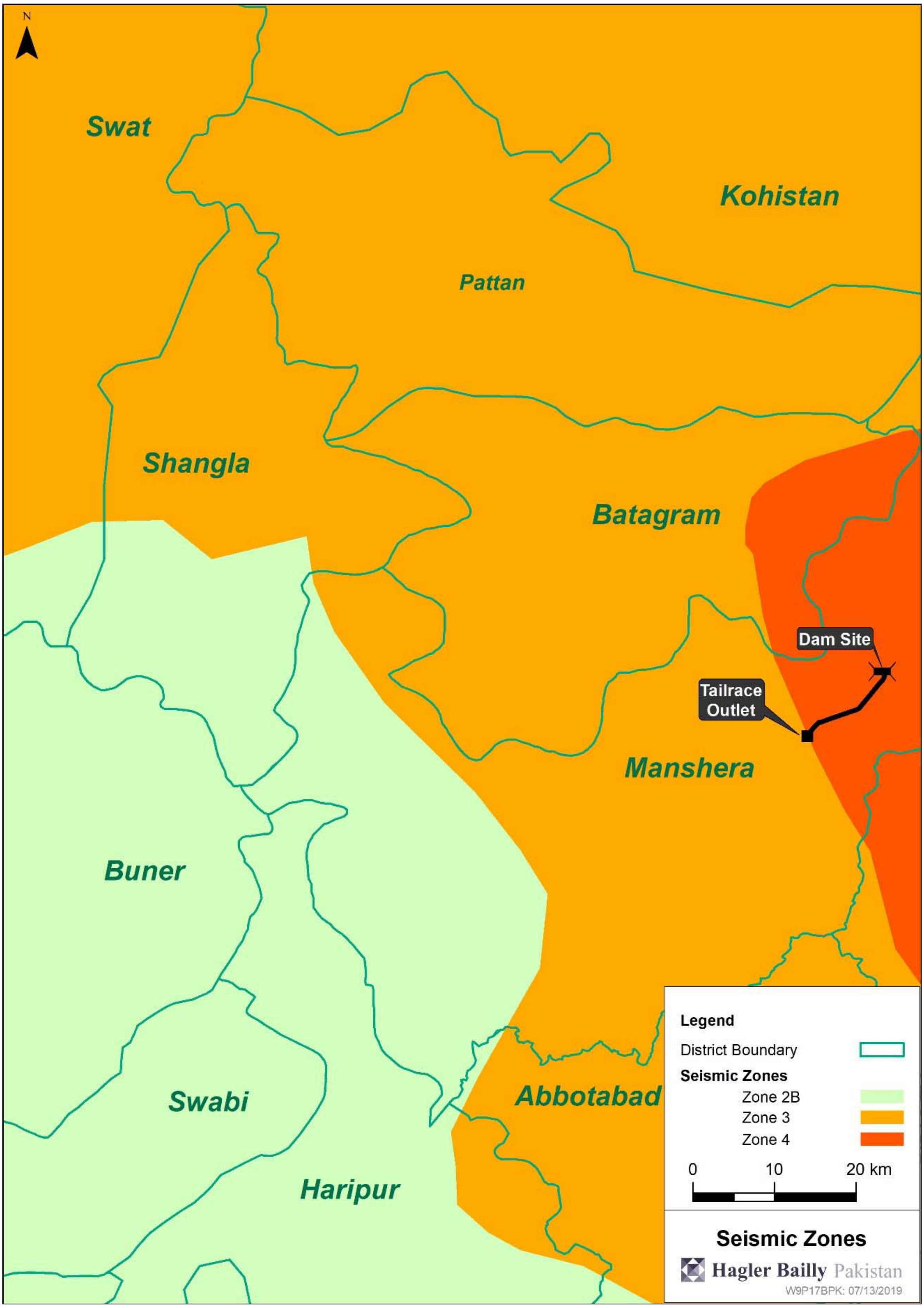
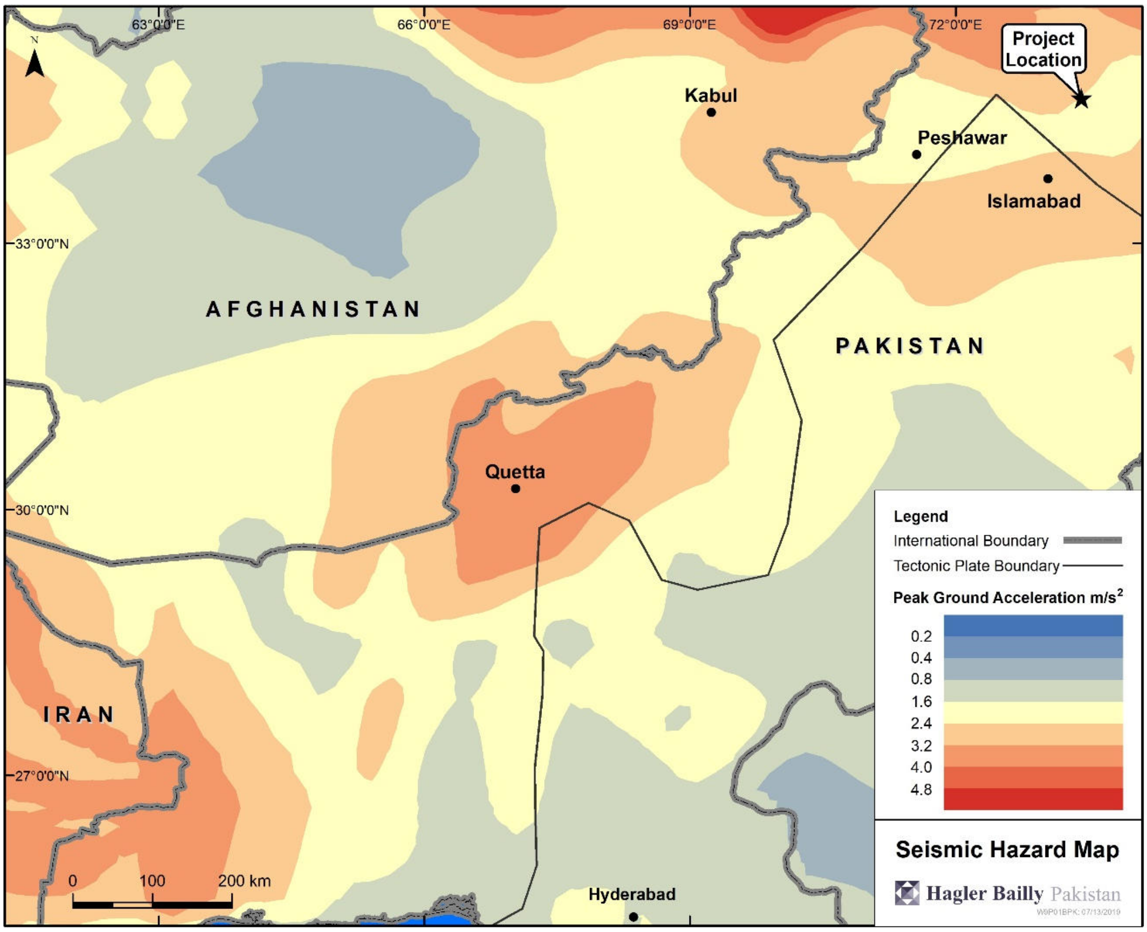


Exhibit 4.11: Seismic Zone Categorization, PBC 2007

Seismic Zone	*Peak Horizontal Ground Acceleration*
1	0.05 to 0.08g
2A	0.08 to 0.16g
2B	0.16 to 0.24g
3	0.24 to 0.32g
4	> 0.32g

The Global Seismic Hazard Map Project (GSHAP) is shown in **Exhibit 4.12**. The peak ground acceleration (PGA) with 10% probability of exceedance in 50 years (475 years average return interval) is between 1.6 meter per second squared (m/s^2) and 2.4 m/s^2 at the Project site.

Exhibit 4.12: Seismic Hazard Map of Paksitan



Source: Adapted from Giardini, D., Grünthal, G., Shedlock, K. M. and Zhang, P.: The GSHAP Global Seismic Hazard Map. Annali di Geofisica 42 (6), 1225-1228, 1999.

Lithology and Soils

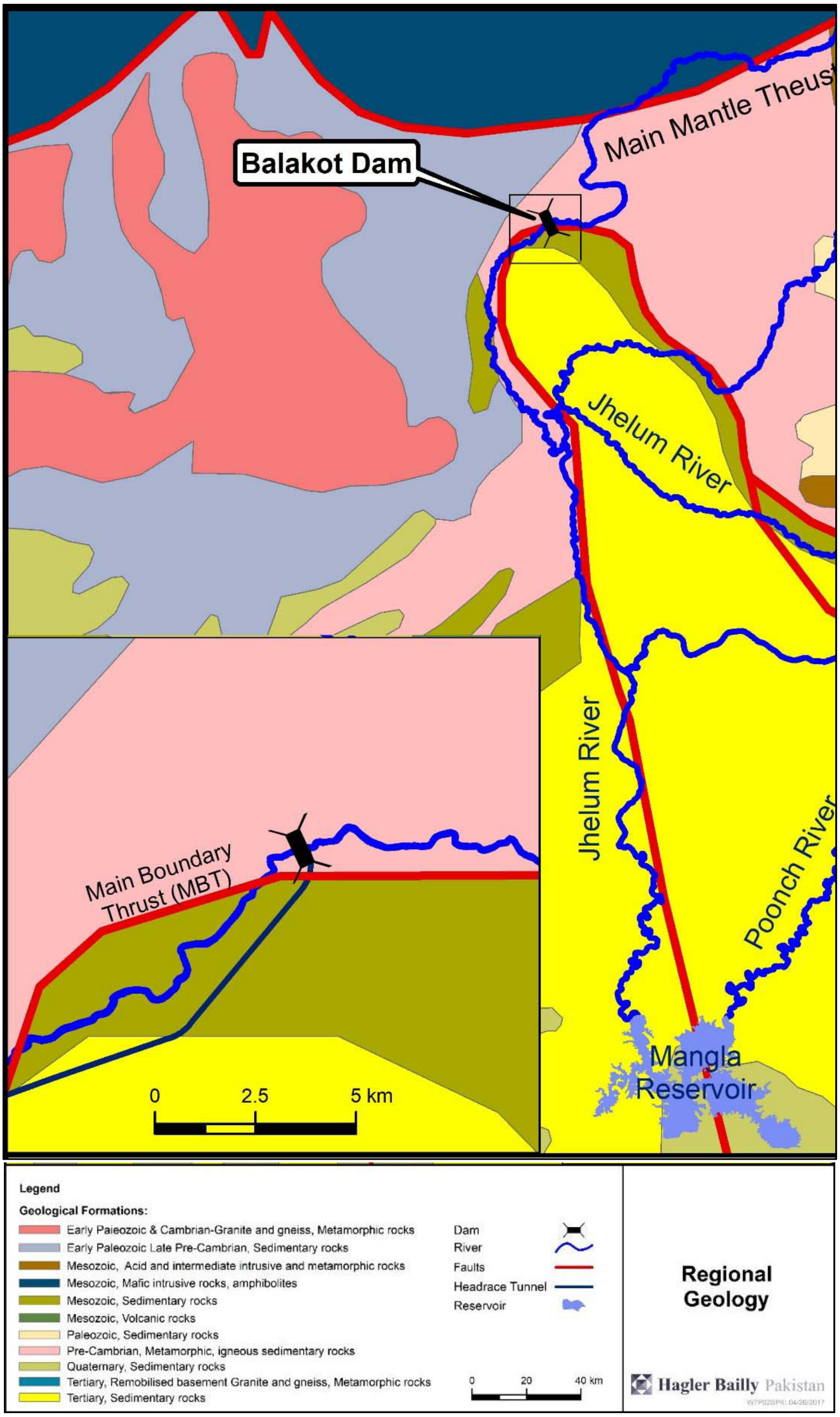
The Project is located in rocks belonging to Murree Formations. The Murree Formation is of early Miocene age, and consists of dark red to purple and greenish grey sandstone and siltstone, purple to reddish brown shale, mudstone and lenses of conglomerates. These rocks are exposed at the dam site and consist of alternate beds of sandstone and shale as shown in **Exhibit 4.13**. Structurally, the formation shows a high degree of compression in the form of tight folding with repeated faulting and fracturing. At places, it shows open broad folds which have been weathered into steep ridges and valleys with a succession of cliffs and steep slopes.

The Murree Formation exposed in the Balakot area represent as last stages of Neo-Tethys and the beginning of Siwalick system in the area which is indicated by sandstone and shale deposits. The lithological units in the region, are shown in **Exhibit 4.14**.

Exhibit 4.13: Alternate Bedding of Sandstone and Mudstone/Shale near the Dam Axis

Source: Aqualogus, June 2019, Draft Final Report D2.2B – Feasibility Study for the 300 MW Balakot Hydropwoer Project, for the Asian Development Bank and Pakhtunkhwa Energy Development Organization

Exhibit 4.14: Regional Geology



The soils of the Project area are composed of piedmont alluvial deposits, where upper layer of the plain/leveled land consists mostly of silty clay loam soils, rich in organic matter content. The subsurface strata is generally sandy loam with gravel. The soils of the hill slopes consist mostly of thin layered sandy loam soils, underlain by rocks or gravelly materials. The valley terraces in-between the mountains are very fertile and used for intensive cropping, while, the hill slopes are used for forest vegetative cover.

Soil samples were collected on April 13, 2017 and analyzed for establishing baseline conditions to establish soil fertility and identify any current soil contamination. A total of 4 samples were collected from locations listed in **Exhibit 4.15** and shown in **Exhibit 4.16**. Soil samples were analyzed in the HBP Laboratory and ALS Malaysia[4]. The detailed sampling methodology and lab analysis reports are provided in **Appendix C**. The sampling results are summarized in **Exhibit 4.17**.

Exhibit 4.15: Sampling Locations for Soil Quality

ID	*Coordinates*	*Description*	*Notes and Justification*
S1	34° 39' 38.16" N 73° 27' 42.32" E	Agricultural land, Paras	To check agricultural fertility and proposed location of labor camps which may lead to contamination
S2	34° 38' 49.53" N 73° 26' 28.79" E	Pine forest, Dam site	Location of dam site which may lead to contamination.
S3	34° 36' 12.12" N 73° 22' 56.61" E	Scrub forest, Powerhouse site	Location of powerhouse site which may lead to contamination.
S4	34° 34' 54.90" N 73° 22' 07.70" E	Agricultural land, Sangar	To check agricultural fertility and proposed location of labor camps which may lead to contamination.

4 HBP Lab conducted pH, EC and organic matter tests, whereas the remaining were conducted at ALS Malaysia

Exhibit 4.16: Soil Sampling Locations

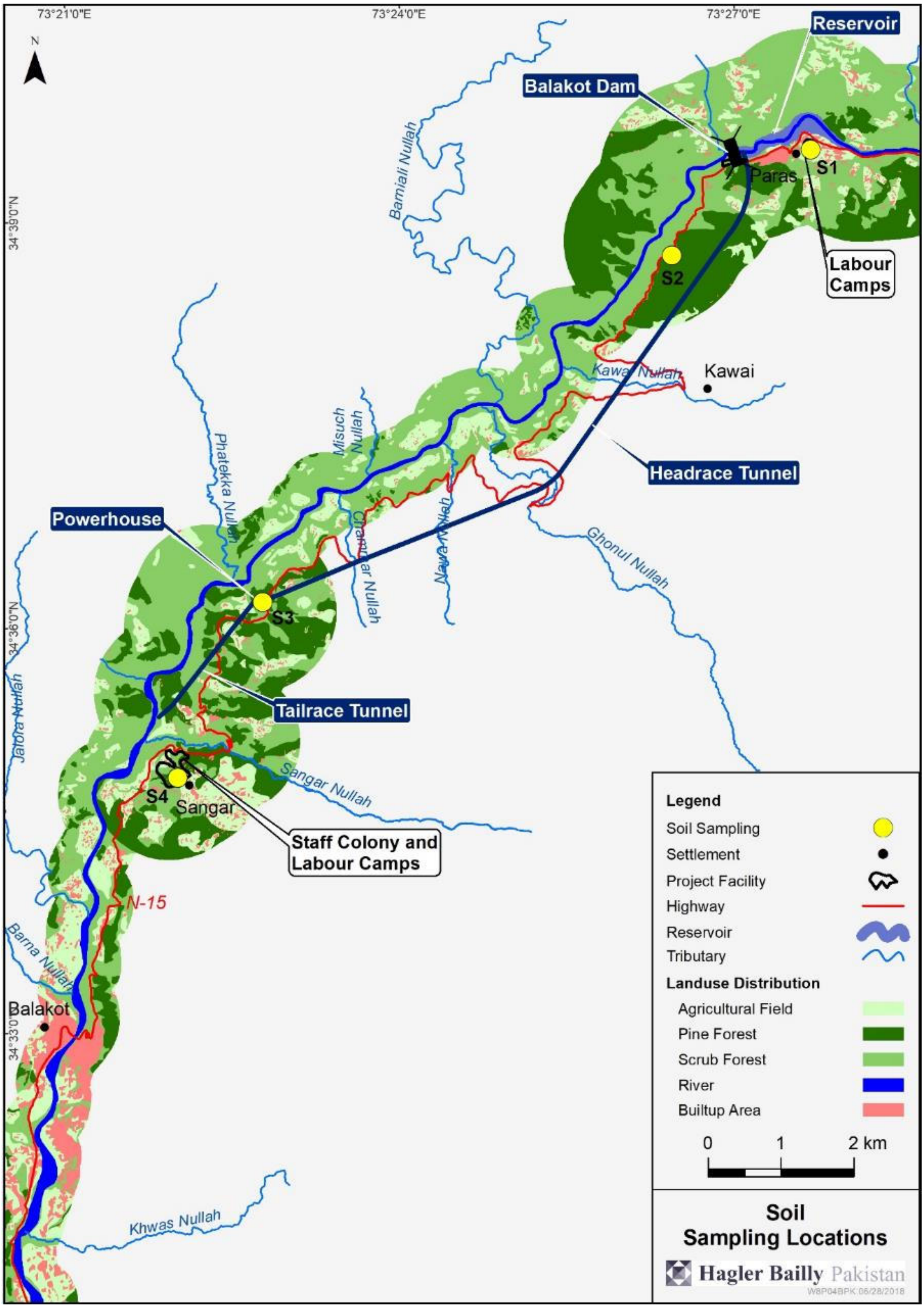


Exhibit 4.17: Soil Quality Test Results

Parameter	*Method*	*LOR*	*Unit*	*S1*	*S2*	*S3*	*S4*
				Agriculture	*Pine Forest*	*Scrube Forest*	*Agriculture*
Physical							
pH	CSSS	0.1		8.1	8.1	7.9	7.9
Electrical Conductivity (EC)	CSSS	1	µS/cm	233	474	377	258
Macro-nutrients and Organics							
Nitrate	APHA4500-NO3-H	0.1	mg/kg	11.6	<0.1	<0.1	1.8
Phosphate	APHA4500-P-F	1	mg/kg	<1	<1	<1	<1
Potassium	USEPA6010B	5	mg/kg	2,220	609	908	1,040
Organic Matter	CSSS	0.1	%	2.86	2.69	5.46	3.72
Organic Carbon	CSSS	0.05	%	1.64	1.55	3.13	2.13
Metals and Major Ions							
Arsenic	USEPA6010B	1	mg/kg	8	4	6	4
Barium	USEPA6010B	5	mg/kg	152	54	50	61
Boron	USEPA6010B	5	mg/kg	<5	<5	<5	<5
Cadmium	USEPA6010B	1	mg/kg	<1	<1	<1	<1
Chromium	USEPA6010B	1	mg/kg	43	25	56	17
Copper	USEPA6010B	1	mg/kg	34	19	28	23
Iron	USEPA6010B	1	mg/kg	25,100	14,200	22,600	11,000
Lead	USEPA6010B	1	mg/kg	17	12	16	16
Manganese	USEPA6010B	1	mg/kg	501	710	798	770
Mercury	USEPA7471A	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
Nickel	USEPA6010B	1	mg/kg	54	37	88	20
Selenium	USEPA6010B	5	mg/kg	<5	<5	<5	<5
Silver	USEPA6010B	1	mg/kg	<1	<1	<1	<1
Zinc	USEPA6010B	1	mg/kg	78	38	72	58

Note: LOR = Level of Reporting, mg/kg = milligram per kilogram, µS/cm = micro Siemen per centimeter

Key observations on the basis of the results presented in **Exhibit 4.17** are as follows:

- **Physical:** The pH of soil samples at all sampling locations ranges between 7.9 and 8.1. The maximum pH is observed as 8.1 at S1 (agricultural land, Paras) and minimum as 7.9 at S3 (scrub forest, powerhouse site). Higher values of EC are observed under forest based land use system compared to the agricultural land. The maximum EC is observed as 474 µS/cm at S2 (pine forest, dam site).

- **Nutrients and Organics:** Organics at all sampling locations don't vary significantly. The maximum organic matter and organic carbon values are observed at S3 as 5.46% and 3.13%, respectively. Phosphates were not detected at any of the sampling locations. Nitrates are only observed on agricultural land (S1 and S4) with the maximum value as 11.6 mg/kg at S1. Potassium is also high at S1 (agricultural land, Paras) and S4 (agricultural land, Sangar) with the maximum value as 2,220 mg/kg at S1. Macronutrient contents shows high fertility at S1 (agricultural land, Paras) and S4 (agricultural land, Sangar).
- **Metals and Major Ions:** Metal contents do not vary significantly through the area sampled, indicating absence of contamination from any industrial activity or spills. Results for Boron, Cadmium, Mercury, Selenium and Silver were below the level of reporting.

4.1.5 Visual Character

The visual baseline documents the current aesthetic and visual conditions of the proposed Project site as seen from the nearby receptors.

Methodology and Sampling Locations

To document the visual baseline a survey was conducted on May 5, 2017. Visual survey locations are listed in **Exhibit 4.18** and shown in **Exhibit 4.19. Exhibit 4.20** shows the views of Project facility locations from nearby receptors.

Exhibit 4.18: Visual Survey Locations

ID	*Coordinates*	*Altitude (m)*	*Bearing of Image Center*	*Location*	*Rationale*
V1	34° 39' 46.6" N 73° 27' 16.6" E	1,356	Southeast	Right Bank: reservoir	View towards Paras where reservoir will inundate land
V2	34° 39' 00.6" N 73° 26' 29.4" E	1,335	West	Left Bank: downatream of dam site	View downstream of the dam site
V3	34° 36' 07.1" N 73° 22' 52.5" E	1,366	Northwest	Left Bank: powerhouse site	View towards construction activity site near the powerhouse site
V4	34° 35' 05.2" N 73° 21' 48.7" E	1,070	Northwest	Left Bank: tailrace outfall	View near the tailrace outfall

Exhibit 4.19: Visual Survey Locations

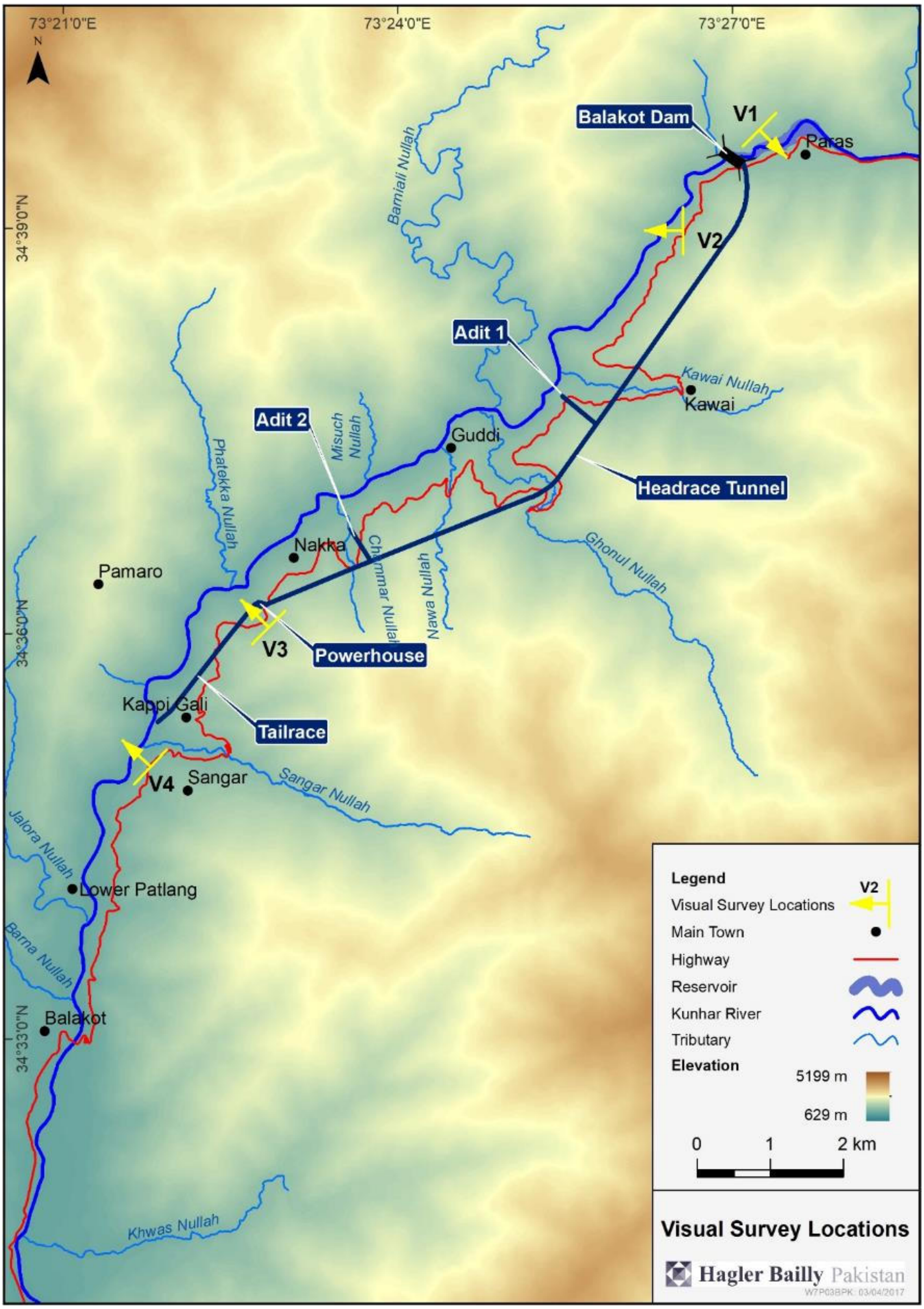
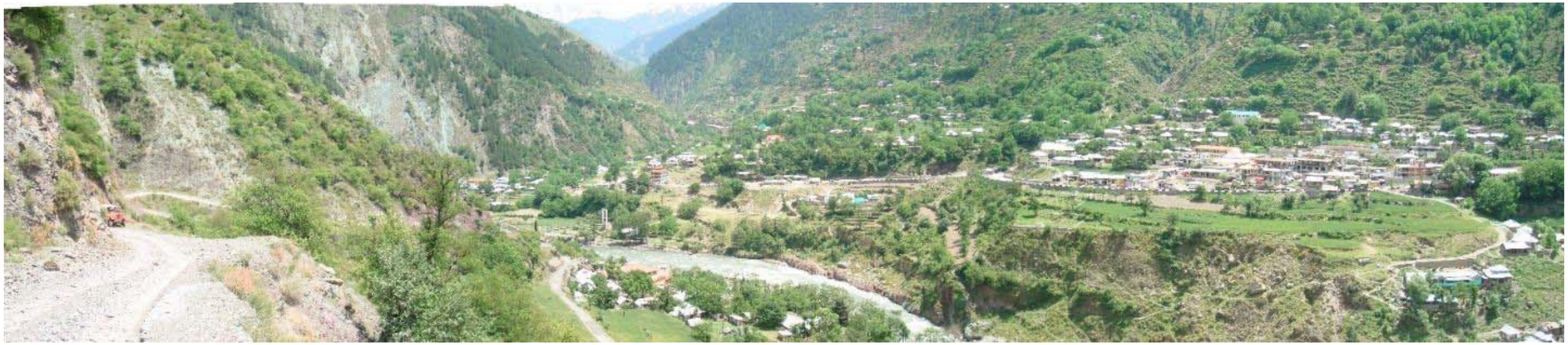


Exhibit 4.20: Visual Survey Photographs



View from V1 (180 degree view, at 1356 meters elevation, centered at bearing Southeast, right bank). The village of Paras and agricultural fields can be seen in the distance.

View from V2 (180 degree view, at 1335 meters elevation, centered at bearing West, left bank). River downstream of the Dam site can be observed. Steep hills and trees hinder visibility

View from V3 (180 degree view, at 1366 meters elevation, centered at bearing Northwest, left bank). View of the Powerhouse site. Mountainous terrain hindered visibility

View from V4 (180 degree view, at 1070 meters elevation, centered at bearing Northwest, left bank). View of the Kunhar River after the tailrace outfall. The valley starts to widen as the river approaches Balakot.

The following method was used for the visual survey:

- A compass was used to record the bearings, in degrees, for the photographs.
- GPS coordinates of the locations were recorded.
- A tripod was used to take the photographs.

Photographs were stitched to form 180° panoramic views in the direction of Project activities.

Results and Analysis

The mountainous landscape, deep gorges and vegetation greatly restricts visibility to a maximum of 0.5 to 1.5 km at receptor locations.

4.1.6 Climate Baseline

The objective of climate baseline is to characterize the climatic conditions in the Study Area. This includes characterization of the monthly trends in weather parameters (temperature, precipitation, relative humidity, wind speed and direction) and the extreme conditions that occur in the Study Area.

Data Sources

A regional climate overview was established using available data from Balakot weather station. This is the nearest Pakistan Meteorological Department (PMD) weather station to the Project. The description of weather station is presented in **Exhibit 4.21.**

Exhibit 4.21: Details of Balakot Weather Station

World Meteorological Organization (WMO) Identification Number	41536
Established	1957
Location	73° 21' E, 34° 32' N
Location with respect to dam site	16 km northeast
Location with respect to powerhouse site	8 km northeast
Elevation (m amsl)	980.0
Data period used in the analysis	1961-1990 (30 Years)

Data Analysis

The climate analysis of Project area was carried out by classifying it into different seasons as below.

Summer (mid-March to mid-June)

Characterized by high temperatures, moderate rainfalls with moderate humidity and high speed-winds.

Summer Monsoon (mid-June to mid-September)

The summer monsoon, hereafter referred to as the Monsoon, is characterized by high temperatures (although milder than the summer), significantly high rainfalls with high humidity and moderate speed-winds, slightly lower than summers.

Post-Monsoon summer (mid-September to mid-November)

Characterized by moderate temperatures, low rainfalls with moderate humidity higher than summers, as the humidity again reduces after monsoon and low speed-winds.

Winter (mid-November to mid-March)

Characterized by very low temperatures, moderate rainfalls, with an increasing amount of rainfall at the end of the winter, with relative humidity greater than post-monsoon summer and moderate speed-winds.

The summary of climate analysis is presented in **Exhibit 4.22**. The parameters are tabulated in **Exhibit 4.23** and graphed in **Exhibit 4.24** to **Exhibit 4.28.** Wind frequency distribution is presented in **Exhibit 4.29**.

Exhibit 4.22: Seasonal Variation

Season	*Temperature and Humidity*	*Rainfall*	*Wind*
Summer *(mid-March to mid-June)*	Daily maximum temperature averages between 19°C and 35°C. Daily minimum gradually increases from 8°C in March to 21°C in June. Morning humidity reduces from 67% in March to 54% in June. Same trend was observed in afternoon humidity that also reduces from 51% in March to 34% in June.	30% of total rainfall occur in summers with maximum amount of rainfall observed in March (189 mm). The mean number of rainy days during this period ranges from 6 to 10 per month. Monsoon generally starts by late June.	Predominant wind direction is southwest with mean wind speed of 1.1 m/s. however, wind keeps on changing direction between southwest and northwest. 24% of the time winds were calm during this period.
Monsoon *(mid-June to mid-September)*	Daily maximum temperature drops by a few degrees and averages between 30°C and 32°C. Daily minimum temperatures gradually decreases and varies between 17°C and 21°C. Morning humidity increases to 89% in August and then reduces to 81% in September. Same trend was seen in afternoon humidity. It increases to 66% in August and then reduces to 54% in September.	45% of total rainfall occur in monsoons with maximum amount of rainfall observed in July (359 mm). In August rainfall slightly reduces to 293 mm. The mean number of rainy days during this period are between 6 and 14 per month.	The wind speed decreases in monsoon with the mean speed of 0.6 m/s during this period. Winds are southwesterly. 30% of the time winds were calm during this period.
Post-monsoon summer *(mid-September to mid-November)*	Daily maximum temperature decreases by about 3°C and averages between 21°C and 27°C. Daily minimum temperatures start decreasing and drops to 6°C by November. Morning humidity decreases sharply to 75% in October and November. Afternoon humidity drops sharply in October to 44% and remains near 49%.	By the end of September the monsoon rainfall ends. Only about 5% of total rainfall occur in post-monsoon summer. Amount of rainfall significantly reduces to 45 mm in October. The number of rainy days are less than 5 during these months.	Further reduction in wind speed occur during this period with the mean speed of 0.6 m/s. Winds are southwesterly. 17% of the time winds were calm during this period.
Winter *(mid-November to mid-March)*	Daily maximum temperature averages between 14°C and 16°C. Daily minimum temperature averages between 2°C and 4°C. Morning humidity again increases to 78% and then drops to 72% in February. Afternoon humidity again increases to 59% in December and then drops to 55% in February.	The amount of rainfall starts increasing with the advent of winter. About 20% of the total rainfall occurs during this season with maximum amount in February (154 mm). The mean number of rainy days are between 5 and 8 per month.	Wind speeds tend to increase in start of January with the mean speed of 0.6 m/s during this period. Predominant wind direction is southwest however, also blows from northwest. 29% of the time winds were calm during this period.

Note: Morning measurements were made at 5:00 AM and afternoon measurements were made at 5:00 PM (Pakistan Standard Time)
A day is defined as *rainy days* if the total amount of rainfall for that day exceeds 2.5 mm.

Exhibit 4.23: Weather Parameters

Month	*Temperature (ºC)*			*Humidity (%)*		*Rainfall (mm)*	*Number of Rainy days*	*Wind Speed (m/s)*	
	Mean	*Min*	*Max*	*5:00 AM*	*5:00 PM*			*Max*	*Mean*
Jan.	8.1	2.0	14.0	76	58	94.9	5.5	3.6	0.5
Feb.	9.6	3.9	15.4	72	55	153.5	7.8	3.6	0.9
Mar.	13.5	7.6	19.5	67	51	188.6	9.7	3.6	1.0
Apr.	19.0	12.6	25.3	62	46	134.3	8.4	3.6	1.1
May.	24.1	17.2	31.0	54	36	77.0	5.9	5.1	1.1
Jun.	28.2	21.0	35.3	54	34	98.4	6.8	6.2	1.1
Jul.	26.8	21.3	32.3	81	59	359.4	13.7	3.6	0.7
Aug.	25.9	20.6	31.3	89	66	292.5	12.4	3.6	0.5
Sep.	24.0	17.1	30.9	81	54	100.8	6.4	2.6	0.6
Oct.	19.4	11.5	27.5	75	44	44.7	2.9	3.6	0.7
Nov.	14.0	6.2	21.9	75	49	45.9	2.7	2.6	0.5
Dec.	9.4	2.9	16.0	78	59	81.2	5.0	3.6	0.4

Exhibit 4.24: Mean Monthly Temperatures (°C)

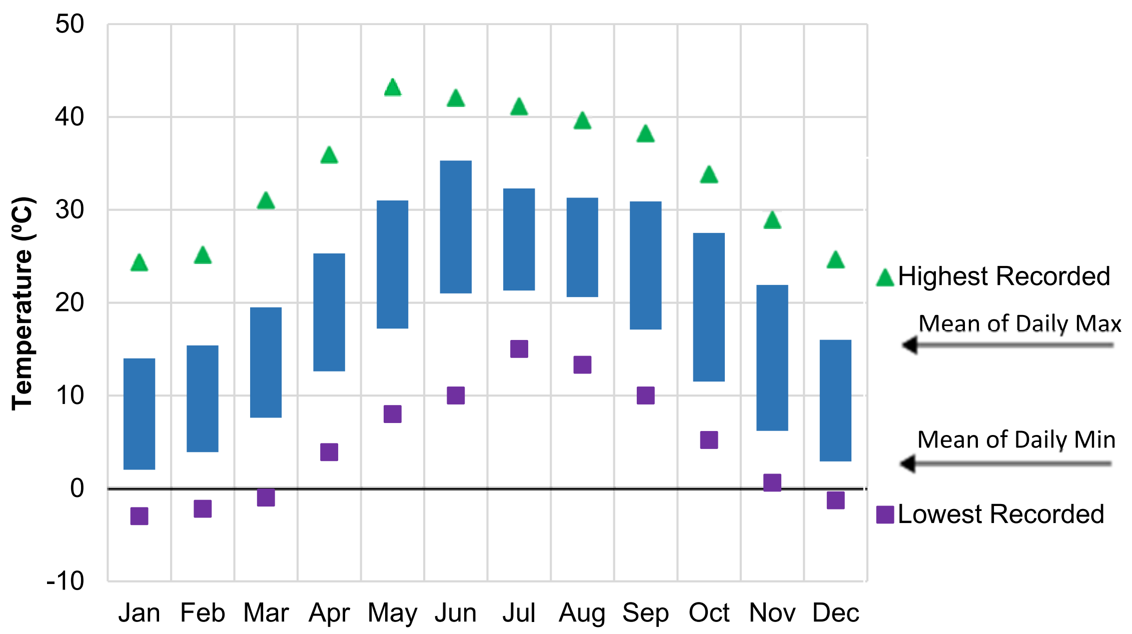


Exhibit 4.25: Mean Monthly Relative Humidity (%)

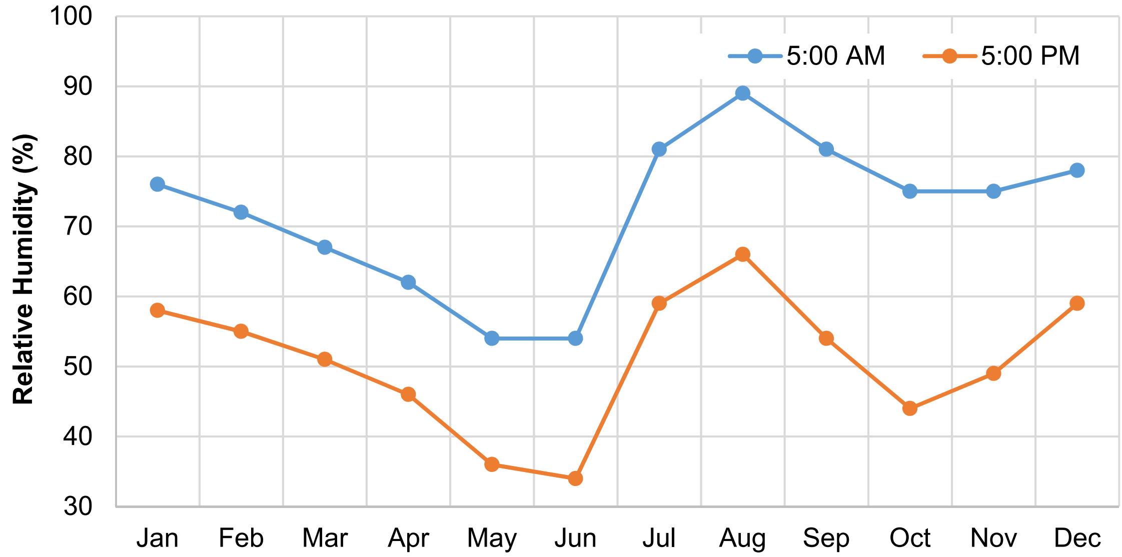


Exhibit 4.26: Mean Monthly Rainfall (mm)

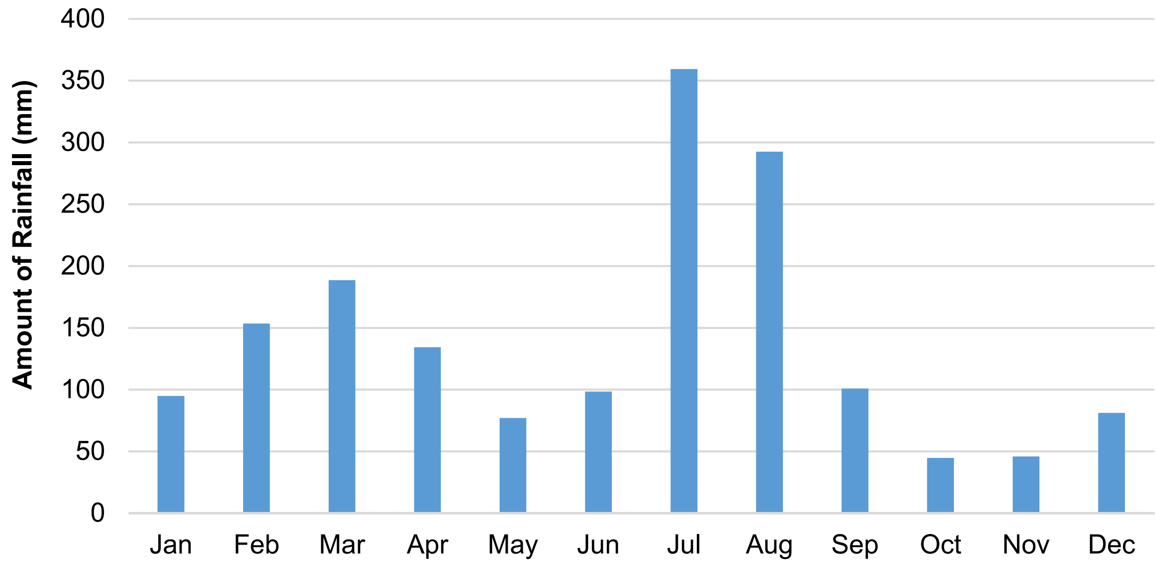


Exhibit 4.27: Mean Number of Rainy Days

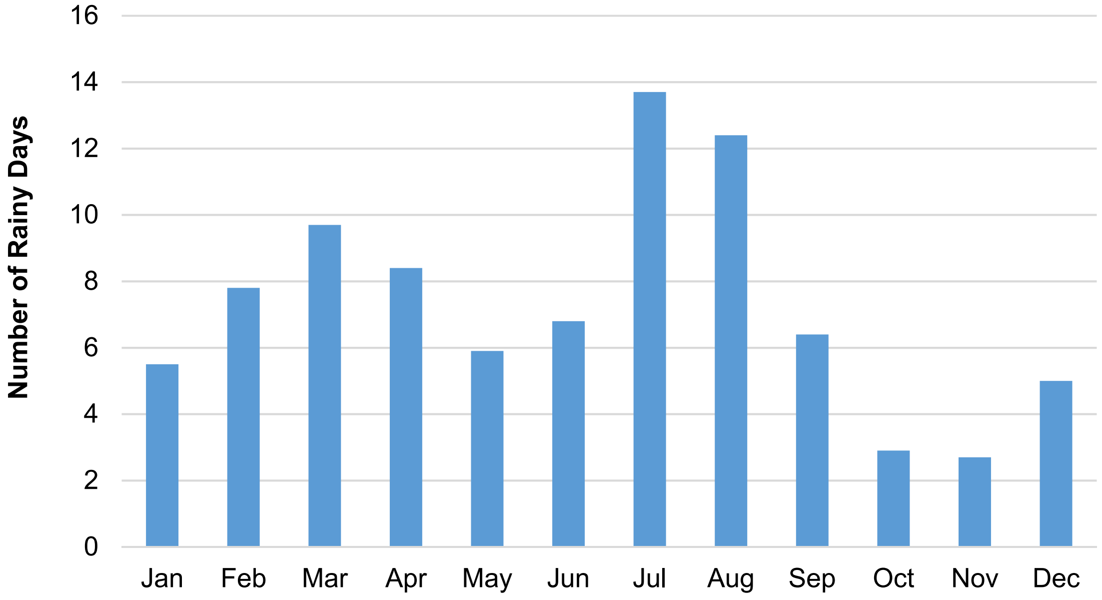


Exhibit 4.28: Mean Monthly Wind Speed (m/s)

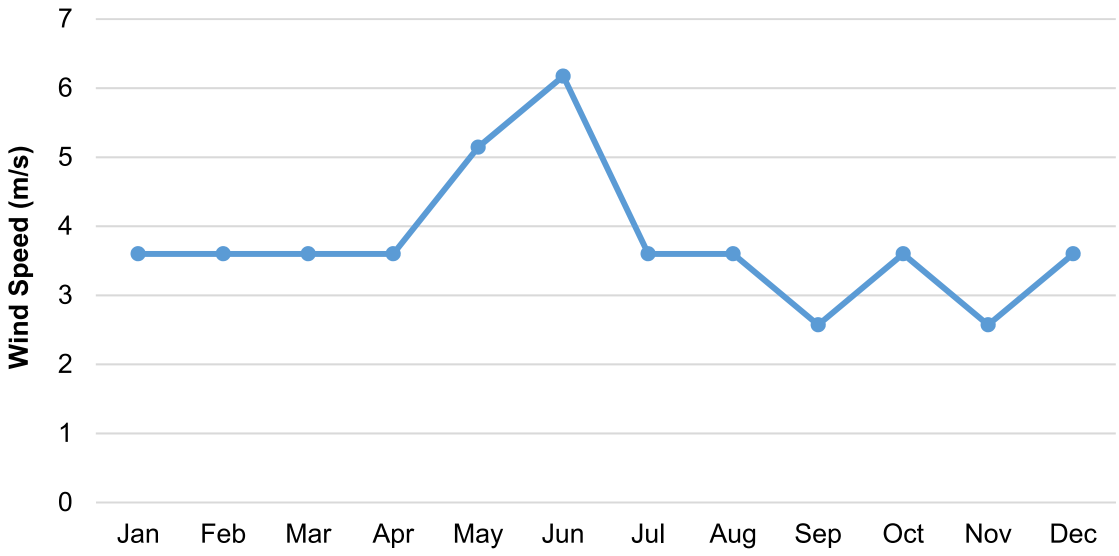


Exhibit 4.29: Wind Frequency Distribution (%)

Month	Wind Speed Ranges (m/s)									Wind Direction							
	Calm	0.5 to 2	2 to 4	4 to 6	6 to 9	9 to 12	12 to 14	14 to 17	> 17	N	NE	E	SE	S	SW	W	NW
Jan.	67%	27%	6%	0.2%	0%	0%	0%	0%	0%	0%	3%	0%	2%	1%	17%	0%	10%
Feb.	47%	44%	8%	0.5%	0%	0%	0%	0%	0%	1%	4%	0%	4%	0%	31%	0%	12%
Mar.	39%	43%	16%	1%	0%	0%	0%	0%	0%	0%	6%	0%	6%	1%	30%	0%	17%
Apr.	45%	39%	15%	1%	0%	0%	0%	0%	0%	0%	3%	0%	5%	1%	31%	0%	15%
May.	35%	46%	18%	1%	0%	0%	0%	0%	0%	0%	4%	0%	8%	2%	34%	0%	17%
Jun.	36%	44%	18%	2%	0.4%	0%	0%	0%	0%	1%	5%	0%	6%	2%	38%	0%	12%
Jul.	62%	28%	10%	1%	0%	0%	0%	0%	0%	0%	1%	0%	6%	1%	28%	0%	2%
Aug.	68%	28%	4%	0.2%	0%	0%	0%	0%	0%	0%	1%	0%	8%	1%	22%	0%	1%
Sep.	63%	35%	3%	0%	0%	0%	0%	0%	0%	0%	1%	0%	5%	2%	28%	0%	2%
Oct.	47%	49%	3%	1%	0%	0%	0%	0%	0%	0%	1%	0%	8%	7%	33%	0%	4%
Nov.	62%	37%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	2%	25%	0%	8%
Dec.	77%	21%	2%	0.2%	0%	0%	0%	0%	0%	0%	1%	0%	1%	0%	17%	0%	4%

Note: Calm are the winds less than 0.5 m/s.

N:North S: South E: East W: West

NE: Northeast SE: Southeast SW: Southwest NW: Northwest

Weather Extremes

Weather extremes for the Balakot weather station are given in **Exhibit 4.30** for temperature and in **Exhibit 4.31** for precipitation.

Exhibit 4.30: Temperature Extremes in the Study Area

Month	*Lowest Recorded*		*Highest Recorded*	
	Value	*Year*	*Value*	*Year*
Jan.	-3.0	1974	24.4	1971
Feb.	-2.2	1972	25.2	1985
Mar.	-1.0	1979	31.1	1971
Apr.	3.9	1989	36.0	1974
May.	8.0	1987	43.3	1988
Jun.	10.0	1979	42.1	1984
Jul.	15.0	1975	41.2	1985
Aug.	13.3	1988	39.7	1987
Sep.	10.0	1979	38.3	1962
Oct.	5.2	1982	33.9	1971
Nov.	0.6	1962	29.0	1979
Dec.	-1.3	1986	24.7	1988

Exhibit 4.31: Extreme Precipitation Conditions

Month	*Wettest Year*		*Heaviest Rainfall in 24 hour*		*Driest Year*	
	Rain (mm)	*Year*	*Rain (mm)*	*Year*	*Rain (mm)*	*Year*
Jan	226.0	1980	67.3	1973	0.0	1966
Feb	345.1	1980	80.8	1971	22.0	1985
Mar	373.6	1980	108.5	1973	14.0	1971
Apr	277.1	1965	105.1	1979	48.0	1974
May	191.7	1982	64.7	1979	6.0	1980
Jun	283.7	1978	84.1	1977	28.6	1990
Jul	914.9	1988	213.8	1988	113.6	1983
Aug	567.2	1983	245.0	1983	148.9	1989
Sep	199.3	1977	79.0	1978	3.3	1971
Oct	241.3	1987	88.0	1987	0.0	1984
Nov	192.7	1986	103.0	1986	0.0	1968
Dec	324.2	1990	80.1	1990	0.0	1981

Comparison of Climatic Normal with Recent Data

Climatic normal data for the time period of 1961 – 1990 was compared with more recent data from 1991 – 2011 for temperature and precipitation. Climatic normal are based on 30-year period and developed by the PMD. A comparison of the datasets is shown in **Exhibit 4.32** and graphed in **Exhibit 4.33** to **Exhibit 4.34.**

The following conclusions can be drawn:

- **Temperature:** There is slight variations in temperature observed in recent data as compared to climatic normal. The increase in mean temperatures in recent years is 0.2°C. This shows that overall temperature is increased at the Project site.
- **Rainfall:** The amount of rainfall only increased in the months of January, June and September by an amount of 1 mm, 3 mm and 29 mm, respectively. However, in the rest of the months the amount decreases. The decrease in annual amount of rainfall is 175 mm.

Possible reasons for the change in weather parameters may be because of climate change or urbanization, which can explain increased temperatures and decreased amount of rainfalls.

Exhibit 4.32: Comparison between Climatic Normal and Recent Data

Month	*Mean Temperature (ºC)*		*Rainfall (mm)*	
	1961-1990	*1991-2011*	*1961-1990*	*1991-2011*
Jan	8.1	8.2	94.9	95.9
Feb	9.6	9.9	153.5	152.1
Mar.	13.5	14.1	188.6	152.5
Apr	19.0	19.0	134.3	104.1
May	24.1	24.2	77.0	72.5
Jun	28.2	27.2	98.4	101.4
Jul	26.8	26.8	359.4	324.3
Aug	25.9	26.0	292.5	236.7
Sep	24.0	24.1	100.8	129.8
Oct	19.4	19.8	44.7	40.2
Nov	14.0	15.1	45.9	36.9
Dec	9.4	10.5	81.2	49.6
Annual	**18.5**	**18.7**	**1,671.2**	**1,496.0**

Exhibit 4.33: Comparison of Monthly Temperatures (ºC)

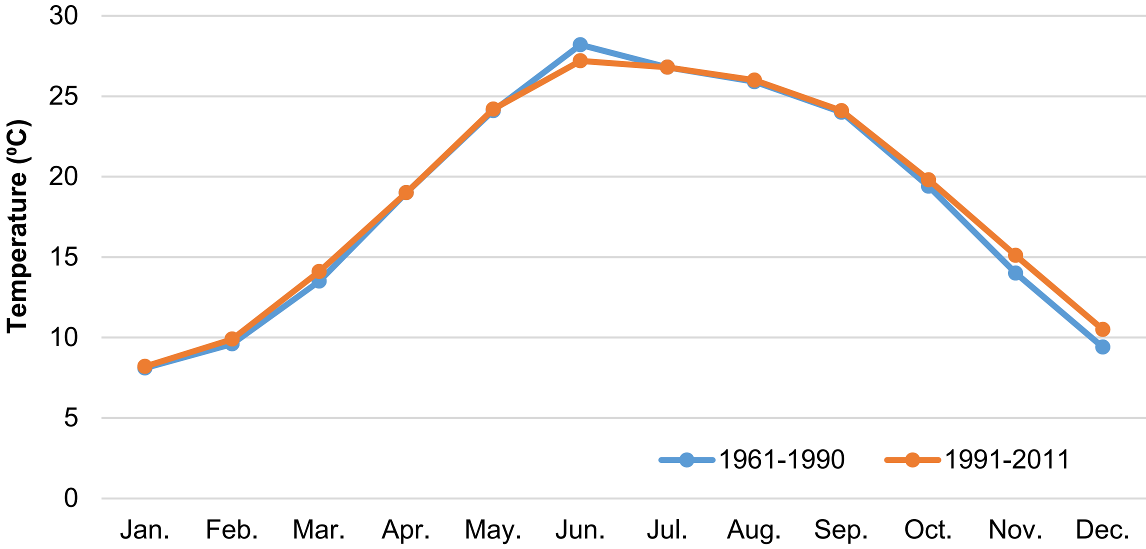
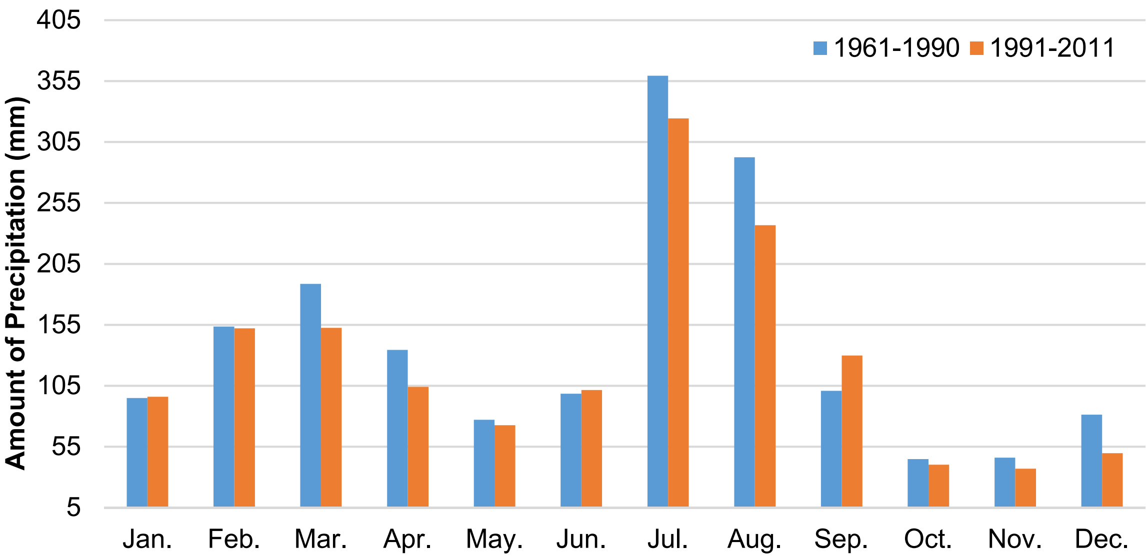


Exhibit 4.34: Comparison of Mean Monthly Rainfall (mm)



4.1.7 Water Resources

Water resources in the area consist of surface water including rivers and nullahs and groundwater including springs and boreholes.

Regional Hydrology

The Project Dam and Powerhouse are located on the Kunhar River. This section describes the hydrology of the Kunhar River up to its confluence with the Jhelum River.

The catchment area, Kunhar River, and its' principal tributaries up to its confluence are shown in **Exhibit 4.35**.

The Kunhar River originates from the glaciers above Lulusar Lake in the Kaghan Valley of KP. Glaciers of Malka Parbat and Makra Peak and the waters of Saiful Muluk Lake feed the river. It passes through Jalkhand, and meets Jhelum River at Rarra. The drainage area of the river is 2,535 km^2, with elevation ranging from 600 to 5,000 m.[5] It is one of the biggest tributaries of the Jhelum River Basin and the only main tributary situated entirely in Pakistan's territory. Snowmelt from the Kunhar Basin contributes 65% of the total discharge of the Kunhar River and 20-40% of the Jhelum River at Mangla.[6]

Although the Kunhar River discharges into the Jhelum River, flow changes due to the Project will not result in flow changes in the Jhelum River due to the near complete Patrind HPP downstream of the Project.

The Kunhar River has a steep gradient and flows through narrow gorges through much of its length. The bed elevation plot of the Kunhar River, and its key tributaries are shown in **Exhibit 4.36.**

Flow Regime

The Kunhar River had gauging stations installed by Surface Water Hydrology Project (SWHP), WAPDA. Gauging stations in the vicinity of the Project are shown in **Exhibit 4.35.** Gari Habibullah (1960-1994) and Naran (1960-2005).stations were closed and moved to and Talhata in 1995 and Kaghan in 2009 respectively.

Data from the Gari Habibullah gauging station was selected as the primary source of data due to its location and long term data availability. Furthermore, data from Talhata (which is 2 km upstream from the Gari Habibullah station) was appended to the Gari Habibullah data by adopting a catchment ratio approach shown below to create a 51 year record of gauging data (from 1960 to 2010):

$$Flow_{Gari\ Habibullah} = 1.01 \times Flow_{Talhata})$$

In the Feasibility Study it was noted that the flow data was found missing for year 1993 and October and November 2005. Hence a relationship between Naran and Gari Habibullah was developed using the mean daily flows for years 1960 to 1992, to estimate the missing year data for the year 1993 and for October and November 2005. The relationship[7] used is shown below:

$$Q_G = -0.0054Q_N^2 + 2.6158Q_N + 5.6281 \qquad R^2 = 0.9798$$

Where Q_G is the flow at Gari Habibullah and Q_N is the flow at Naran stream gauging station. Monthly average flows at each gauging station are shown in **Exhibit 4.37.** As can be observed peak flows are observed during June on the river throughout the river.

5 Mahmood R, Jia S, Babel M. S., January 16, 2016, Potential Impacts of Climate Change on Water Resources in the Kunhar River Basin, *Water, Multidisciplinary Digital Publishing Institute*, Basel, Switzerland

6 Ibid

7 Feasibility Study of Project 2013

Temperature Regime

The Kunhar River has two temperature regimes as illustrated in **Exhibit 4.38.** Upstream of Kaghan the water is cooler with average summer temperatures of 8-10 C whereas downstream of Kaghan temperatures are higher and near 12-13 C. The Jhelum River at its confluence with the Kunhar has a temperature of 16-17ºC and the cooler waters of the Kunhar have a moderating influence on the Jhelum.

Exhibit 4.35: Kunhar River Catchment

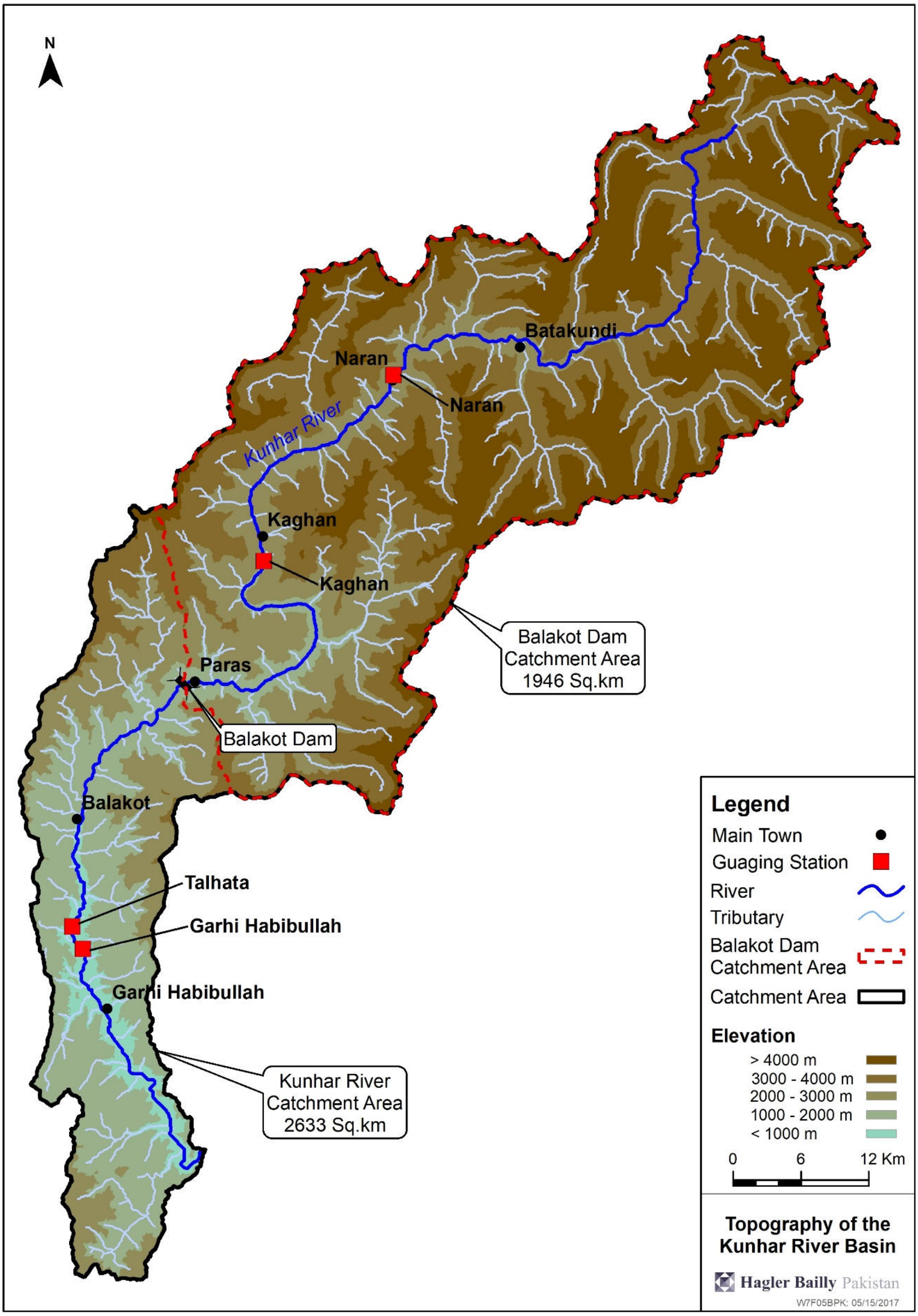


Exhibit 4.36: Kunhar River Bed Elevation

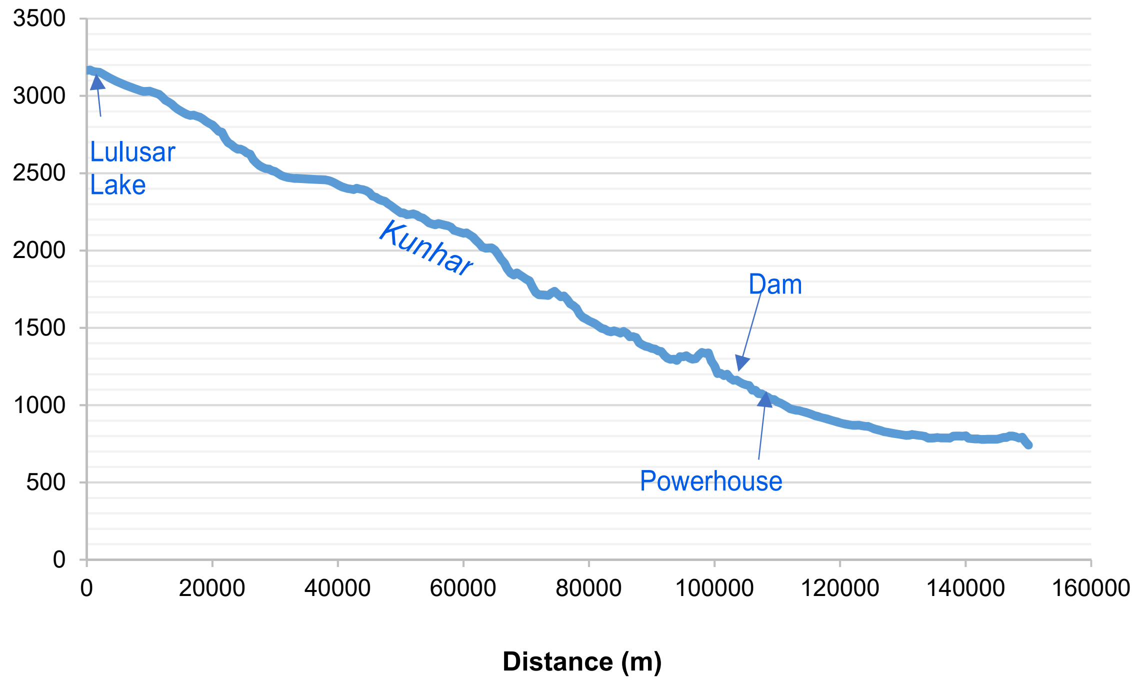


Exhibit 4.37: Daily Average Flow along Kunhar River

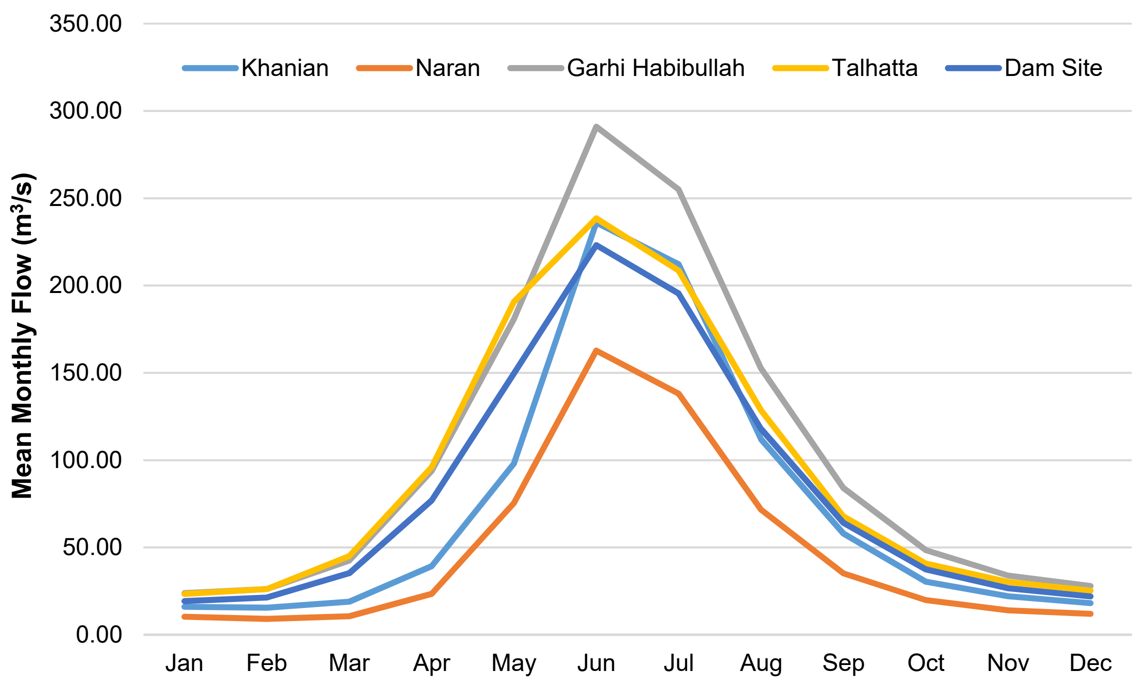
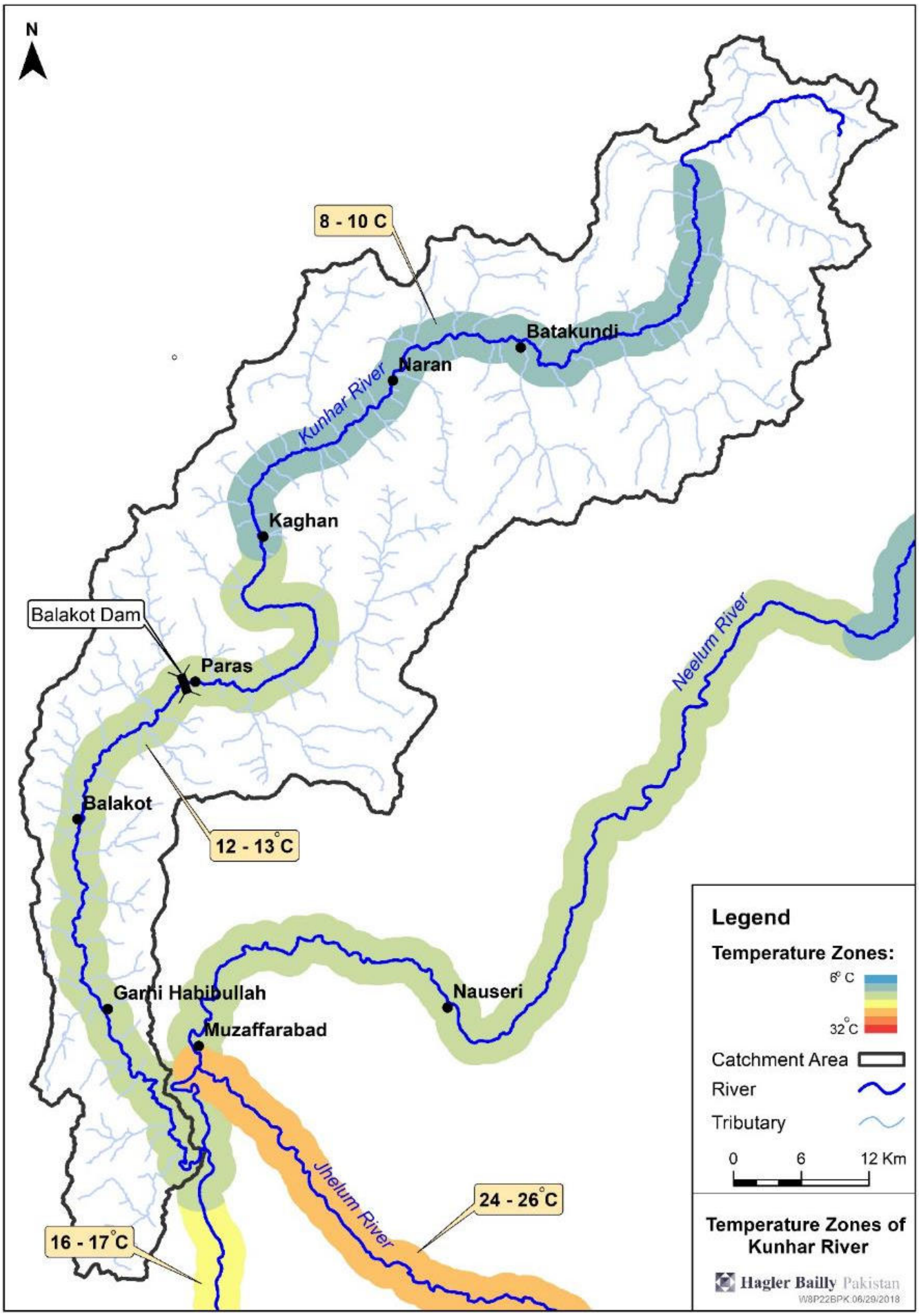


Exhibit 4.38: Temperature Zones of Kunhar River



Dam Site Hydrology

The hydrology at the dam site is typical of Himalayan rivers, characterized by peak flows in the month of June associated with melting of snow at higher elevations in the catchment, followed by declining flows in the summer supported by monsoon rainfall and continuing snowmelt in the months of July and August. The dry or low flow winter season typically extends from October through February when the flows are reduced to the order of one sixth of peak in the month of June.

The Project site hydrology based on the Feasibility Study is summarized below. The daily average flow at the dam site is shown in **Exhibit 4.37**. Annual run off frequencies at the dam site are summarized in **Exhibit** 4.39. Flood frequencies at the dam and powerhouse sites are summarized in **Exhibit 4.40**. Median values of hydrology parameters of ecological importance are presented in **Exhibit 4.41**. These are calculated via DRIFT (for details see **Environmental Flow Assessment Report** in **Volume 2C** of the **EIA**).

Exhibit 4.39: Flow Exceedance Frequency at Dam Site

Exceedance Time (%)	*Driest Year (2001)*	*Wettest Year (1992)*	*Average Flow Year (1963)*	*Mean Daily Flows (1960-2010)*	*All Daily Flows (1960-2010)*
100	11.4	18.1	16.8	19.6	6.5
90	13.7	23.5	19.1	20.9	19.4
80	16.7	30.4	23.7	23.6	23
70	20.8	55.8	28.3	28.3	27.3
60	23.8	68.2	34.1	37.1	34.3
50	31.1	108.3	41.6	50.3	48.6
40	40.1	143.5	70.5	78.3	73
30	55.4	172.2	112.8	120.6	108.4
20	73.6	218.1	150.2	171.1	154.5
10	104.7	274.4	232.1	221	215.9
–	182.3	1388.6	331.1	252.1	1388.6

Exhibit 4.40: Flood Frequency

Return Period (Years)	*Floods at Project Dam Site (m^3/s)*	*Floods at Project Powerhouse Site (m^3/s)*
2	414	447
5	752	813
10	1,060	1,146
50	1,887	2,040
100	2,280	2,466

Return Period (Years)	*Floods at Project Dam Site (m^3/s)*	*Floods at Project Powerhouse Site (m^3/s)*
500	3,263	3,529
1,000	3,714	4,016
10,000	5,312	5,745
Probable Maximum Flood	5,702	

Exhibit 4.41: Hydrology Parameters of Ecological Importance in Low Flow Section

Parameter	*Baseline Value*
Mean annual runoff (m^3/s)	90.5
Dry: minimum 5-day discharge (m^3/s)	17.4
Wet season: peak 5-day discharge (m^3/s)	319.6
Dry season: onset (calendar week)	43
Wet season: onset (calendar week)	16
Dry season: duration (days)	175
Wet season: duration (days)	133

Community Water Supply Census

A census was carried out to map the community water resources for villages near Project facilities. A 500 m buffer around the underground headrace tunnel in the uphill direction and up till the Kunhar River in the downward direction was demarcated for the survey to account for the distance to which the impact of the tunnel on ground water might possibly extend. This area and the surveyed water resource infrastructure are shown in **Exhibit 4.42**. The complete census results are presented in **Appendix D.**

Methodology and Sampling Locations

During the census, mountain springs were documented. The location and water quality at the origin of the spring was noted. The following key information was collected at each water source:

- Spring location (village name, neighborhood (if applicable) and geographical coordinates
- Ground elevation with respect to datum (mean sea level) to the accuracy of the GPS
- Spring usage:
  - Approximate water extraction rate
  - Approximate number of users
  - Water extraction method

- Basic chemical parameters (measured on site): pH, electrical conductivity (EC) and temperature
- Time and date of measurement
- Pictures

Results and Analysis

A total of 70 springs were identified and characterized within the hydrocensus area. Of the 70 springs, 1 went dry completely and did not used after the 2005 earthquake.

Small tanks are typically built around springs to store water, and act as constant head for water supply pipelines, or such that communities can manually draw water from the tank. Images depicting the water infrastructure are shown in **Exhibit 4.43**.

A detailed summary of the results is provided in **Exhibit 4.44**. Based on the pH and electrical conductivity, the water is fresh and potable.

The total number of households relying on the springs within the area covered by the hydrocensus is 1,905. The springs are the sole supply for the majority of households for potable water. 50% of active water sources are used to supply drinking water to livestock as well. This is in line with the socioeconomic surveys and discussions during the surveys across the Study Area, where it was reported the drinking water supply is largely, given some exceptions, from springs, and, given some exceptions, the livestock do not typically venture close to the river to drink river water, and are therefore, also reliant on spring water.

During the 2005 earthquake, the drinking water supply infrastructure for many communities within the Study Area, largely dependent on springs, was damaged. The communities reported that some springs also dried up after the earthquake.

Exhibit 4.42: Hydrocensus Locations

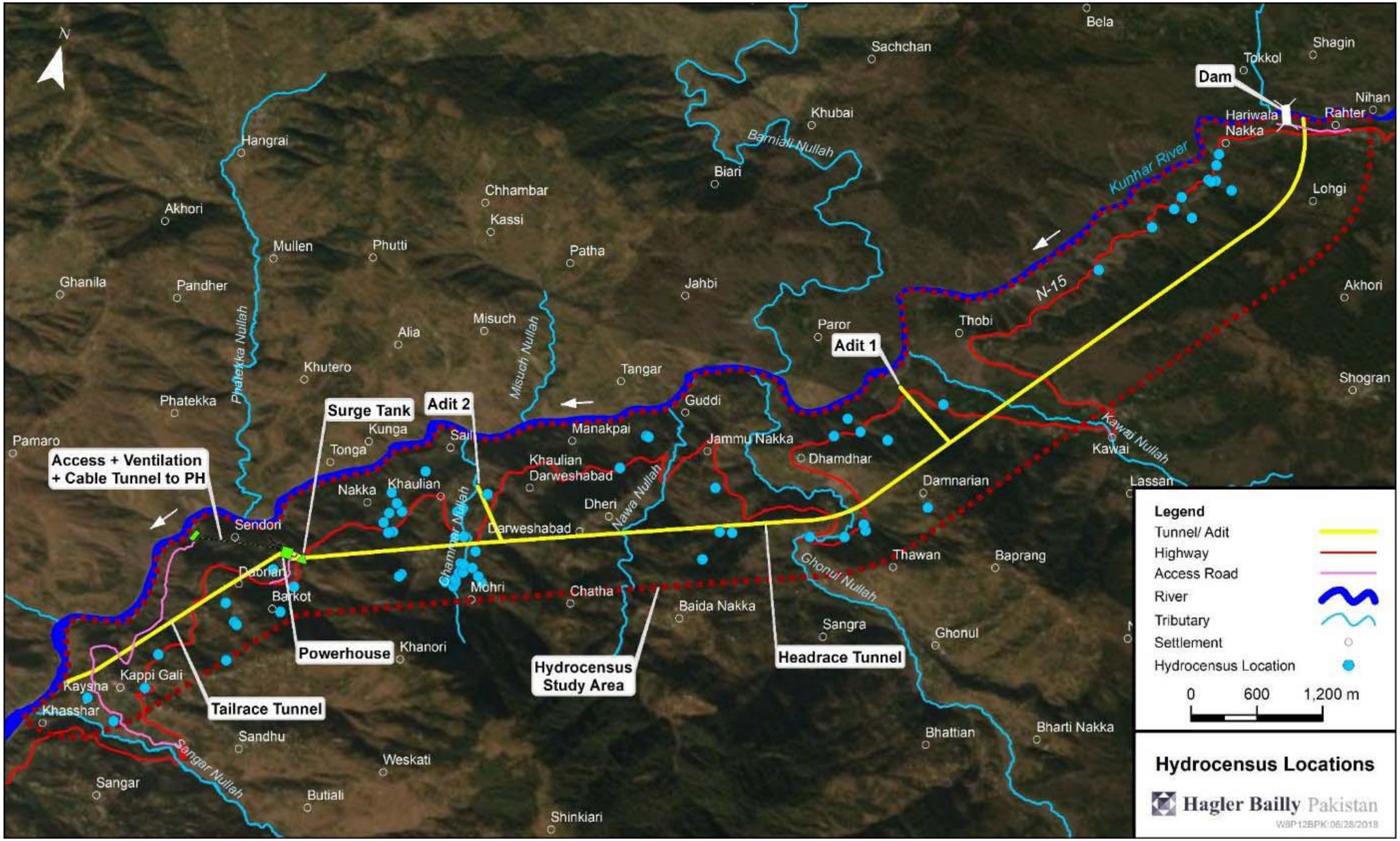


Exhibit 4.43: Photographs of Water Resource Infrastructure

Spring outlet at S-98

Spring outlet and collection structure at S-4

Spring outlet and collection structure at S-94

Spring outlet and collection structure at S-5

Free flowing spring at S-7

Spring outlet and collection structure at S-10

Exhibit 4.44: Summary of Mountain Spring and Borehole Census Results

Parameter Group	*Parameter*	*Value*
Number Surveyed	Mountain Springs	70
Status	Active	68
	Inactive	2
Elevation (m amsl)	Minimum	1,126
	Mean	1,413
	Median	1,392

Parameter Group	Parameter	Value
	Maximum	1,807
pH	Minimum	7.3
	Mean	8.0
	Median	8.1
	Maximum	8.5
Electrical Conductivity (µS/cm)	Minimum	222
	Mean	349
	Median	344
	Maximum	505
Temperature (˚C)	Minimum	12.0
	Mean	16.9
	Median	17.0
	Maximum	23.0
Average age of spring	Pre-1950 (i.e. more than 67 years)	72%
	Pre-2005 earthquake (i.e. between 67 and 12 years)	24%
	Post 2005 earthquake (i.e. less than 12 years)	1%
	Age not available	3%
Water use	Human drinking	77%
	Human other uses	66%
	Livestock use	50%
Household water usage (L/day) *Not counting dry springs*	Minimum	-
	Mean	252
	Median	200
	Maximum	1,000
Households using water (households per spring)	Minimum	-
	Mean	28
	Median	8
	Maximum	500
Livestock water use (livestock per spring	Minimum	-
	Average	32
	Median	6
	Maximum	200
Extraction method (# of springs)	Manual	31
	Pipe	44
	Both Manual and with Pipe	7
	Motor	0

Note: The analysis also includes springs that flow only during selected months of the year

Demand for River Water for Other Uses

River water is not used for irrigation as the slopes on the river bank are steep, cost of pumping water to agricultural lands located at elevations above the river is high, and agriculture depends on rain and water available from streams flowing down the mountain slopes. There is no large or medium scale industry that depends on water, and level of industrialization is very low. River water is not suitable for drinking as it is contaminated by fecal coliform, and communities use water from springs for drinking purposes. Livestock is also mainly dependent on spring water and water from open mountain streams flowing down the slopes. River water can be turbid in seasons, and use of river water by livestock is limited to a relatively small fraction of total households that are located close to the river. These uses are insignificant in comparison to the total flow of the river. Quantification of river water use was therefore not considered to be necessary. Identifications of community sources of drinking water, mainly springs, that could be potentially impacted by the project was carried out in detail and is described in the previous section.

Water Quality

Water quality samples from Kunhar River and community springs were collected and analyzed for establishing baseline conditions for surface and groundwater.

Methodology and Sampling Locations

A total of seven samples and two quality control duplicates were collected and analyzed. Of these, four surface water samples were collected and analyzed from different sections of the Kunhar River and one from a main tributary. Two were collected from community springs located along the headrace tunnel of the Project. **Exhibit 4.45** describes the sample locations and rationale for their selection. The locations are shown in **Exhibit 4.46**. The detailed methodology adopted for sample collection is presented in **Appendix E**.

Water was sampled in February and April. Samples taken in February were sent to SUPARCO Water for metals and HBP Lab for the remaining parameters, whereas samples collected in April were sent to ALS Malaysia for metals, Excel Labs Islamabad for microbiology and HBP Lab Islamabad for the remaining parameters. On-site water quality testing was also carried out with the hand-held meters for pH, conductivity, temperature and dissolved oxygen.

Results and Analysis

The results of the river water quality analysis are summarized in **Exhibit 4.47**. The complete results are given in **Appendix E**.

Key observations on the basis of the results are as follows:

- All the water quality parameters (with the exception of microbiology) are within NEQS and WHO drinking water standards.
- All river and tributary water samples were found bacteriologically contaminated and unsatisfactory for drinking due to fecal contamination. Of the two springs

tested, one contained bacteriological contamination while the other was satisfactory for drinking.

- Fifteen metals were analyzed for metal content at each sampling location. Results of the analyzed metals are found within permissible levels for drinking water NEQS. However, reported aluminum value at location W4 is highest among all samples and is exceeding both the NEQS and WHO standards. This can be attributed to higher colloidal particles in river water.
- No major differences were found within the water quality at all sampling locations.

Exhibit 4.45: Sampling Locations for Surface and Groundwater Quality

ID	*Coordinates*	*Description*	*Notes and Justification*	*Dates of Sampling*
W1	33° 39' 38.1"N 73° 28' 18.1" E	Upstream of Project Dam, Kunhar River	Background river water conditions	Feb. 28, 2017
W2	34° 35' 02.3" N 73° 21 44.0" E	Near Sangar village, Kunhar River	Kunhar River before Balakot town (upstream Balakot)	Feb. 28, 2017
W3	34° 29' 12.9" N 73° 21' 20.9" E	Near Tarana village, Kunhar River	Kunhar River after Balakot town (downstream Balakot)	Feb. 28, 2017
W4	34° 26' 38.6" N 73° 21' 32.0" E	Talhatta gauging station, Kunhar River	Reported use of river water by local residents	Apr. 14, 2017
W5	34° 37' 54.0" N 73° 26' 34.1" E	Kawai Nullah	Tributary water quality baseline conditions	Apr. 14, 2017
W6	33° 37' 47.6" N 73° 25' 45.8" E	Community spring near Kawai	Spring water quality along headrace tunnel	Apr. 14, 2017
W7	33° 35' 36.6" N 73° 22' 22.4" E	Community spring near Kappi Gali	Spring water quality along headrace tunnel	Apr. 14, 2017
W8	33° 37' 47.6" N 73° 25' 45.8" E	Duplicate of W6	Quality control sample	Apr. 14, 2017

Exhibit 4.46: Water Quality Sampling Locations

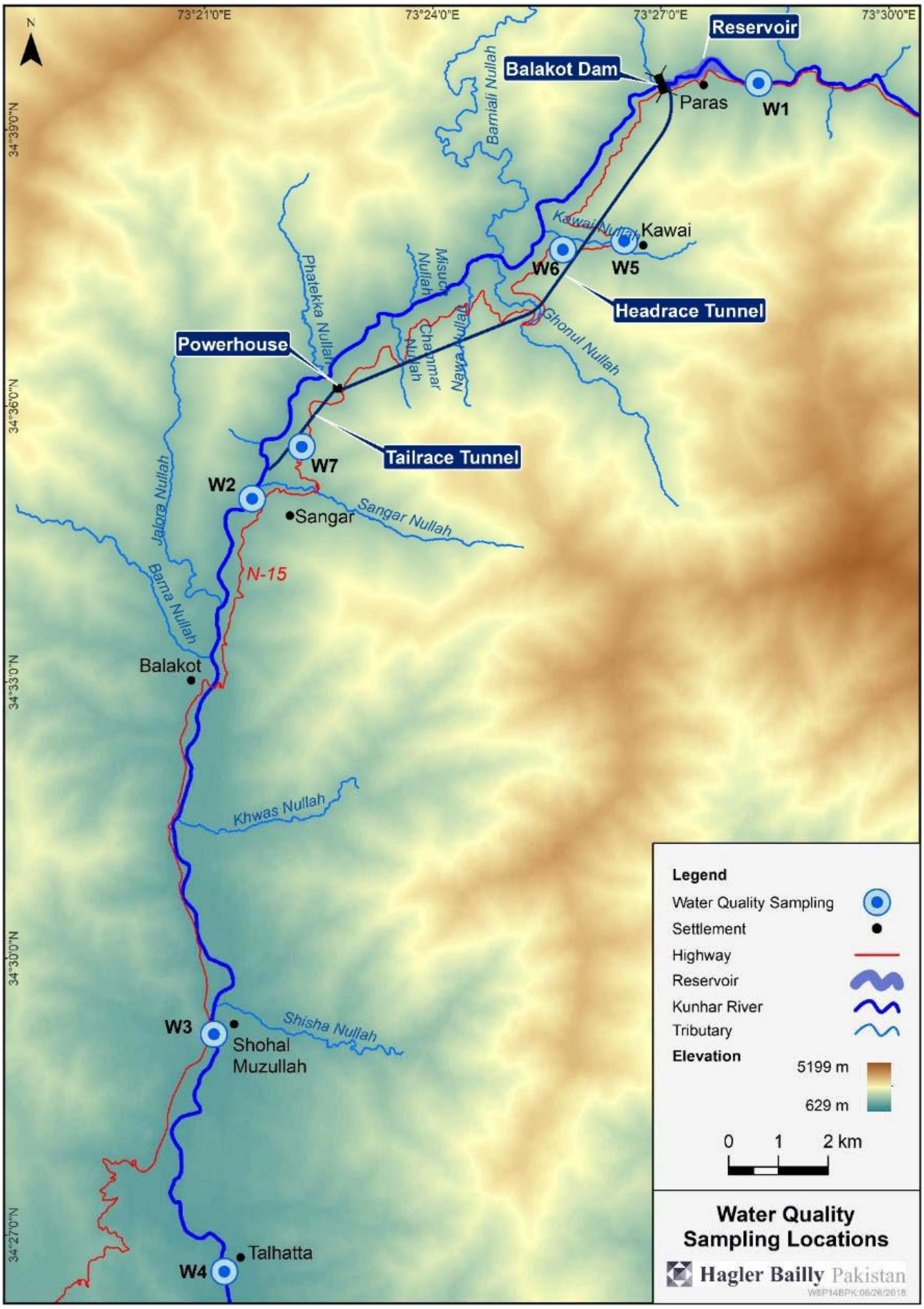


Exhibit 4.47: Water Quality Test Results

Parameter	*Unit*	*LOR*	*WHO Guideline*	*NEQS for Drinking Water*	*W1*	*W2*	*W3*	*W4*	*W5*	*W6*	*W7*	*W8*
Field Tests												
Temperature	°C	1	–	–	7.5	8.2	9.2	14.8	14.8	14.5	18.5	14.5
DO	mg/l	0.1	–	–	11.2	11.5	11.5	10.7	9.6	7.6	7.8	7.6
EC	µS/cm	1	–	–	260	312	285	218	348	472	363	473
General Parameter												
TDS	mg/l	10	<1,000	<1,000	194	218	208	130	178	322	206	323
pH		0.1	6.5 – 8.5	6.0 – 8.5	8.2	8.4	8.5	8.2	8.5	7.5	8.2	7.5
TSS	mg/l	4	–	–	–	43.5	40.5	107	15	<4	<4	<4
BOD	mg/l	5	–	–	<5	<5	<5	5.3	5.6	<5	<5	<5
COD	mg/l	5	–	–	<5	<5	5.3	10.4	11.8	<5	<5	<5
Turbidity	NTU	0/0.01*	<5	<5	1.66	4.83	4.72	15	6	4	6	4
Nitrate	mg/l	0.1/0.01*	50	50	0.025	0.047	0.053	0.28	0.23	<0.1	<0.1	<0.1
Phosphate	mg/l	0.1/0.02*	–	–	<0.02	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1	<0.1
Metals (Total) and Major Cations												
Aluminum	µg/L	1	200	200	37	82	95	220	74.2	18.1	3.6	18.1
Antimony	µg/L	1	20	5	<1	<1	<1	<1	<1	<1	<1	<1
Arsenic	µg/L	1	10	50	<1	6	5	1.2	3	<1	7.9	<1
Barium	µg/L	1	700	700	7	15	18	27.9	87.3	38.8	300	36.8
Boron	µg/L	1	300	300	11	19	16	<1	4.7	16.3	<1	14.7
Cadmium	µg/L	1	3	10	<1	<1	<1	<1	<1	<1	<1	<1

Parameter	*Unit*	*LOR*	*WHO Guideline*	*NEQS for Drinking Water*	*W1*	*W2*	*W3*	*W4*	*W5*	*W6*	*W7*	*W8*
Chromium	µg/L	1	50	50	<1	5	8	1.2	<1	<1	<1	<1
Lead	µg/L	1	10	50	<1	<1	<1	1	3.3	<1	<1	<1
Manganese	µg/L	1	500	500	<1	21	24	79.3	10.2	<1	<1	<1
Mercury	µg/L	1	1	1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	µg/L	1	20	20	<1	7	9	3.5	<1	<1	<1	<1
Silver	µg/L	1	–	–	7	9	10	<1	<1	<1	<1	<1
Tin	µg/L	1	–	–	–	–	–	<1	<1	<1	<1	<1
Selenium	µg/L	1	10	10	<1	<1	<1	–	–	–	–	–
Zinc	mg/l	0.1	3	5	–	–	–	<0.1	<0.1	<0.1	<0.1	<0.1
Microbiology												
MPN of Coliforms:	No./100 ml			–	–	–	–	–	18+	1+	18+	1+
MPN of E.Coli	No./100 ml			–	–	–	–	–	18+	0	18+	0

Note:

LOR = Level of Reporting, DO = Dissolved Oxygen, EC = Electrical Conductivity, TDS = Total Dissolved Solids

TSS = Total Suspended Solids, BOD = Biological Oxygen Demand, COD = Chemical Oxygen Demand, MPN = Most probable number

mg/l = milligram per liter, µg/L = microgram per liter, NTU = Nephelometric Turbidity Unit µS/cm = microsiemen per centimeter

" – "means that standards are not defined for this parameter or the parameter was not analyzed, * First LOR is for W1, W2 and W3. Second LOR is for remaining samples

4.1.8 Ambient Air Quality

This section describes the current ambient air quality in the area where Project activities are proposed.

The pollutants selected for evaluation, based on the expected emissions from the Project activities and the level of risk to human health posed by these pollutants, are as follows:

- Sulfur dioxide (SO_2)
- Oxides of Nitrogen (NO_X)—Mainly Nitrogen dioxide (NO_2) and Nitric oxide (NO)
- Respirable particulate matter—Coarse (PM_{10})[8] and Fine ($PM_{2.5}$)[9]

Emission Sources

There are two main sources of emissions in the Study Area, which are discussed below.

1. **Wood/Liquefied Petroleum Gas (LPG) burning**. Wood burning and LPG are used for cooking and heating. Due to the incomplete combustion in the primitive stoves wood is a significant source of PM_{10}, $PM_{2.5}$ whereas combustion of LPG is a significant source of NO_x but both sources also results in SO_2 emissions.
2. **Traffic**. Combustion of petrol and diesel is a source of NO_x and SO_2 emissions with diesel burnt in heavy transport vehicles is the main source of SO_2. Vehicle exhaust result in $PM_{2.5}$ emissions whereas tire movement, especially on tracks and unsealed road result in dust emissions (PM_{10} and $PM_{2.5}$).

Methodology and Sampling Locations

Air quality sampling was carried out at four different locations in the Study Area between March 19 and May 8, 2017. A description of sampling locations and the rationale of selection is given in **Exhibit 4.48**. The sampling locations, along with nearby settlements and roads are shown in **Exhibit 4.49**. The detailed methodology is provided in **Appendix F**.

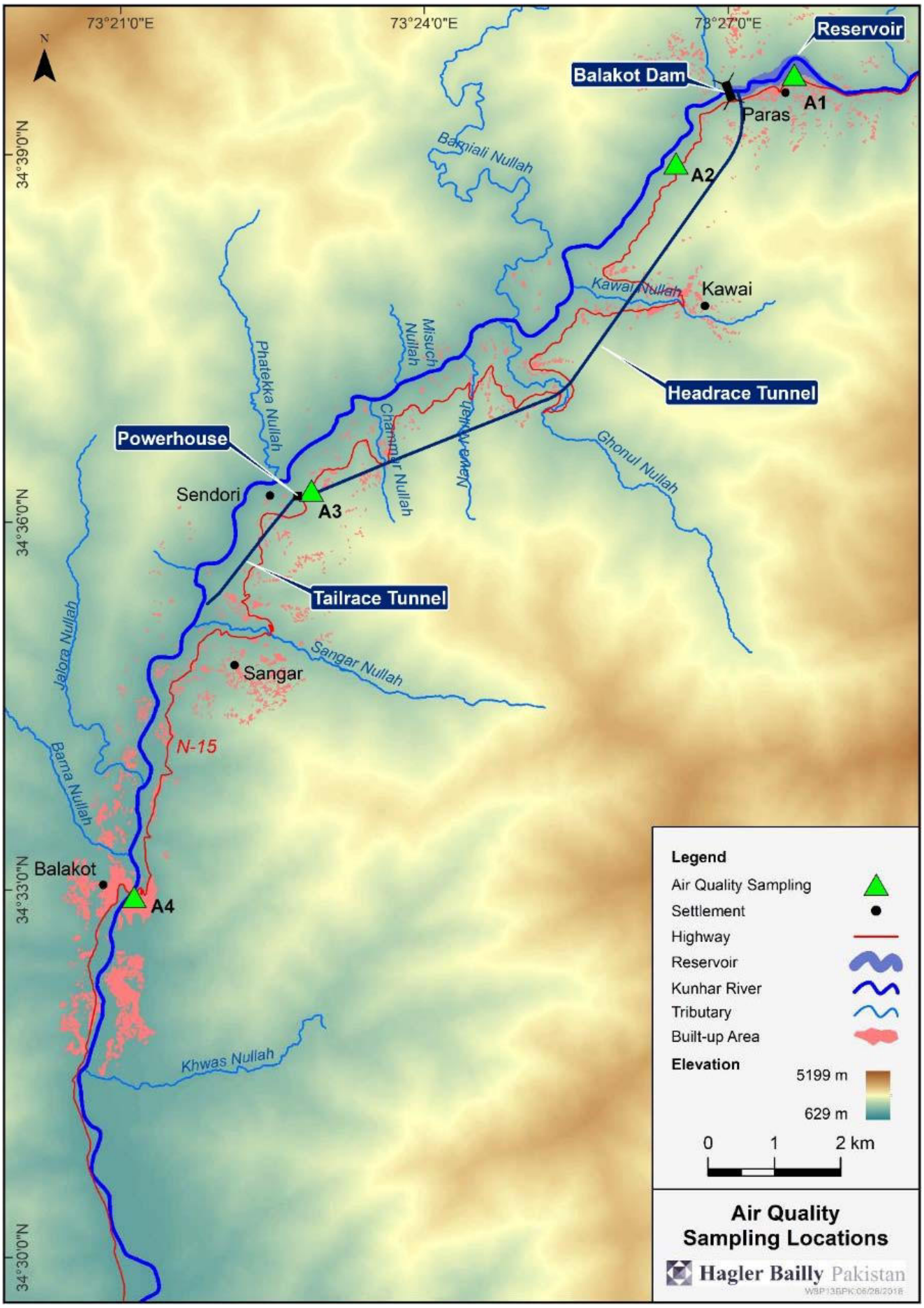
Exhibit 4.48: Details of Air Quality Sampling Locations

Sample ID	*Coordinates*	*Location*	*Rationale for Site Selection*
A1	34° 39' 41.3" N 73° 27' 39.2" E	Paras	Near proposed labor camp in Paras
A2	34° 39' 01.1" N 73° 26' 30.9" E	Hariwala Nakka	Near proposed dam site
A3	34° 36' 18.2" N 73° 22' 57.6" E	Nalla	Near proposed powerhouse site
A4	34° 32' 57.2" N 73° 21' 17.1" E	Balakot	Near proposed labor camp in Sangar
A5	34° 39' 41.3" N 73° 27' 39.2" E	Paras	duplicate of A1

8 PM_{10} is particulate matter 10 micrometers or less in diameter

9 $PM_{2.5}$ is particulate matter 2.5 micrometers or less in diameter

Exhibit 4.49: Air Quality Sampling Locations



Results

The air quality sampling results are summarized in **Exhibit 4.50** and the values exceeding the NEQS and IFC-EHS limits are highlighted. The complete results are produced in **Appendix F**.

Exhibit 4.50: Results of Ambient Air Quality Sampling (µg/m^3)

Sample ID	*NO_x*	*NO_2*	*NO**	*SO_2*	*PM_{10}*	*$PM_{2.5}$*
LOR	0.033 µg of NO_x	0.01 µg of NO_2	-	0.03 µg of S	100 µg	100 µg
A1	6.9	6.1	0.8	1.8	104.7	65.2
A2	2.0	2.1	**	<1.3	78.6	52.4
A3	5.2	3.0	2.2	1.4	117.8	65.4
A4	16.8	13.8	3.0	20.1	130.9	78.5
A5 (duplicate of A-1)	7.1	5.6	1.5	<1.2	–	–
A6 (field blank)	1.5	0.4	1.1	<1.2	–	–
NEQS (annual)	**100*** **	**40**	**40**	**80**	**120[a]**	**15[a]**
NEQS (24-hour)	**140*** **	**80**	**40**	**120**	**150**	**35**
IFC (annual – interim target 1)	**–**	**–**	**–**	**–**	**70[a]**	**35[a]**
IFC (24-hour – interim target 1)	**–**	**–**	**–**	**125**	**150**	**75**

Note:

a: annual does not apply to particulate matter data reported above

"–" means either the data is not available or the standard is not defined.

* NO results are derived by subtracting NO_2 from NO_x.

** Where nitric oxide (NO) results have not been calculated result for NO_X was lower than result for NO_2.

*** Standards for NO_x are not defined and calculated in terms of NO_2. NO_x annual standard = annual standard of NO_2 + 1.5 × annual standard of NO. Same is for 24-hour standards.

The following analysis of results are presented:

- The annual and 24-hour concentrations of SO_2, NO_x, NO_2 and NO comply with both the NEQS and IF-EHS limits. This leaves a wide room to incorporate emissions of the proposed Project. The maximum levels of SO_2, NO_x, NO_2 and NO are 20.1, 16.8, 13.8 and 3.0 µg/m^3, respectively observed at A4 (Balakot town). This is mainly due to the high traffic in the town and concentrated use of LPG and wood for domestic purposes.
- The 24-hour PM_{10} concentration comply with both the NEQS and IFC-EHS limits at all sampling locations. The 24-hour $PM_{2.5}$ concentration exceeds the NEQS at all sampling locations however, it complies with IFC-EHS interim target 1 at all locations except at A4 (Balakot town) where it exceeds both the NEQS and IFC-EHS limits. The highest readings of PM_{10} and $PM_{2.5}$ were recorded at A4 (Balakot town) along N-15 highway.

- The concentration of all pollutants at A2 (near dam site) are lowest among all sampling locations. A2 is mainly contributed by natural sources and is dominated by forest. The nearest settlement is about 780 m away from A2.

4.1.9 Traffic

Traffic baseline is prepared to assess the current traffic conditions on the road route that will be used for the Project related transportation of services during construction and operation of the Project. The objectives of the traffic study are to document present traffic situation, identify existing road capacity, bottle necks (congestion points) and potential impacts due to the Project traffic during construction and operation.

Transportation Route

The transport route for the Project is described in **Section 3**. A discussion on the possible alternate routes and the reason for the selection of this route is given in **Section 5**

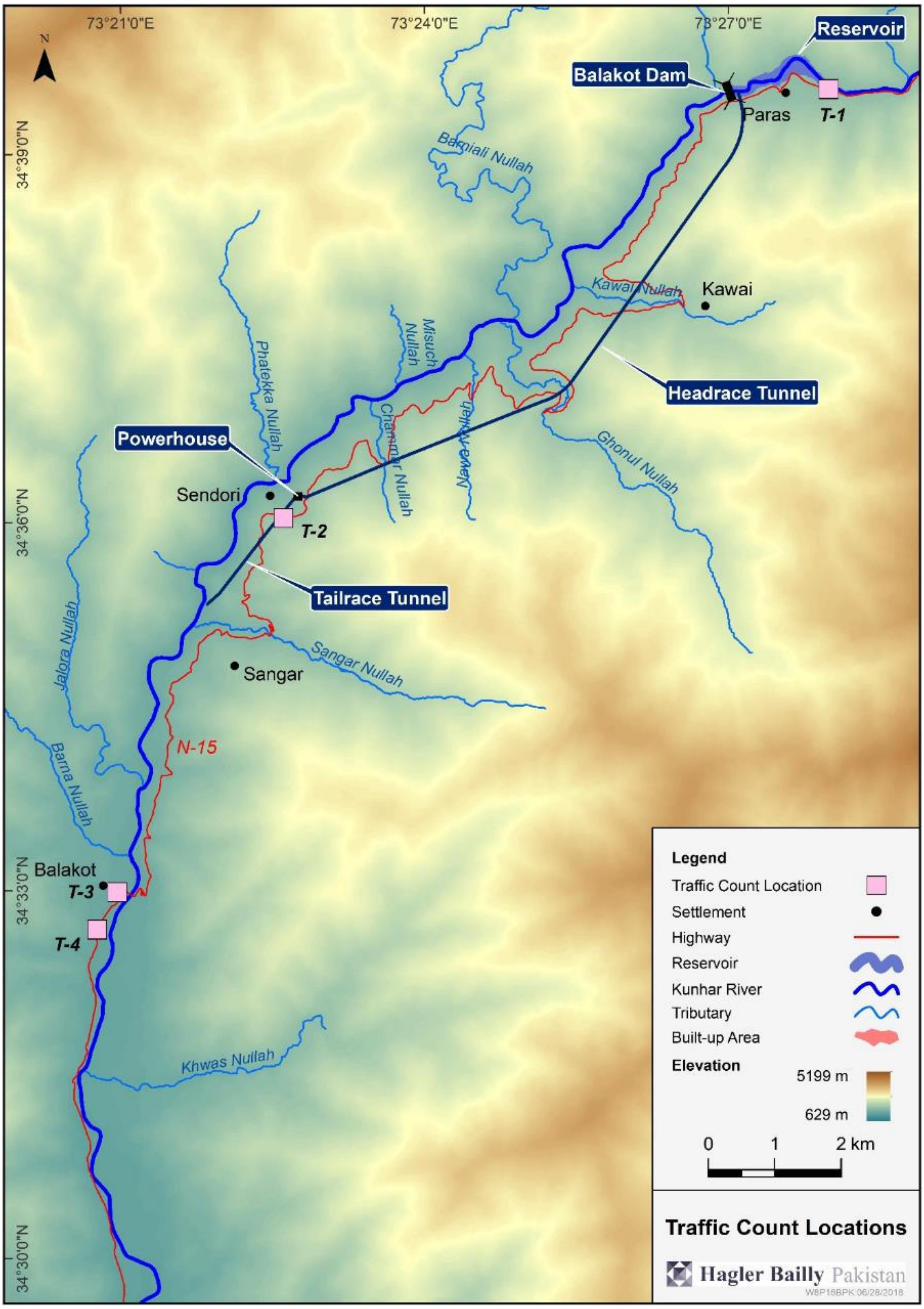
Methodology and Sampling Locations

Traffic counts were conducted at four locations listed in **Exhibit 4.51** and shown in **Exhibit 4.52.** A team of qualified surveyors was selected and a pilot count was conducted before the actual survey. At the counting site, two people were stationed for daytime and two for nighttime to separately count the daily traffic in both directions. The traffic count was recorded over a 24-hour period on a weekday (May 4, 2017) and a weekend (May 7, 2017).

Exhibit 4.51: Traffic Count Locations

ID	*Coordinates*	*Location*	*Rationale*
T1	34° 39' 39.1" N 73° 27' 57.8" E	Paras	Traffic at dam and reservoir site.
T2	34° 36' 06.8" N 73° 22' 52.5" E	Sendori	Traffic at powerhouse site.
T3	34° 33' 01.8" N 73° 21' 11.7" E	Balakot market	Traffic in Balakot town
T4	34° 32' 42.1" N 73° 20' 55.2" E	Balakot	Traffic in Balakot town

Exhibit 4.52: Traffic Count Locations



Passenger Car Equivalent (PCE) or Passenger Car Unit (PCU) is a metric unit used to assess traffic-flow rate.[10] PCU, is a measure of the relative space requirement of a vehicle compared to that of a passenger car under a specified set of roadway, traffic and other conditions. The value assigned to each of the classification of the vehicles may depend on a number of factors such as:

- dimensions, power, speed, acceleration and braking characteristics of the vehicle;
- road characteristics such as geometrics including gradients, curves, access controls, type of road: rural or urban, presence and the type of intersections;
- transverse and longitudinal clearances between vehicles moving on road, which in turn depends upon the speeds, driver characteristics and the classes of other moving vehicles;
- environmental and climatic conditions and;
- Traffic control methods, speed limits, and barriers.

The PCU for different classes of vehicles are not defined universally, however, the values used here are typical for Pakistani road conditions. The PCUs are calculated on the basis of traffic counts. **Exhibit 4.53** shows PCU factor for each vehicle**.**

Exhibit 4.53: Two-Way Traffic at each Traffic Count Location

Vehicle	*PCU Factor*
Motorcycles	0.50
Auto rickshaws	0.75
Cars (sedans)	1.00
Jeeps/Pickups	1.25
Mini Bus	1.50
Bus	2.00
Truck – 2 axle	2.50
Truck – 3 axle	3.00
Truck – 4 axle	3.50
Truck – 5 axle	4.00

Results and Analysis

The summary of the two-way traffic count at the sampling locations is presented in **Exhibit 4.54**. The hourly traffic volume is graphed in **Exhibit 4.55** for weekday and in **Exhibit 4.56** for the weekend. Detailed data is included as **Appendix G**. Key findings are presented below:

10 Ahuja, Amanpreet Singh (2004). *Development of passenger car equivalents for freeway merging section*

- There was an increase in traffic on the weekends for points T1 (about 25 to 30% more vehicles) and T2 (50% increase in vehicles heading to Balakot town) as they are on the transit route to tourist locations.
- Although the morning peak (9 am) shows a significant drop on the weekends at T3 and T4 (from 700-800 vehicles to 500-600 vehicles), the traffic volumes are still generally higher on the weekend with steady flows throughout the day.
- According to the police check post near T1 the traffic increases between 20 to 25 times the measured traffic during the peak tourist season months of June and July due to transit traffic going on to Naran, Kaghan and beyond.

Exhibit 4.54: Two-Way Traffic at each Traffic Count Location (Non-Season)

Summary	Traffic point	Day Type	Bikes	Cars	Pick-up	Buses	Truck	Tractor/ Trailer	Total	%LTV	%HTV	Total PCUs
Paras to Kaghan	T1	Weekday	100	647	427	18	144	2	1,338	88%	12%	1,637
		Weekend	189	775	521	31	151	3	1,670	89%	11%	1,976
Kaghan to Paras	T1	Weekday	98	623	384	8	133	9	1,255	88%	12%	1,538
		Weekend	149	846	466	30	160	1	1,652	88%	12%	1,969
Sendori to Paras	T2	Weekday	96	493	422	26	119	1	1,157	87%	13%	1,425
		Weekend	149	600	389	21	96	8	1,263	90%	10%	1,478
Paras to Sendori	T2	Weekday	71	479	341	10	98	8	1,007	88%	12%	1,239
		Weekend	147	776	427	41	162	2	1,555	87%	13%	1,882
Balakot to Dabrian	T3	Weekday	1,407	2,129	809	34	121	9	4,509	96%	4%	4,257
		Weekend	1,625	2,462	1,195	57	199	29	5,567	95%	5%	5,506
Dabrian to Balakot	T3	Weekday	921	1,727	529	34	99	8	3,318	96%	4%	3,197
		Weekend	1,064	2,498	965	35	204	24	4,790	95%	5%	4,916
Balakot to Mansehra	T4	Weekday	696	1,927	499	50	82	7	3,261	96%	4%	3,244
		Weekend	753	2,549	846	60	130	12	4,350	95%	5%	4,482
Mansehra to Balakot	T4	Weekday	1,209	2,195	1,044	54	93	11	4,606	97%	3%	4,498
		Weekend	897	1,948	859	39	123	8	3,874	96%	4%	3,902

Exhibit 4.55: Weekday Hourly Traffic PCU

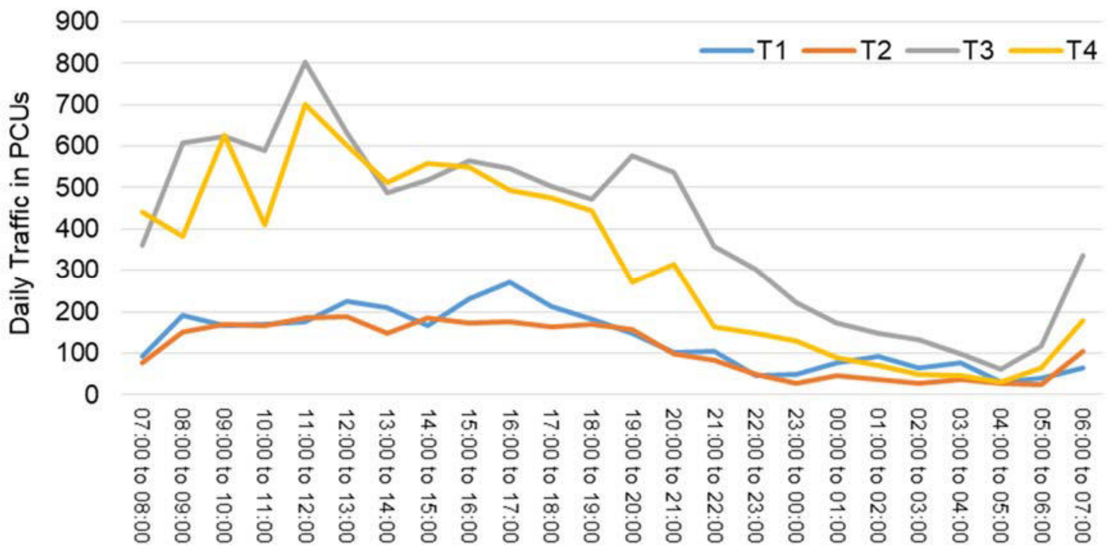
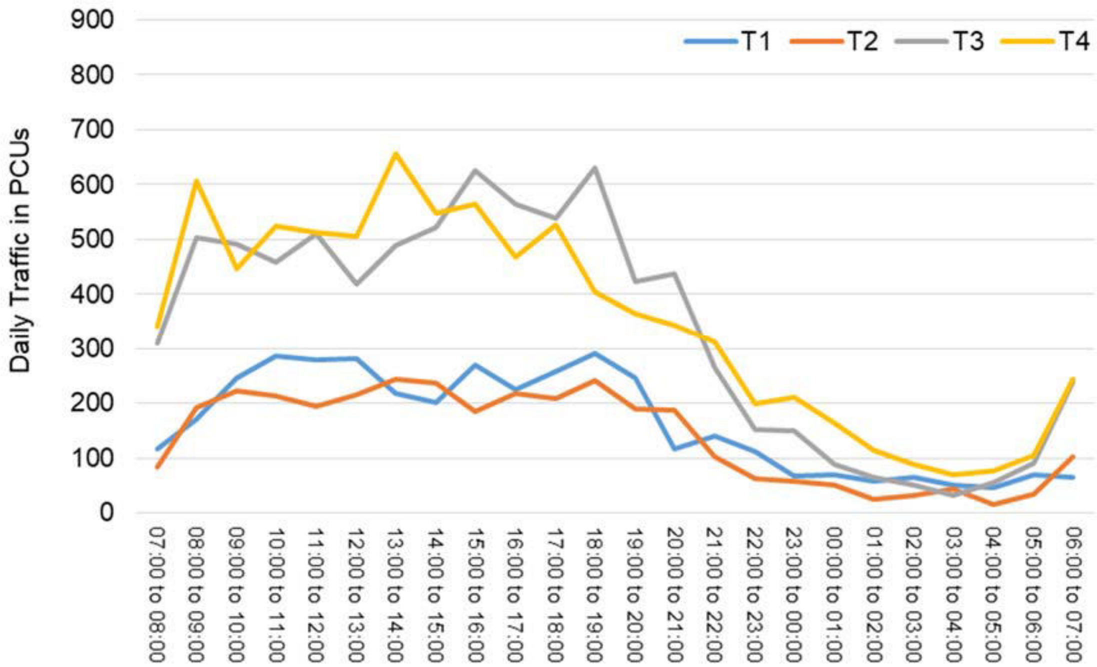


Exhibit 4.56: Weekend Hourly Traffic PCU



4.1.10 Noise Levels

This section defines the baseline ambient noise levels in the Study Area in a manner that can be used for the assessment of the noise impact of the proposed Project. Sound levels were measured at selected locations considered representative of the nearby receptors of possible noise pollution from the Project.

Noise is defined as a loud, undesired sound that interferes with normal human activities. If it affects the well-being of the surrounding community (environmental noise), it is considered a nuisance and normally has no direct health impacts. Exposure to very high noise levels (exceeding 85 dBA), particularly for prolonged period can cause hearing loss. This level of noise is usually encountered in the workplace around construction sites and is considered an occupational hazard.

In general, human sound perception is such that a change in sound level of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and an increase of 10 dB is perceived as a doubling of sound level.

The following is a brief description of terminology used in this assessment:

- *Sound*: A vibratory disturbance created by a vibrating object, which, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone
- *Noise*: Sound that is loud, unpleasant, unexpected, or otherwise undesirable
- *Decibel (dB)*: A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micro-pascals
- *A-Weighted Decibel (dB(A))*: An overall frequency-weighted sound level in decibels, which approximates the frequency response of the human ear. The typical human ear is not equally sensitive to all frequencies of the audible sound spectrum. As a consequence, when assessing potential noise impacts on people, an electronic filter is used that de-emphasizes certain frequencies in a manner corresponding to the human ear's decreased sensitivity to low and extremely high frequencies. All of the noise levels reported in this Section are A-weighted
- *Equivalent Sound Level (L_{eq})*: The equivalent steady state sound or vibration level, which in a stated period of time, typically one hour, would contain the same acoustical or vibration energy.

Methodology and Sampling Locations

Noise measurements were taken at four locations listed in **Exhibit 4.57** and shown in **Exhibit 4.59.**

Exhibit 4.57: Noise Sampling Locations

ID	*Location*	*Coordinates*	*Dates of Survey*	*Distance from River (m)*	*Elevation Difference from River (m)*	*Description*
N1	Paras	34° 39' 41.6" N 73° 27' 39.1" E	May 6 to 7, 2017	192	38	Small town, main road
N2	Powerhouse Site	34° 36' 10.1" N 73° 22' 42.7" E	May 4 to 5, 2017	576	201	Forest, main road
N3	Sangar	34° 34' 54.7" N 73° 22' 10.4" E	May 5 to 6, 2017	720	288	Small town, main road
N4	Balakot	34° 32' 44.3" N 73° 20' 56.0" E	May 7 to 8, 2017	210	19	Large town, main road

The noise levels were measured using portable Cirrus Research plc.'s sound level meter, Model CR:1720. The instrument meets the International standards IEC 61672-1:2002, IEC 660651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986, and ANSI S1.43-1997 where applicable. The instruments have a resolution of 0.1 dB.

The meter was calibrated at the start of measurement at each site, using Cirrus Research plc.'s acoustic calibrator, Model: CR:514. The sound meter and calibrator were factory calibrated on September 28, 2015. The instrument was mounted on a tripod, to avoid interference from reflecting surfaces within the immediate neighborhood, and a wind shield was used in all measurements. Photographs of the sampling equipment setup are provided in **Exhibit 4.58.**

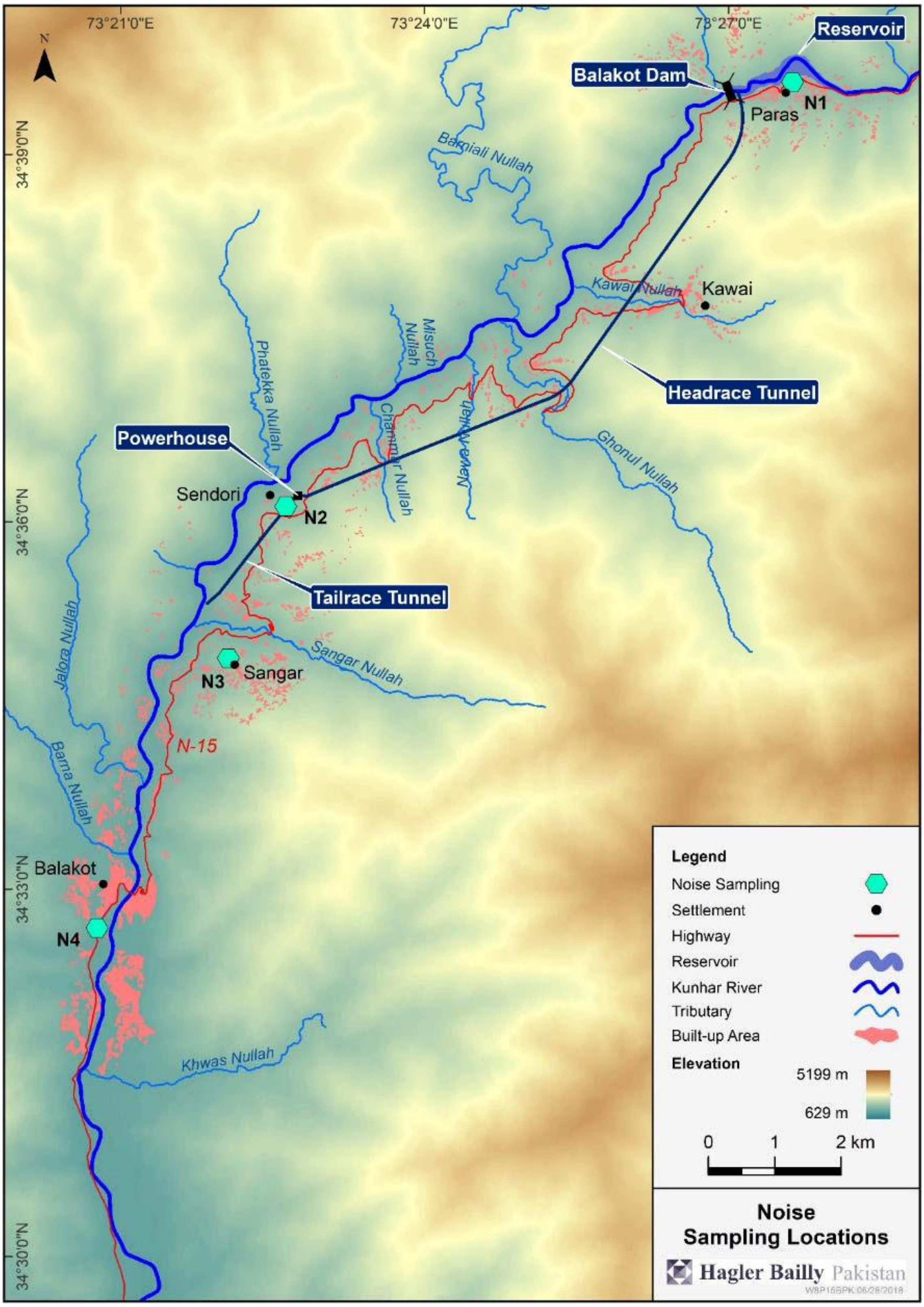
Noise readings were taken for 24 hours at each site between May 4 and May 8, 2017.

Exhibit 4.58: Noise Sampling Site Photographs

Sound meter at N1

Sound meter at N3

Exhibit 4.59: Noise Sampling Locations



Results

A summary of the results and NEQS are provided in **Exhibit 4.60.** L_{10} and L_{90} refer to percentile noise levels that are exceeded 10% and 90% of the time, respectively. The levels are calculated excluding the 10% upper and lower extreme ranges of the noise data. Hourly variations are captured in **Exhibit 4.61**. Weather data measured during the sampling exercise is given in **Exhibit 4.62.**

Exhibit 4.60: Summary Statistics of Sound Levels during the Survey

ID	*Location*	*24 hour (dBA)*				*Daytime*	*Nighttime*
		L_{10}	L_{50}	L_{90}	L_{EQ}	L_{EQ}	L_{EQ}
N1	Paras	46.0	46.6	44.8	49.5	44.4	41.6
N2	Powerhouse site	50.1	50.0	50.2	51.5	49.8	48.6
N3	Sangar	42.0	42.3	41.5	45.3	40.2	37.5
N4	Balakot	60.1	61.1	57.9	63.5	59.1	53.4
					NEQS Limits	**55**	**45**
					IFC Limit	**55**	**45**

Exhibit 4.61: Hourly Noise Levels

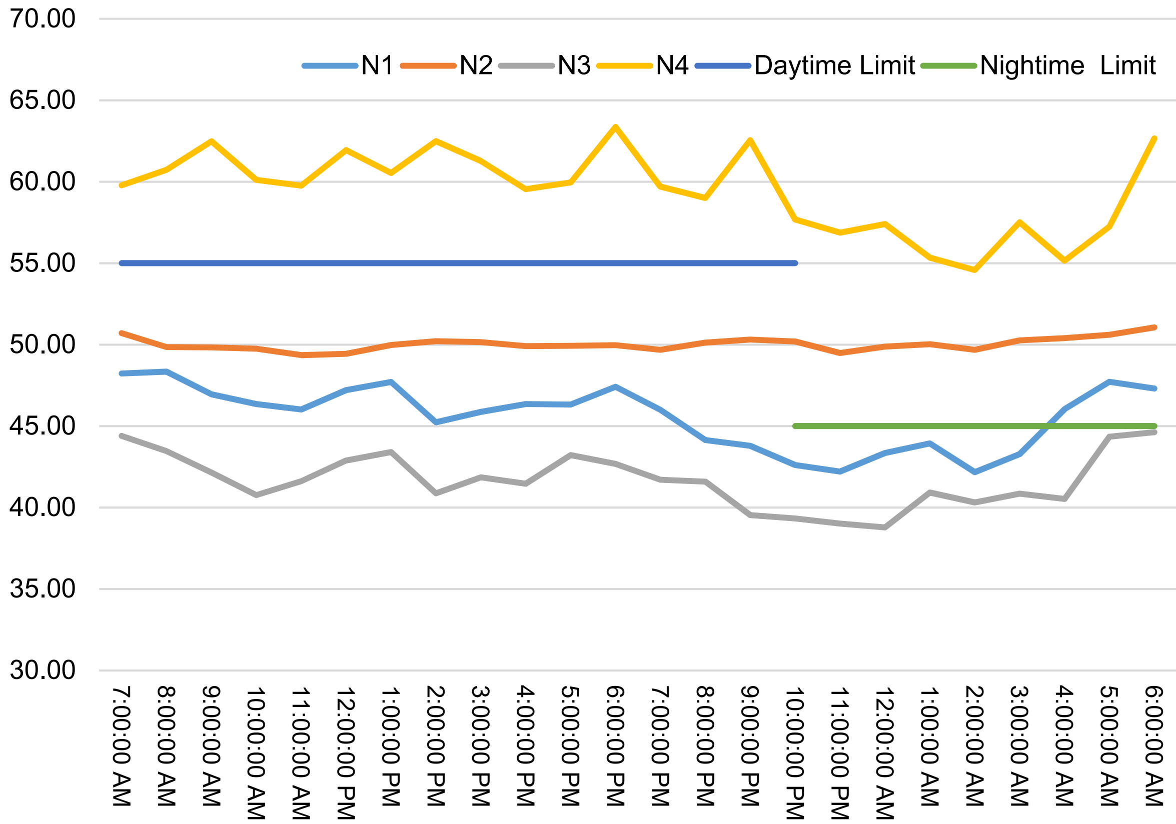


Exhibit 4.62: Weather Parameters during Noise Sampling

ID		Temperature deg C	Wind Speed (m/s)	Relative Humidity (%)	Barometric pressure (mb)
N1	Mean	23.6	0.2	49.4	870.6
N2	Mean	21.0	0.5	45.5	872.7
N3	Mean	21.0	0.5	45.5	872.7
N4	Mean	26.5	1.2	42.1	901.1

Small Town: Noise levels in both the small towns of Paras (N1) and Sangar (N3) are well within NEQS noise limits and within IFC-EHS limits for most hours other than early morning hours in Paras where the nightime limits are crossed.

Large Town: The noise levels at N4, which was located within the market of Balakot Town were high and exceed both daytime and nightime NEQS and IFC-EHS limits. Natural sources such as wind (of which the speed went up to 5.4 m/s during sampling) and river noise may also have contributed to the high noise levels.

Forests: Noise levels at N2 are steady throughout the day and night at around 50 dbA as there are no varying antropogenic sources of noise in the area. Constant sources of noise include noise from the river and wind.

4.2 Ecology Baseline

The ecology baseline has been prepared to present the ecological conditions in the Project area.

4.2.1 Objectives and Scope

The baseline was prepared with the following objectives:

- Qualitative and quantitative assessment of terrestrial vegetation, periphyton[11], macro-invertebrates, fish, herpetofauna[12], birds and mammals.
- Identification of key species, their relative abundances and their conservation status.
- Compiling reports of wildlife sightings in the Study Area by the resident communities.
- Identification of any additional habitats, and microhabitats.
- Analysis to further develop the basis for evaluating the potential impacts of Project-related activities on the biodiversity, specifically identification and evaluation of critical habitats.

[11] Aquatic organisms, such as certain algae, that live attached to rocks or other surfaces

[12] The reptiles and amphibians of a particular region, habitat, or geological period

4.2.2 Sources of Information

Sources of information for preparation of the ecological baseline included published literature and reports, and field surveys conducted for collection of data. The following report which provides ecological information collected recently in the proximity of Project area was consulted:

- Hagler Bailly Pakistan, March 20, 2017, Environment and Social Impact Assessment for Kohala Hydropower Project, Kohala Power Company (Pvt) Ltd
- Hagler Bailly Pakistan, September 2016, Biodiversity Strategy for Jhelum-Poonch River Basin – Preparatory Phase, Fish Surveys in Tributaries, for the International Finance Corporation

4.2.3 Study Areas

There are two types of ecological resources that are of concern, aquatic and terrestrial. Therefore, two types of Study Areas were defined, an Aquatic Study Area and a Terrestrial Study Area.

The Aquatic Study Area includes the stretch of the Kunhar River from Faridabad upstream of the Project to Bissian downstream of the Project. It was selected taking into consideration the maximum extent of impacts of the Project both upstream and downstream of it. The reservoir is expected to form along a stretch 2.8 km upstream of the dam. The Aquatic Study Area extends past the upstream end of the reservoir till just past Faridabad, to account for the maximum extent of the impact upstream of the reservoir. It extends downstream till Bissian, a location representative of the impacts of release from the tailrace tunnel. Approximately 10 km downstream of Bissian is the start of the reservoir of Patrind HPP, which has altered the riverine habitat and created a barrier downstream of the Project. The Aquatic Study Area also includes tributaries in this stretch but only those with a significant perennial flow that support breeding of fish are included. The Aquatic Study Area is shown in **Exhibit 4.63**.

The Terrestrial Study Area comprises a 1 km buffer around selected locations where Project-related facilities are to be located. Project-related activities will occur within the Project-related facilities. The flora and fauna within a 1 km radius of these activities is expected to be impacted by them. Sampling Locations were selected within all habitat types where Project facilities will be located. Sampling Locations were also selected at other sites in the Terrestrial Study Area, with representative sampling by proportion of habitat type. Scrub Forest makes up the highest percentage of the habitat in the Terrestrial Study Area followed by Pine Forest and Agriculture Area. **Exhibit 4.64** shows the Terrestrial Study Area.

Exhibit 4.63: Aquatic Study Area

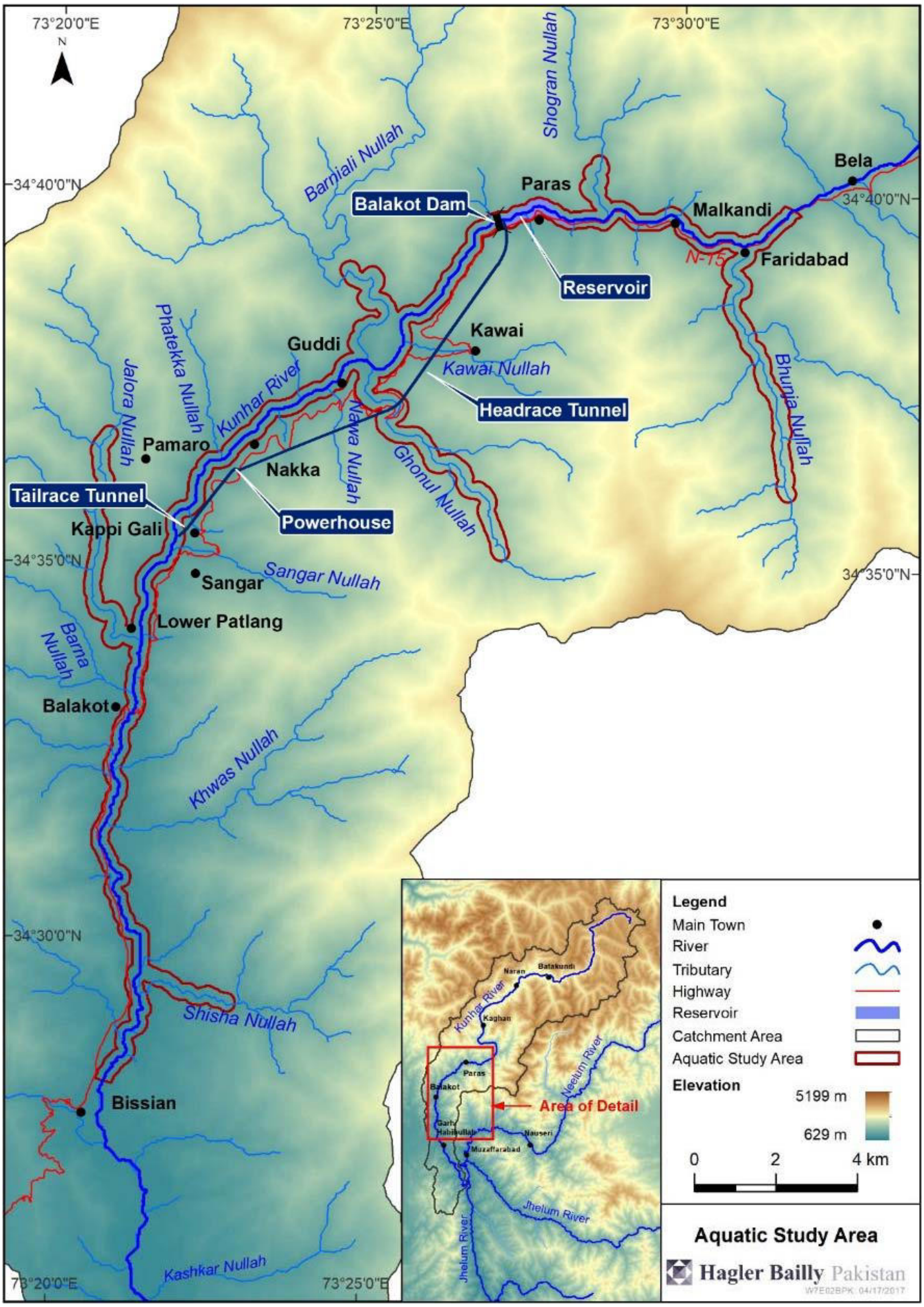
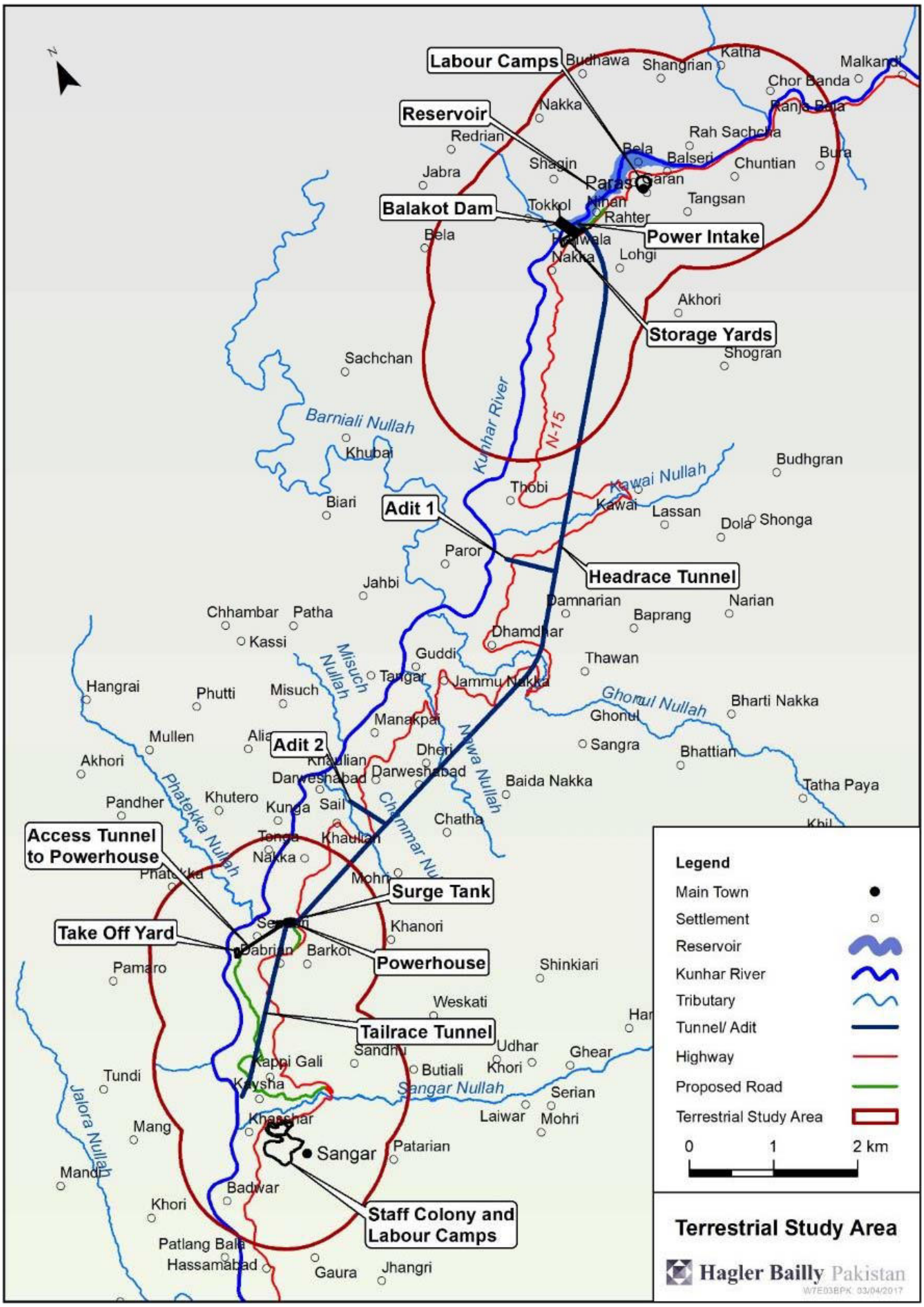


Exhibit 4.64: Terrestrial Study Area



4.2.4 Methodology

The field survey plan for data collection is provided in **Appendix H**. The methodology used for each biological resource is summarized below.

Surveys

The winter survey for fish fauna was carried out between February 24, 2017 and March 1, 2017. The spring survey for fish fauna was carried out between May 13, 2017 and May 16, 2017. The survey for terrestrial ecology was carried out between May 19, 2017 and May 23, 2017.

Representatives from the Fisheries Department, KP and the Wildlife Department, KP accompanied the teams to observe sampling. Photographs of staff from the Departments observing field sampling are provided in **Exhibit 4.65**.

Exhibit 4.65: Government Department Staff Observing Field Sampling, May 2017 Survey

Mr Qaiser Javed from Fisheries Department, KP observing samples collected for fish fauna

Mr Sarmad Shah, Sub-Divisional Forest Officer, Balakot, Wildlife Department, KP (extreme right) walking with the team to Sampling Location T8

Aquatic Ecology

Sampling for aquatic ecology was carried out for the following:

- Fish
- Macro-invertebrates
- Periphyton
- Riparian Vegetation

Sampling Locations

Sampling Locations for fish fauna, macro-invertebrates, periphyton and riparian vegetation are shown in **Exhibit 4.66**. The justification for the selection of these Sampling Locations is provided in **Exhibit 4.67**. The list of Sampling Locations in the tributaries is provided in **Exhibit 4.68.**

Fish

In the February 2017 Survey, sampling was carried out at the Sampling Locations shown in **Exhibit 4.66**. The sampling in May 2017 was also carried out at the same Sampling Locations. The methods for data collection included the use of two different types of nets, gill nets and cast nets, as well as electrofishing. Details of the use of each method are provided in **Appendix H**.

Statistical analysis was carried out to determine fish community structure and species diversity. The details of the application of these statistical methods is provided in **Appendix H**.

Macro-invertebrates

Macro-invertebrates sampling was conducted in the May 2017 Survey at the Sampling Locations shown in **Exhibit 4.66.**

The methods for sampling are described in **Appendix H**, along with details of how the samples were processed in the laboratory.

The data collected was used to generate information on the abundance of macro-invertebrates for each taxon.

Periphyton Biomass

Periphyton could not be collected during the February 2017 Survey. Sampling for periphyton was attempted in May 2017 Survey as well, however, periphyton was again not present due to the fast flow of the river, which erodes and washes out biomass on the cobblestones. The proposed Sampling Locations for both the February 2017 Survey and May 2017 Survey are shown in **Exhibit 4.66**. Methods for data collection and sample analysis are described in detail in **Appendix H**.

Exhibit 4.66: Sampling Locations for Fish, Macro-invertebrates, Periphyton and Riparian Vegetation

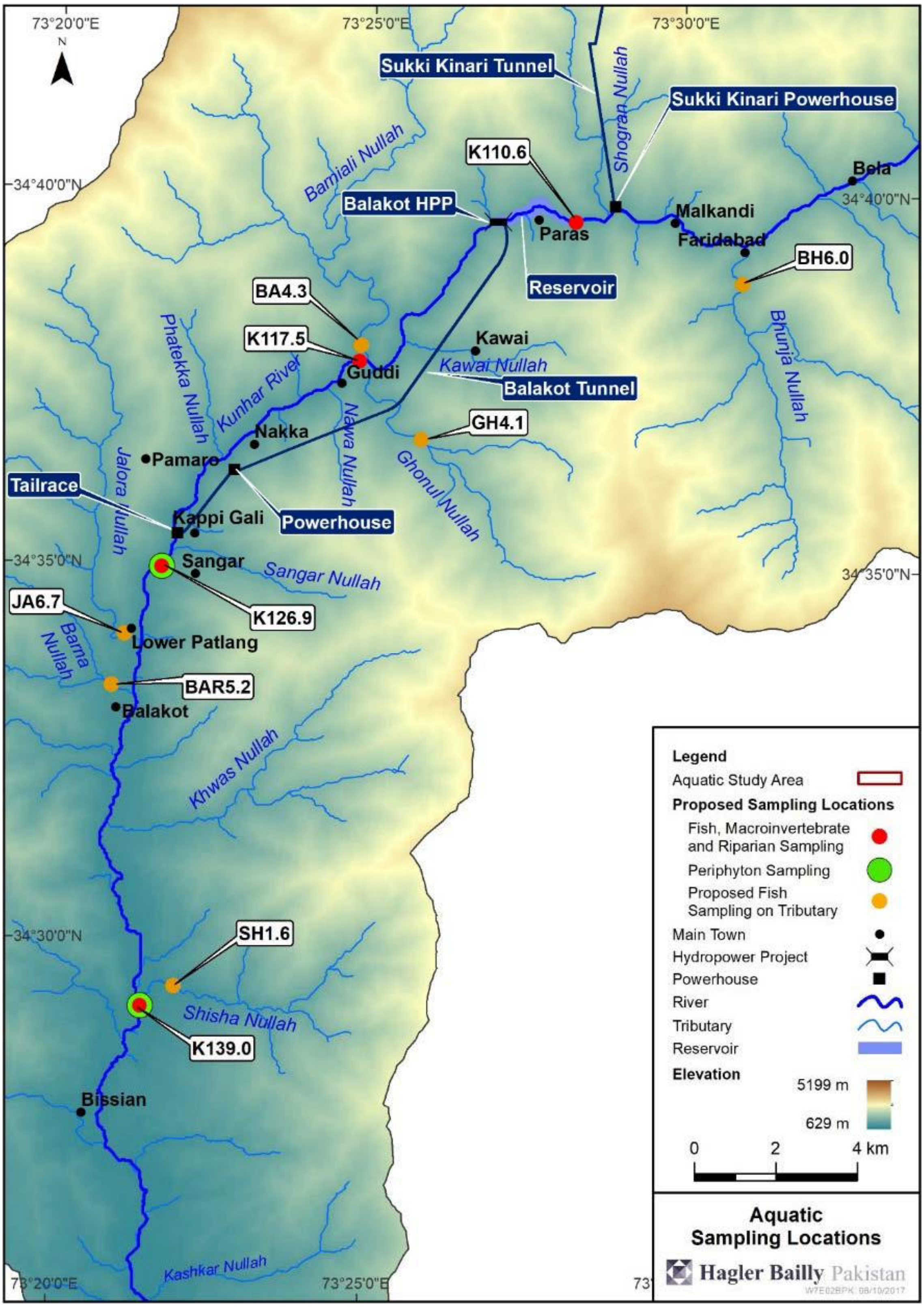


Exhibit 4.67: Justification for Selection of Sampling Locations on Main River

River Segment	Sampling Location ID	Expected impacts from the Project
Upstream of Dam	K110.6	This location is upstream of the reservoir of proposed dam and will be impacted by the barrier to migration created by the dam
Downstream of Dam	K117.5	This location will be impacted by the lower flows due to the diversion of the river flow into the power generation tunnel
Downstream of Diversion Tunnel	K126.9, K139.0	Both temperature and flow of water at this location will be impacted by variations in flow.

Exhibit 4.68: List of Sampling Locations for the Tributaries

Tributary (Local Name)	Sampling Location ID
Shogran Nullah	SH1.7
Bhunja Nullah	BH6.0
Barnialai Nullah	BA4.3
Makra Nullah	MA4.1
Barna Nullah	BAR6.7
Shisha Nullah	SH1.6

Riparian Vegetation

The methodology used for riparian vegetation is the same as that used for sampling of terrestrial flora. Sampling was carried out at the banks of all the aquatic ecology Sampling Locations (**Exhibit 4.66**).

Terrestrial Ecology

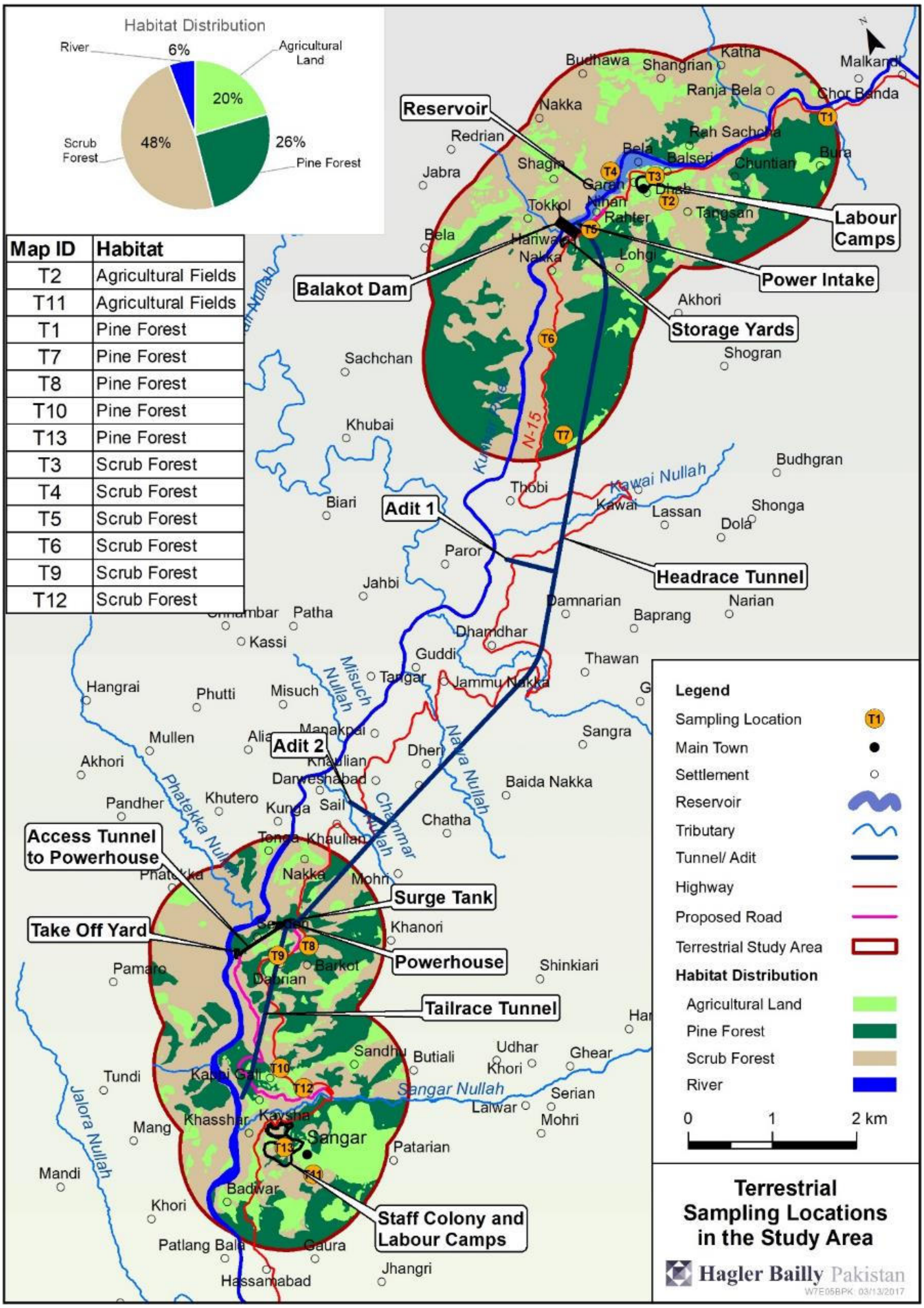
Sampling for terrestrial ecology included the following:

- Terrestrial Flora
- Mammals
- Avifauna
- Herpetofauna

Sampling Locations

Sampling Locations for terrestrial ecology are provided in **Exhibit 4.69**. The locations were determined taking into account three main habitat types identified using ***Google Earth***^{TM} satellite imagery. These include Agricultural Area, Scrub Forest and Pine Forest. The number of Sampling Locations were distributed between these habitat types within the Terrestrial Study Area, with 10 in the two Forest habitat types (six in Scrub Forest and four in Pine Forest) and four in Agricultural Area habitat type. Ground-truthing was carried out during sampling to determine the actual habitat at that sampling location. The habitat type of each Sampling Location, after ground-truthing, is provided in **Exhibit 4.69** and **Exhibit 4.70.**

Exhibit 4.69: Sampling Locations for Terrestrial Flora and Fauna



Map ID	Habitat
T2	Agricultural Fields
T11	Agricultural Fields
T1	Pine Forest
T7	Pine Forest
T8	Pine Forest
T10	Pine Forest
T13	Pine Forest
T3	Scrub Forest
T4	Scrub Forest
T5	Scrub Forest
T6	Scrub Forest
T9	Scrub Forest
T12	Scrub Forest

Exhibit 4.70: Habitat Types for the Terrestrial Sampling Locations

Sampling Locations	*Relative Position of Sampling Location*
T2, T11	Agricultural Area
T1, T7, T8, T10, T13	Pine Forest
T3, T4, T5, T6, T9, T12	Scrub Forest

Terrestrial Flora

The methods used for sampling and analysis of terrestrial flora are described in **Appendix H**. The data collection and analysis on terrestrial flora was used to generate information on the following:

- Cover
- Relative Cover
- Density
- Relative Density
- Frequency
- Relative Frequency
- Importance Value Index

The results of the sampling and analysis are provided in **Section 4.8**.

Mammals

Mammals were sampled at the Sampling Locations shown in **Exhibit 4.69**. The methods used for sampling were different for small and large mammals. These methods are described in detail in **Appendix H**. Sampling for mammals was used to collect information about the presence, abundance and distribution of mammal species in the three habitat types, Agricultural Area, Scrub Forest and Pine Forest, within the Terrestrial Study Area.

Avifauna

Avifauna was sampled at the Sampling Locations shown in **Exhibit 4.69**. The methods used for sampling are described in detail in **Appendix H**. Sampling for birds was used to collect information about diversity, abundance and distribution of bird species within the Terrestrial Study Area. It also identified the presence of any birds of conservation importance present within the Terrestrial Study Area.

Herpetofauna

Herpetofauna was sampled at the Sampling Locations shown in **Exhibit 4.69**. The methods used for sampling are described in detail in **Appendix H**. Sampling for herpetofauna was conducted to collect information about the presence, diversity, abundance and distribution of reptile and amphibian species within the Terrestrial Study Area.

4.2.5 Protected Areas or Areas of Special Importance for Biodiversity

There are both aquatic and terrestrial areas that are either protected or of special importance to biodiversity near the Project.

The part of the Kunhar River above Balakot Bridge (**Exhibit 4.71**) is protected as it is stocked by the Fisheries Department, KP. This includes protected status of the river and riparian areas, however, the exact area within the terrestrial areas is not known. There are also terrestrial Protected Areas within the Mansehra District. A map showing the terrestrial Protected Areas and areas of special importance for biodiversity is provided in **Exhibit 4.71**. A map showing the Important Bird Areas (IBAs) is shown in **Exhibit 4.72**.

Terrestrial Protected Areas

Information about the terrestrial Protected Areas, including national parks, wildlife sanctuaries and game reserves was obtained from the Wildlife Department of KP. This information is currently unpublished. The Protected Area closest to the dam site is the Manshi Wildlife Sanctuary, located 5 km away. The second closest is the Saif-ul-Maluk National Park, located 23.5 km from the dam site.

Mansehra Wildlife Division

There is a diversity of habitat types within Mansehra Wildlife Division consisting of Scrub forests, Chir pine Forests, Moist Temperate Forests, Dry Temperate Forests, Sub Alpine Forests, Alpine Pastures and Wetlands.

There are two types of wetlands found in Mansehra Wildlife Division.

- High altitude wetlands are found in upper Kaghan Valley. The most important amongst them are Saiful Maluk Lake, Lulusar Lake, Dudipat Sar Lake and Ansoo Lake etc.
- Low altitude wetlands are found in areas around Lower Kunar and Siran Rivers.

Exhibit 4.71: Map of Protected Areas

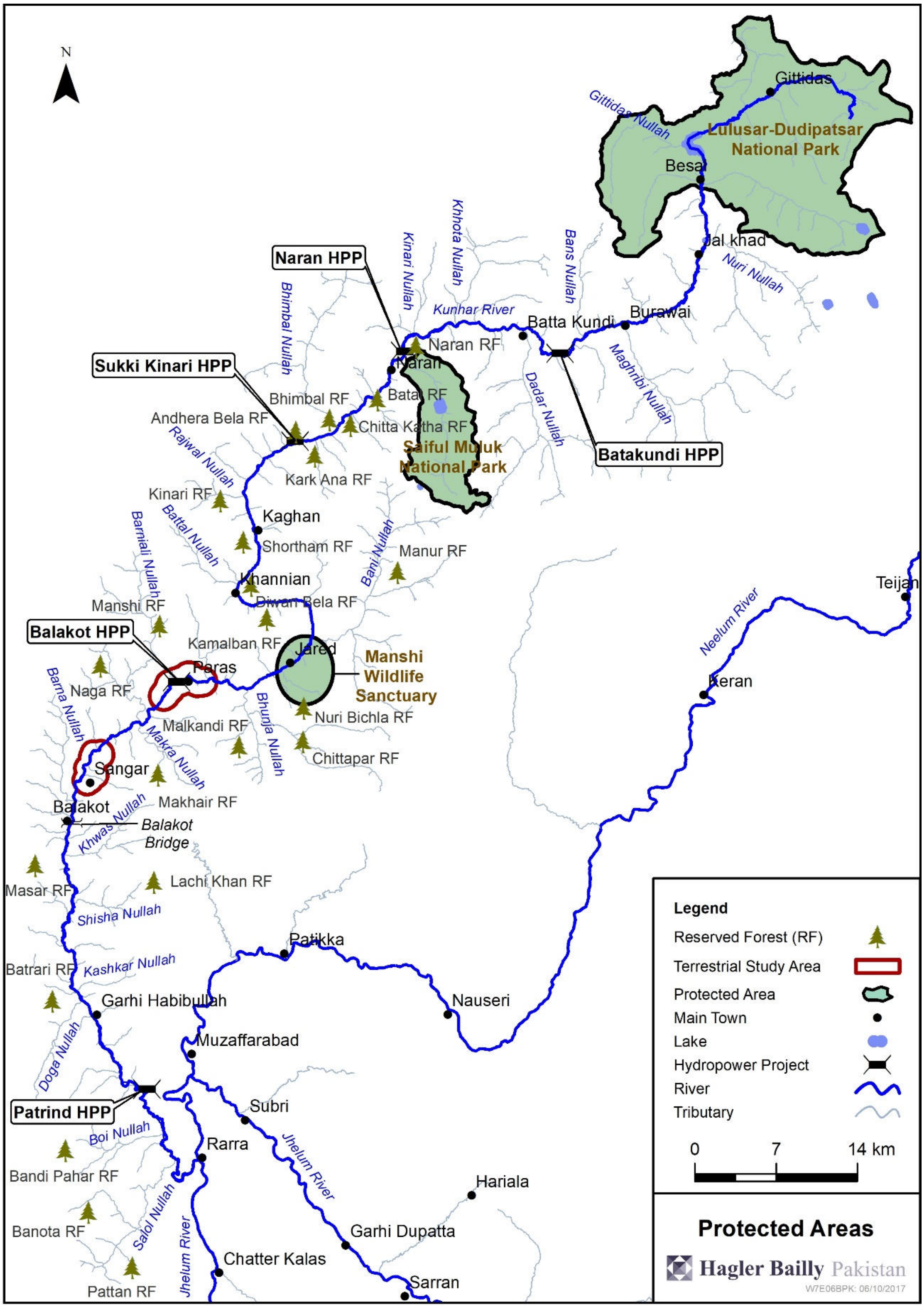
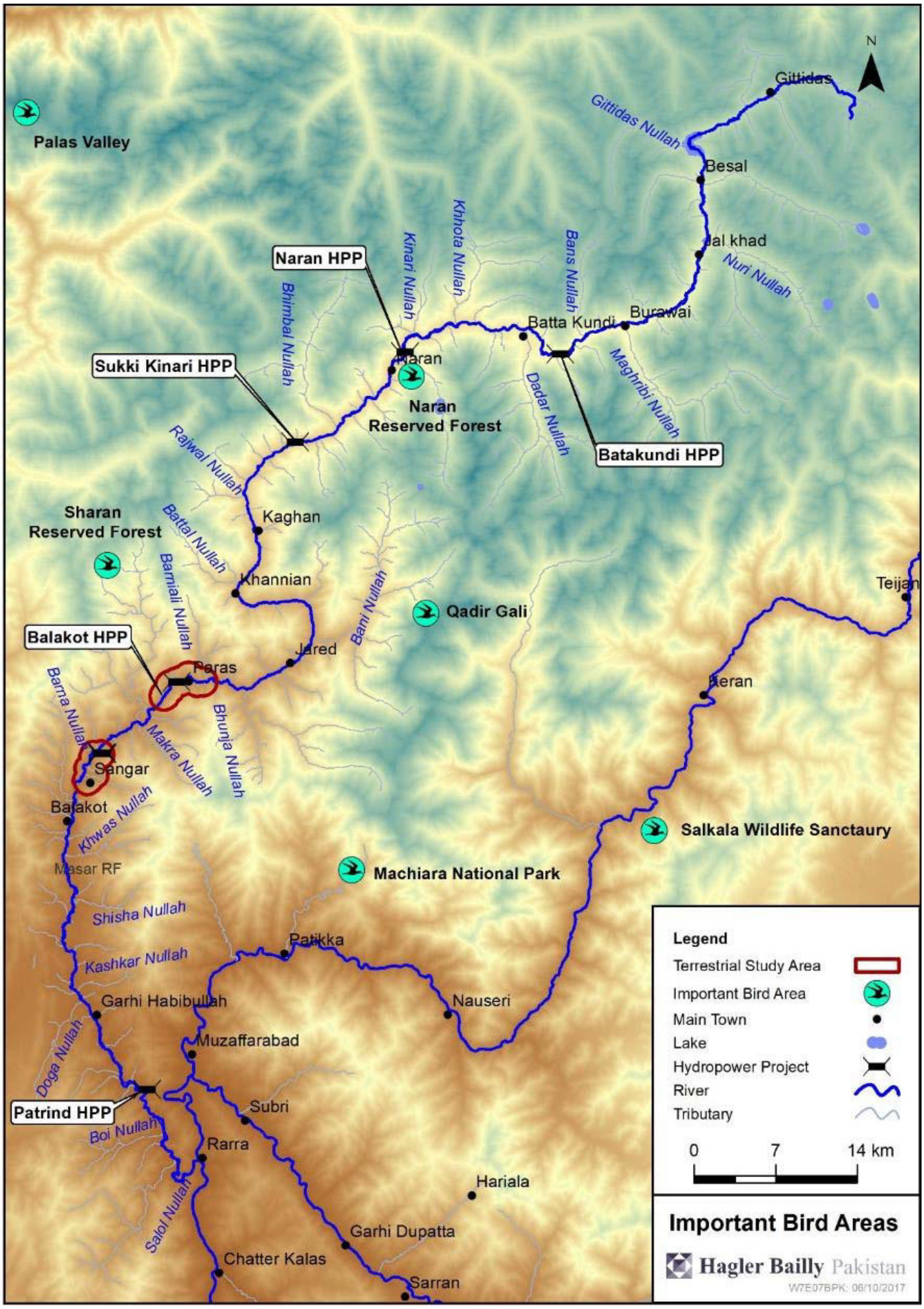


Exhibit 4.72: Map of Important Bird Areas



Due to diversity of habitat types there is a wide diversity of flora and fauna which makes Mansehra Wildlife Division a very important site for protection and conservation. The human population is increasing rapidly which is not only fragmenting habitat but also degrading it. Local communities are highly dependent upon natural resources which presents a challenge for conservation. Mansehra Wildlife Division maintains regular contact with the local communities to persuade them and to educate them about the importance of natural resources and to enlist their support in conservation of biodiversity. There are 12-15 communities organized to protect and manage Community Game Reserves and other protected areas in Mansehra. Similar efforts are being undertaken to organize communities living around the national parks of Kaghan Valley so that they help in protection and manage their natural resources, for example tapping into the benefits from eco-tourism. There is informal interaction with the communities of Upper Siran and Kanshian that are living around the habitat for re-introduction of Chir pheasants.

Terrestrial Protected Areas in the vicinity of the Terrestrial Study Area include ten community Game Reserves, two National Parks and one Wildlife Sanctuary. Other hot spots suitable for being declared as Protected Areas have been identified by the Wildlife Department, KP. Some of these patches of habitat are Bichla Manoor Reserve Forests, Sharhan Reserve Forests; Shogran Reserve Forests and adjoining habitat in Kaghan Valley, Hillan and Chorr in Battagram Districts. These areas are important for their biodiversity and in need of protection from habitat degradation and over exploitation. A description of each type of Protected Area is provided below.

National Parks

There are two National Parks in Mansehra Wildlife Division including the Saiful Maluk National Park and Lulusar-Dudipat National Park.

Saiful Maluk National Park

Saiful Maluk was declared a National Park on April 28, 2003. Total area of this national park is 12,026 acres. The human population around the National Park is about 20,000. Important fauna of the Park includes, Snow Leopard, Marmot, Brown Bear, Himalayan Ibex, Snow Cock, Snow Partridge and Himalayan Griffin Vulture.

Microtopographic features and morphological and physiological characteristics of the vegetation give rise to patterns which vary in size and are found intermittently. For example, Junipers is prostrate with spreading aerial parts. Its compact patches are found all over pastures, but particularly on rocky ridges. Salix occupies depressions on cooler aspects. Species of Polygonum have extensive rhizomes and several patterns are usually visible in pastures. Iris form more or less compact patches distributed all over the area, giving the impression of pure stands. Potentilla-Astragalus type vegetation is present.

The large number (63) of species indicates the richness of floral diversity. Prevailing conditions suggest that more palatable species have disappeared due to heavy grazing. Most forbs (17 species)[13] have poor palatability and are therefore abundant. Some forbs have medical value, and locals use them to treat both humans and livestock. Fresh leaves

[13] A forb is a family of plants that have broad leaves and herbaceous structures.

or branches of some are used as food. Woody species are a good source of fuel wood and thatch. Dry branches and stems of Juniper and Salix are collected for fuel.

An estimated 0.1 million people visit the Saiful Maluk Park area every year. Threats to the national Park are over exploitation of natural resources, ill-planned tourism, pollution, illegal fishing, modification of land for cultivation, and ill-planned construction.

Lulusar Dudipat National Park

Lulusar-Dudipat was declared National Park on April 28, 2003. The human population around it is about 15,000, mainly nomadic and semi-nomadic peoples. The important fauna of the Park includes Snow leopard, Marmot, Brown Bear, Himalayan Ibex, Snow Cock, Snow Partridge and Himalayan Griffin Vulture.

An estimated 20,000 people visit the Park area every year. Threats to this National Park are the same as for the Saiful Maluk National Park.

Wildlife Sanctuaries

There is one wildlife sanctuary located 5 km from the Project, the Manshi Wildlife Sanctuary.

Manshi Wildlife Sanctuary

This sanctuary is located in Kaghan Valley at a height of about 2,438 meters above sea level. The total area is about 2,307 hectares.

Important wildlife species found here are Common Leopard, Black Bear, Grey Goral, Musk Deer, Jungle Cat, Grey Langur, Rhesus Monkey, Kokhlas Pheasant, Chukar, Snow Partridge and Monal Pheasant.

Important flora of the sanctuary is Deodar *Cedrus deodara*, Fir *Abies pindrows*, Biar *Pinus wallichiana*, Kain *Ulmus wallichiana*, Walnut *Juglans regia*, Bankhor *Aesculus spp.*, Guch *Vibernum*, Jangli Gulab *Rosa moschatta*. Medicinal plants include Ban Khakhri *Podophylum hexandrum,* Mamaikh *Paeonia emodi*, Chita podeena *Mentha longifolia*, Ratan jot *Geranium wallichianum* etc.

Game Reserves

There are 10 proposed Game Reserves located near the Project. These are listed below. Their locations and boundaries are not currently available. Details about them are provided in **Appendix I**.

- Pharana
- Behali
- Sheikh Abad
- Bhaili Ghatti
- Jallo
- Kareer
- Battal

- Palsala Dhanaka
- Lassan Thukral
- Khawajgan

The likelihood of notification of these Game Reserves is currently unknown. In addition to these there is a partridge breeding center at Lasan Nawab and Dhodial Pheasantry in Dhodial.

Information about the presence of proposed Game Reserves located in the wider area of the Project is of significance because it indicates that hunting is of interest in the area and that game animals are present. Awareness of this is important to regulate any hunting activities that Project staff might engage in.

4.2.6 Aquatic Ecology

Study of aquatic ecology covered fish fauna, macro-invertebrates, periphyton and riparian vegetation. Sampling was carried out within the Aquatic Study Area to determine species diversity and abundance. The results of sampling and literature review are reported in this section.

Fish

This section provides an overview of the fish fauna present in the Aquatic Study Area along with the results of the surveys carried out for this Project.

Overview of the Fish Fauna in Kunhar River

The long distance migratory species Alwan Snow Trout *Schizothorax richardsonii,* as well as the Himalayan Catfish *Glyptosternum reticulatum* and Kashmir Hillstream Loach *Triplopysa Kashmirensis* are widely distributed species and found in the Kunhar River upstream and downstream of proposed Project. The species Nalbant's Loach *Schistura nalbanti*, Stone Barb *Schistura alepidota*, Arif's Loach *Shistura arifi* and Flat Head Catfish *Glyptothorax pectinopterus* are mainly found in Kunhar River and tributaries downstream of the proposed Balakot dam but they are also recorded from few places upstream. The species Kunar Snow Trout *Schizothorax labiatus* is exclusively found in Kunhar River downstream of the proposed dam site. They tend to migrate in summers towards upper parts of the river. Two introduced species Brown Trout *Salmo trutta fario* and Rainbow Trout *Oncorhynchus mykiss* are found exclusively upstream of the proposed dam. These two are cold water species and of high food value. There is an extensive raceways[14] culture of Rainbow Trout in the areas upstream and downstream of the proposed dam. Alwan Snow Trout (both upstream and downstream of the dam) and Kunar Snow Trout (mostly downstream of the dam) are two other species of food value. They are not cultured but are captured from the river.

A total of ten species have been reported from the Kunhar River based on the surveys carried out in February 2017 and May 2017 as a part of this study, in July 2016 as a part

[14] Raceway is based on the continuous water flowing through the culture tanks

of the Biodiversity Strategy for Jhelum Poonch River basin – Preparatory Phase,[15] and advice from Dr Muhammad Rafique, a fish expert with the Pakistan Museum of Natural History (PMNH). Out of these one species is a long distance migratory species and two are endemic to the Jhelum Basin. The complete list of fish species reported from the Kunhar River is given in **Exhibit 4.73**, along with information about their IUCN Red List Status, endemism and whether they are long-distance migratory or not.

Exhibit 4.73: List of Species Reported from the Kunhar River

No.	*Scientific Name*	*Common Name*	*IUCN Status*	*Endemic*	*Migratory*
1.	*Glyptosternum reticulatum*	Himalayan Catfish	Not Assessed		
2.	*Glyptothorax pectinopterus*	Flat Head Catfish	Not Assessed		
3.	*Salmo trutta fario*	Brown Trout	Not Assessed		
4.	*Oncorhynchus mykiss*	Rainbow Trout	Not Assessed		
5.	*Schistura alepidota*	Stone Barb	Not Assessed		
6.	*Schistura arifi*	Arif's Loach	Not Assessed		
7.	*Schistura nalbanti*	Nalbant's Loach	Not Assessed	✓	
8.	*Schizothorax labiatus*	Kunar Snow Trout	Not Assessed		
9.	*Schizothorax richardsonii*	Alwan Snow Trout	**Vulnerable**		✓
10.	*Triplophysa kashmirensis*	Kashmir Hillstream Loach	Not Assessed	✓	

Note: All species, except the Kunar Snow Trout were observed during the surveys (July 2016, February 2017 and May 2017). In the opinion of Dr Muhammad Rafique, a fish expert with the Pakistan Museum of Natural History (PMNH), the Kunar Snow Trout is also present in the Aquatic Study Area

Results of the July 2016, February 2017 and May 2017 Surveys

Fish surveys were carried out in February 2017 and May 2017 as a part of this study and July 2016 as a part of Jhelum-Poonch Biodiversity Strategy.[16] Fish sampling was carried out using cast nets, electrofishing and gill nets. The method used at each location depended on the morphology of the river or tributary, accessibility, the target fish species, and the possibility of finding the fish in a particular habitat in view of temperatures and fish activity at the time of sampling. It was not possible to apply all methods at all Sampling Locations. **Exhibit 4.74** shows the photographs of field activities performed during the surveys.

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15 Hagler Bailly Pakistan, September 2016. Biodiversity Strategy for Jhelum Poonch River basin – Preparatory Phase, for the International Finance Corporation, Washington D.C.

16 Ibid

Exhibit 4.74: Photographs of Field Activities

a) Electrofishing

b) Cast netting

c) Gill Netting

d) Measuring Fish Length

e) Fish Breeding Maturity Observed

f) Releasing Fish Back to River

Results of the July 2016 Survey

During the July 2016 Survey, sampling was conducted at a total of three Sampling Locations in the Aquatic Study Area. All were downstream of Balakot Town.

- A total of 99 specimens of two fish species were collected from the Kunhar River.
- Maximum relative abundance (46 specimens) was observed at Sampling Location K143.9, Upstream of Banda Balola Village.
- The most abundant fish species observed in the main Kunhar River was Alwan Snow Trout. A total of 53 specimens were collected using electrofishing and cast nets.
- A total of 46 specimens of the endemic Kashmir Hillstream Loach were collected during the surveys, using electrofishing and cast nets.

Results of the February 2017 Survey

During the February 2017 Survey, sampling was conducted at a total of 10 Sampling Locations in the Aquatic Study Area. Four of these are located in the main Kunhar River while five are located in the tributaries. A total of 215 specimens of seven species were collected during the February 2017 Survey from the main Kunhar River and its tributaries, using cast nets, gill nets and electrofishing.

Main Kunhar River

- A total of 45 specimens of four fish species were collected from the main Kunhar River.
- Maximum relative abundance (28 specimens) was observed at Sampling Location K139.0, in the Kunhar River near its confluence with Shisha Nullah.
- The most abundant fish species observed was Alwan Snow Trout, with a total of 32 specimens collected, using electrofishing, gill nets and cast nets.
- The second most abundant fish species was Kashmir Hillstream Loach, with eight specimens collected. All the specimens were collected from Sampling Location K139.0.

Tributaries of Kunhar River

- A total of 170 specimens of six fish species were collected from the Kunhar River.
- Maximum relative abundance (62 specimens) was observed at Sampling Location SH1.6, located at Shisha Nullah near Bissian.
- The most abundant fish species observed from the tributaries of Kunhar River was Alwan Snow Trout. A total of 105 specimens were collected using electrofishing and cast nets.
- The second most abundant fish species was Nalbant's Loach, with 34 specimens collected.

Results of the May 2017 Survey

During the May 2017 Survey, sampling was conducted at a total of nine Sampling Locations in the Aquatic Study Area. Four of these are located in the main Kunhar River while five are located in the tributaries. A total of 549 specimens of nine species were collected from the main Kunhar River and its tributaries.

Main Kunhar River

- A total of 194 specimens of five fish species were collected from the main Kunhar River.
- Maximum relative abundance (146 specimens) was observed at Sampling Location K139.0, in the Kunhar River near its confluence with Shisha Nullah.
- The most abundant fish species observed during the surveys was Alwan Snow Trout with a total of 134 specimens collected, using electrofishing and cast nets.

- The second most abundant fish species was Kashmir Hillstream Loach, with 59 specimens collected. All the specimens were collected from Sampling Location. Kashmir Hillstream Loach was not collected from the tributaries.

Tributaries of Kunhar River

- A total of 355 specimens of eight fish species were collected from the Kunhar River.
- Maximum relative abundance (175 specimens) was observed at Sampling Location JA6.7, Jalora Nullah at the Confluence of Kunhar River, using cast nets and electrofishing.
- The most abundant fish species observed from the tributaries of Kunhar River was Alwan Snow Trout with a total of 170 specimens collected, using electrofishing and cast nets.
- The second most abundant fish species was Nalbant's Loach, with 90 specimens collected.
- The relative abundance of fish species observed during February 2017 Survey is shown in **Exhibit 4.75** while species richness is shown in **Exhibit 4.76**. The relative abundance of fish species observed during May 2017 Survey is shown in **Exhibit 4.77** while species richness is shown in while **Exhibit 4.78**.

A comparatively higher relative abundance and species richness was observed during the May 2017 Survey in comparison with February 2017 Survey. A warmer temperature range (13°C-16.5°C) in May 2017 Survey in comparisons with February 2017 Survey (8°C – 12°C) is the likely reason for higher relative abundance and species richness in the May 2017 Survey. The tributaries downstream of the proposed dam i.e. Jalora Nullah, Barna Nullah and Shisha Nullah are more productive and have a higher abundance of fish in comparison to the tributaries upstream of the dam site. Tributaries downstream are the prominent breeding grounds for most fish species i.e. Nalbant's Loach, Alwan Snow Trout, Arif's Loach, Stone Barb and Flat Head Catfish while comparatively lower breeding was observed in the tributaries upstream of the dam.

Exhibit 4.75: Relative Abundance Observed in main Kunhar River and Tributaries, February 2017 Survey

		Kunhar River					*Tributaries*							
	Sampling Location	*K110.6*	*K117.5*	*K126.9*	*K139.0*		*BAR5.2*	*BA4.3*	*BH6.0*	*GH4.1*	*JA6.7*	*SH1.6*		
		Upstream Paras Town	*Kunhar River near Confluence of Barinali Nullah*	*Kunhar River near Sangar Town*	*Kunhar River near Confluence of Shisha Nullah*	**Total Kunhar River**	*Barna Nullah*	*Barniali Nullah near Confluence of Kunhar River*	*Bhonja Nullah Near Bhonja Village*	*Ghanool Nullah near Ghanool Village*	*Jalora Nullah*	*Shisha Nullah near Confluence of Kunhar River*	***Total Tributaries***	***Total Survey***
Scientific Name	*Common Name*													
Glyptosternum reticulatum	Himalayan Catfish	–	–	–	4	**4**	–	–	1	–	–	–	**1**	**5**
Salmo trutta fario	Brown Trout	–	1	–	–	**1**	–	–	10	–	–	–	**10**	**11**
Schistura alepidota	Stone Barb	–	–	–	–	**–**	10	–	–	–	–	8	**18**	**18**
Schistura arifi	Arif's Loach	–	–	–	–	**–**	–	–	–	–	2	–	**2**	**2**
Schistura nalbanti	Nalbant's Loach	–	–	–	–	**–**	15	–	–	–	5	14	**34**	**34**
Schizothorax richardsonii	Alwan Snow Trout	6	4	6	16	**32**	35	3	3	–	24	40	**105**	**137**
Triplophysa kashmirensis	Kashmir Hillstream Loach	–	–	–	8	**8**	–	–	–	–	–	–	**–**	**8**
Relative Abundance		**6**	**5**	**6**	**28**	**45**	**60**	**3**	**14**	**–**	**31**	**62**	**170**	**215**

Exhibit 4.76: Species Richness Observed in main Kunhar River and Tributaries, February 2017 Survey

		Kunhar River					Tributaries							
	Sampling Location	K110.6	K117.5	K126.9	K139.0		BAR5.2	BA4.3	BH6.0	GH4.1	JA6.7	SH1.6		
		Upstream Paras Town	Kunhar River near Confluence of Barinali Nullah	Kunhar River near Sangar Town	Kunhar River near Confluence of Shisha Nullah	**Total Kunhar River**	Barna Nullah	Barniali Nullah near Confluence of Kunhar River	Bhonja Nullah Near Bhonja Village	Ghanool Nullah near Ghanool Village	Jalora Nullah	Shisha Nullah near Confulence of Kunhar River	**Total Tributaries**	**Total Survey**
Scientific Name	Common Name													
Glyptosternum reticulatum	Himalayan Catfish	–	–	–	✓	✓	–	–	✓	–	–	–	✓	✓
Salmo trutta fario	Brown Trout	–	✓	–	–	✓	–	–	✓	–	–	–	–	✓
Schistura alepidota	Stone Barb	–	–	–	–	–	✓	–	–	–	–	✓	✓	✓
Schistura arifi	Arif's Loach	–	–	–	–	–	–	–	–	–	✓	–	✓	✓
Schistura nalbanti	Nalbant's Loach	–	–	–	–	–	✓	–	–	–	✓	✓	–	✓
Schizothorax richardsonii	Alwan Snow Trout	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	✓	–	✓
Triplophysa kashmirensis	Kashmir Hillstream Loach	–	–	–	✓	✓	–	–	–	–	–	–	✓	✓
	Richness	**1**	**2**	**1**	**2**	**4**	**3**	**1**	**3**	**–**	**3**	**3**	**6**	**7**

Summary

Most Abundant Species	*Schizothorax richardsonii*	**Highest Abundance Location**	SH1.6	**Highest Richness**	SH1.6, JA6.7, BH6.0, BAR5.2
2nd Most Abundant Species	*Schistura nalbanti*	**2nd Highest Abundance Location**	BAR5.2	**2nd Highest Richness**	K117.5, K139.0

Exhibit 4.77: Relative Abundance Observed in main Kunhar River and Tributaries, May 2017 Survey

		Kunhar River					*Tributaries*							
	Sampling Location	*K110.6*	*K117.5*	*K126.9*	*K139.0*		*BAR5.2*	*BA4.3*	*BH6.0*	*GH4.1*	*JA6.7*	*SH1.6*		
		Upstream Paras Town	*Kunhar River near Confluence of Barinali Nullah*	*Kunhar River near Sangar Town*	*Kunhar River near Confluence of Shisha Nullah*	**Total Kunhar River**	*Barna Nullah*	*Barniali Nullah near Confluence of Kunhar River*	*Bhonja Nullah Near Bhonja Village*	*Ghanool Nullah near Ghanool Village*	*Jalora Nullah*	*Shisha Nullah near Confulence of Kunhar River*	***Total Tributaries***	***Total Survey***
Scientific Name	*Common Name*													
Glyptosternum reticulatm	Himalayan Catfish	–	–	1	–	**1**	2	–	3	7	11	–	**23**	**24**
Glyptothorax pectinopterus	Flat Head Catfish	–	–	–	–	–	1	–	–	–	-	–	**1**	**1**
Salmo trutta fario	Brown Trout	–	–	–	–	–	–	–	1	–	-	–	**1**	**1**
Schistura alepidota	Stone Barb	–	–	–	5	**5**	19	–	–	–	17	15	**51**	**56**
Schistura arifi	Arifs Loach	–	–	–	–	–	3	–	–	–	3	3	**9**	**9**
Schistura nalbanti	Nalbant's Loach	–	–	–	–	–	37	–	–	–	32	21	**90**	**90**
Schizothorax richardsonii	Alwan Snow Trout	2	5	32	90	**129**	15	5	4	–	112	34	**170**	**299**
Triplophysa kashmirensis	Kashmir Hillstream Loach	–	–	8	51	**59**	–	–	–	–	–	–	–	**59**
Oncorhynchus mykiss	Rainbow trout	–	–	–	–	–	–	–	10	–	–	–	10	**10**
	Relative Abundance	**2**	**5**	**41**	**146**	**194**	**77**	**5**	**18**	**7**	**175**	**73**		**549**

Exhibit 4.78: Species Richness Observed in main Kunhar River and Tributaries, May 2017 Survey

		Kunhar River					*Tributaries*							
	Sampling Location	*K110.6*	*K117.5*	*K126.9*	*K139.0*		*BAR5.2*	*BA4.3*	*BH6.0*	*GH4.1*	*JA6.7*	*SH1.6*		
		Upstream Paras Town	*Kunhar River near Confluence of Barinali Nullah*	*Kunhar River near Sangar Town*	*Kunhar River near Confluence of Shisha Nullah*	***Total Kunhar River***	*Barna Nullah*	*Barniali Nullah near Confluence of Kunhar River*	*Bhonja Nullah Near Bhonja Village*	*Ghanool Nullah near Ghanool Village*	*Jalora Nullah*	*Shisha Nullah near Confulence of Kunhar River*	***Total Tributaries***	***Total Survey***
Scientific Name	*Common Name*													
Glyptosternum reticulatm	Himalayan Catfish	–	–	✓	–	✓	✓	–	✓	✓	✓	–	✓	✓
Glyptothorax pectinopterus	Flat Head Catfish	–	–	–	–	–	✓	–	–	–	-	–	✓	✓
Salmo trutta fario	Brown Trout	–	–	–	–	–	–	–	✓	–	-	–	✓	✓
Schistura alepidota	Stone Barb	–	–	–	✓	✓	✓	–	–	–	✓	✓	✓	✓
Schistura arifi	Arifs Loach	–	–	–	–	–	✓	–	–	–	✓	✓	✓	✓
Schistura nalbanti	Nalbant's Loach	–	–	–	–	–	✓	–	–	–	✓	✓	✓	✓
Schizothorax richardsonii	Alwan Snow Trout	✓	✓	✓	✓	✓	✓	✓	✓	–	✓	✓	✓	✓
Triplophysa kashmirensis	Kashmir Hillstream Loach	–	–	✓	✓	✓	–	–	–	–	–	–	–	✓
Oncorhynchus mykiss	Rainbow trout	–	–	–	–	–	–	–	✓	–	–	–	✓	✓
	Richness	**1**	**1**	**3**	**3**	**4**	**6**	**1**	**4**	**1**	**5**	**4**	**8**	**9**

Summary

Most Abundant Species	*Schizothorax richardsonii*	**Highest Abundance Location**	JA6.7	**Highest Richness**	BAR5.2
2nd Most Abundant Species	*Schistura nalbanti*	**2nd Highest Abundance Location**	K139.0	**2nd Highest Richness**	JA6.7

Key Observations

A list of the fish species captured is given in **Exhibit 4.79**, along with information on their IUCN status, endemism[17] and migratory status. Of the species captured, Alwan Snow Trout *Schizothorax richardsonii* is listed as Vulnerable in the IUCN Red List 2017. There are two species, Nalbant's Loach *Schistura nalbanti* and Kashmir Hillstream Loach *Triplophysa kashmirensis*, which are endemic to the Jhelum Basin.

Photographs of some of the fish species observed during the surveys are given in **Exhibit 4.80**. A map showing relative abundance and richness observed during the February 2017 Survey is given in **Exhibit 4.81**. A map showing relative abundance and richness observed during the May 2017 Survey is given **Exhibit 4.82**. A map showing a comparison of relative abundance observed during the February and May 2017 Survey is given in **Exhibit 4.83**. A map showing a comparison of species richness observed during the February and May 2017 Survey **Exhibit 4.84**.

Exhibit 4.79: Fish Fauna Recorded from Study Area in Kunhar River and Tributaries, July 2016, February 2017 and May 2017 Survey

No	Scientific Name	Common Name	IUCN Status	Endemic	Migratory
1.	*Glyptosternum reticulatum*	Himalayan Catfish	Not Assessed		
2.	*Glyptothorax pectinopterus*	Flat Head Catfish	Not Assessed		
3.	*Salmo trutta fario*	Brown Trout	Not Assessed		
4.	*Schistura alepidota*	Stone Barb	Not Assessed		
5.	*Schistura arifi*	Arif's Loach	Not Assessed		
6.	*Schistura nalbanti*	Nalbant's Loach	Not Assessed	✓	
7.	*Schizothorax richardsonii*	Alwan Snow Trout	**Vulnerable**		✓
8.	*Triplophysa kashmirensis*	Kashmir Hillstream Loach	Not Assessed	✓	
9.	*Oncorhynchus mykiss*	Rainbow Trout	Not Assessed		

Exhibit 4.80: Photographs of Fish Fauna Recorded from Kunhar River and Tributaries, July 2016, February 2017 and May 2017 Survey

a) *Glyptosternum reticulatum*

b) *Schistura alepidota*

[17] Endemic species refers to species that are endemic to the Jhelum Basin.

c) *Schistura arifi*

d) *Schistura nalbanti*

e) *Oncorhynchus mykiss*

f) *Schizothorax richardsonii*

g) *Glyptothorax pectinopterus*

h) *Triplophysa kashmirensis*

Exhibit 4.81: Fish Relative Abundance and Richness, February 2017 Survey

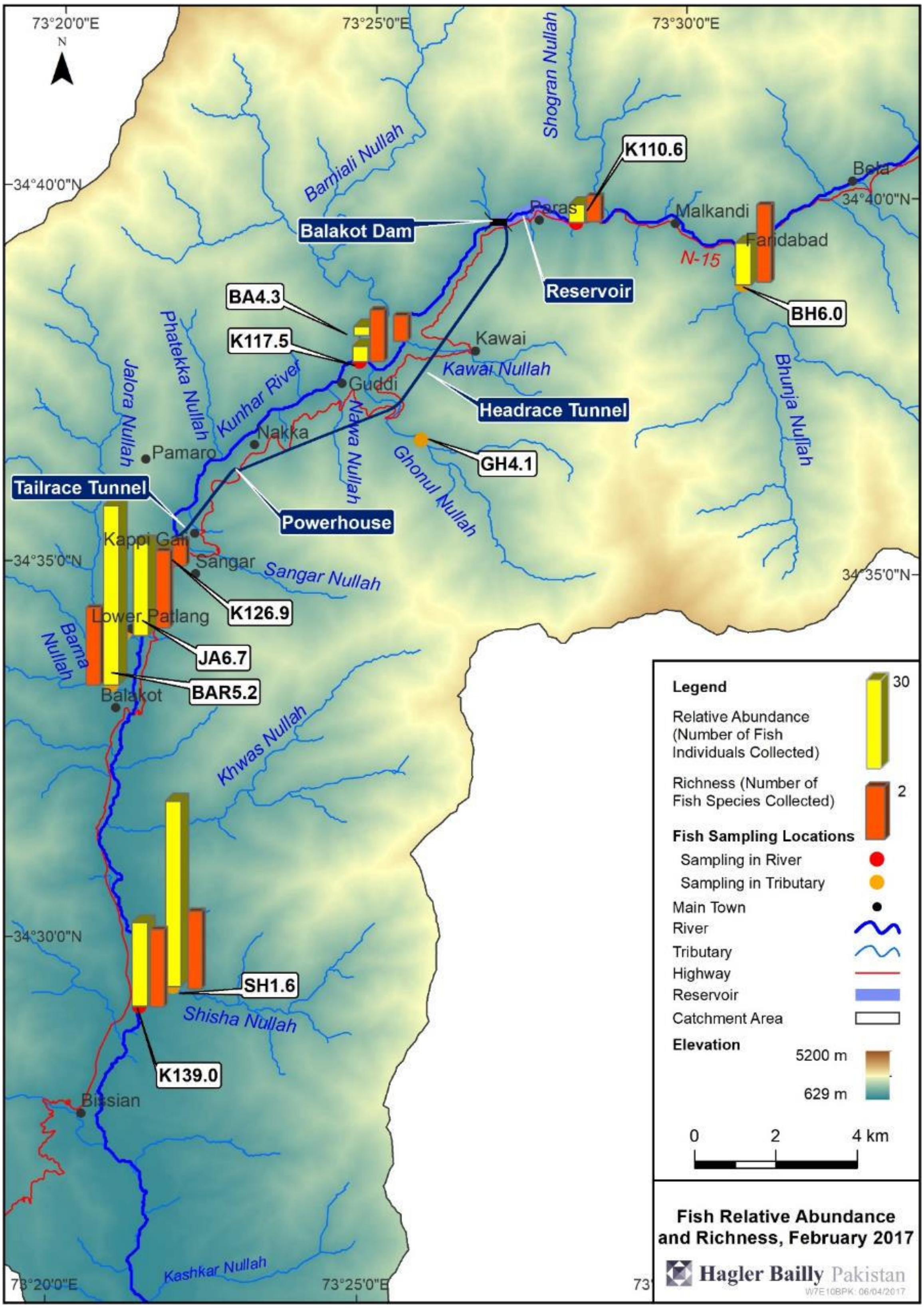


Exhibit 4.82: Fish Relative Abundance and Richness, May 2017 Survey

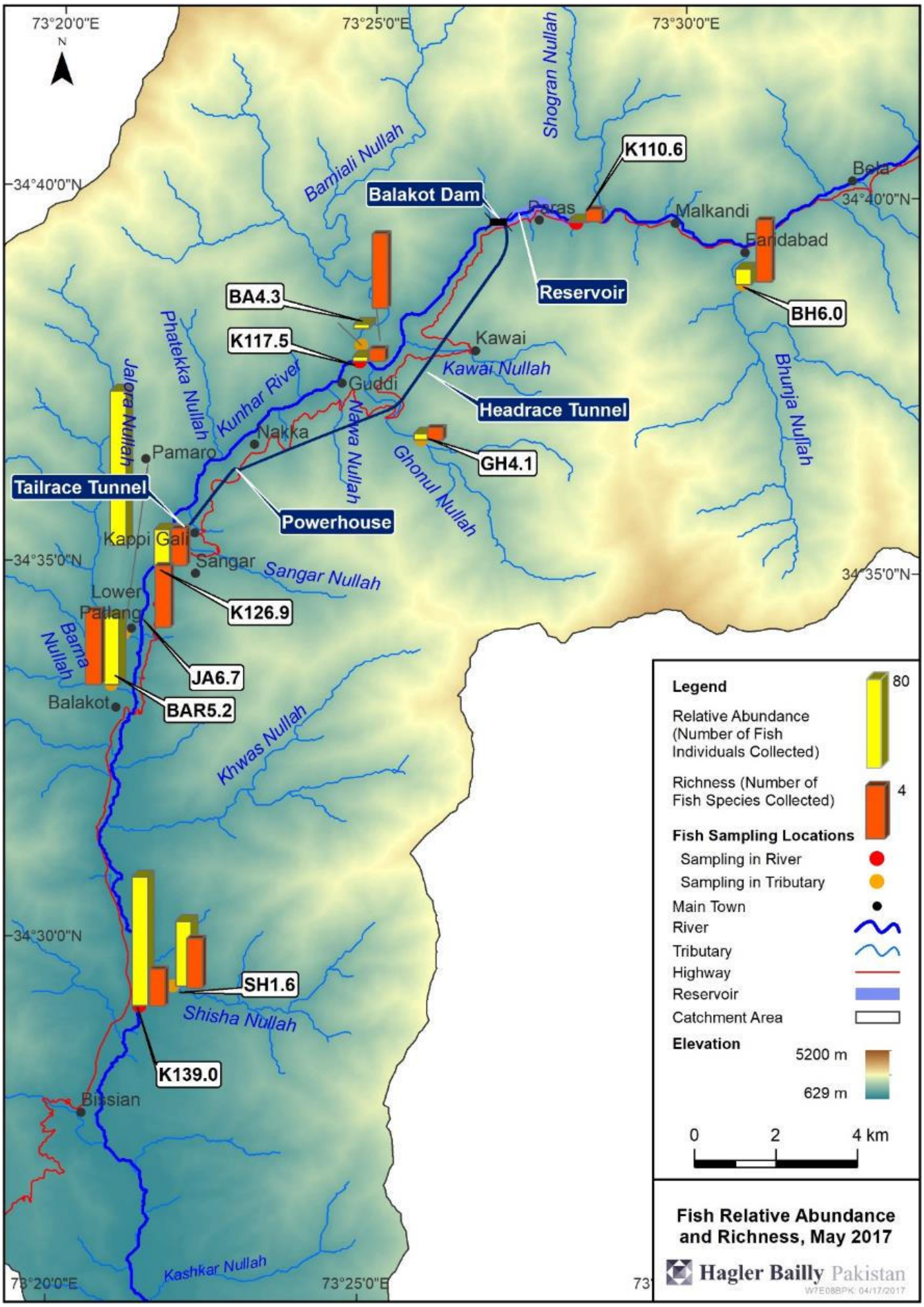


Exhibit 4.83: Comparison of Fish Relative Abundance, February and May 2017 Survey

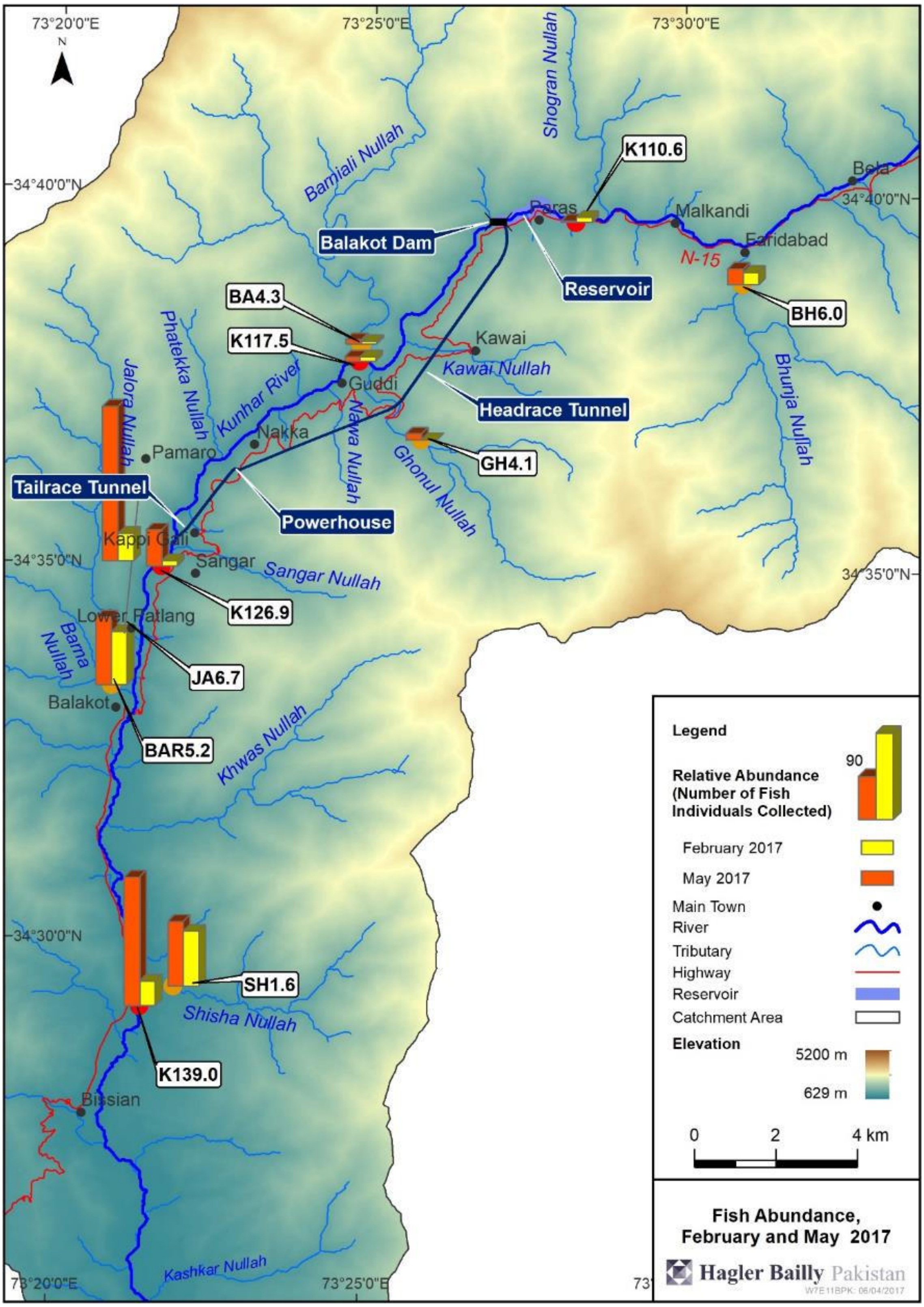
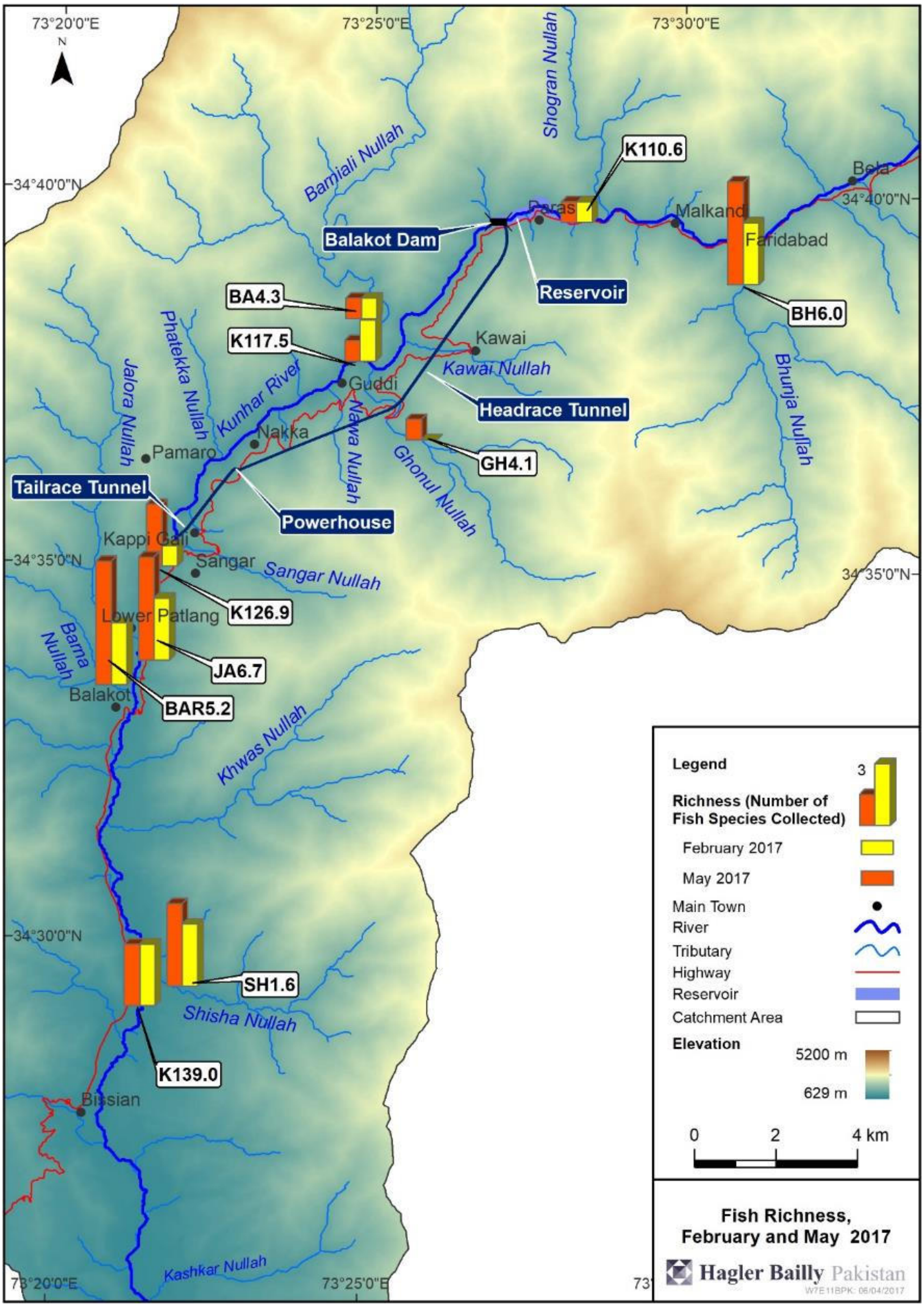


Exhibit 4.84: Comparison of Fish Species Richness, February and May 2017 Survey



Distribution of Fish of Conservation Importance

There are three species of conservation importance in the Kunhar River. These include the Alwan Snow Trout, listed as Vulnerable on the IUCN Red List and two endemic species, the Kashmir Hillstream Loach and Nalbant's Loach.

During the July 2016 Survey, the highest relative abundance of the Alwan Snow Trout was observed at Sampling Location K145.4, located downstream of Banda Balola Village at Kunhar River. The highest relative abundance for the Kashmir Hillstream Loach was observed at Sampling Location K143.9, located upstream of Banda Balola Village at Kunhar River. No specimens of Nalbant's Loach were observed during the July 2016 Survey.

During the February 2017 Survey, the highest relative abundance of the Alwan Snow Trout was observed at Sampling Location SH1.6 (Shisha Nullah near the Confluence of main Kunhar River). The highest relative abundance for the Kashmir Hillstream Loach was observed at Sampling Location K139.0, located at the main Kunhar River near the confluence of Shisha Nullah. The highest relative abundance for the Nalbant's Loach was observed at Sampling Location BAR5.2, located in Barna Nullah near the confluence of main Kunhar River. **Exhibit 4.85** shows the relative abundance of these three fish species observed during the February 2017 Survey.

During the May 2017 Survey, the highest relative abundance of the Alwan Snow Trout was observed at Sampling Location JA6.7 (Jalora Nullah near the Confluence of main Kunhar River). The highest relative abundance for the Kashmir Hillstream Loach was observed at Sampling Location K139.0, located at the main Kunhar River near the confluence of Shisha Nullah. The highest relative abundance for the Nalbant's Loach was observed at Sampling Location BAR5.2, located in Barna Nullah near the confluence of main Kunhar River. **Exhibit 4.86** shows the relative abundance of these three fish species observed during the May 2017 Survey.

Exhibit 4.85: Relative Abundance of Fish Species of Conservation Importance, February 2017 Survey

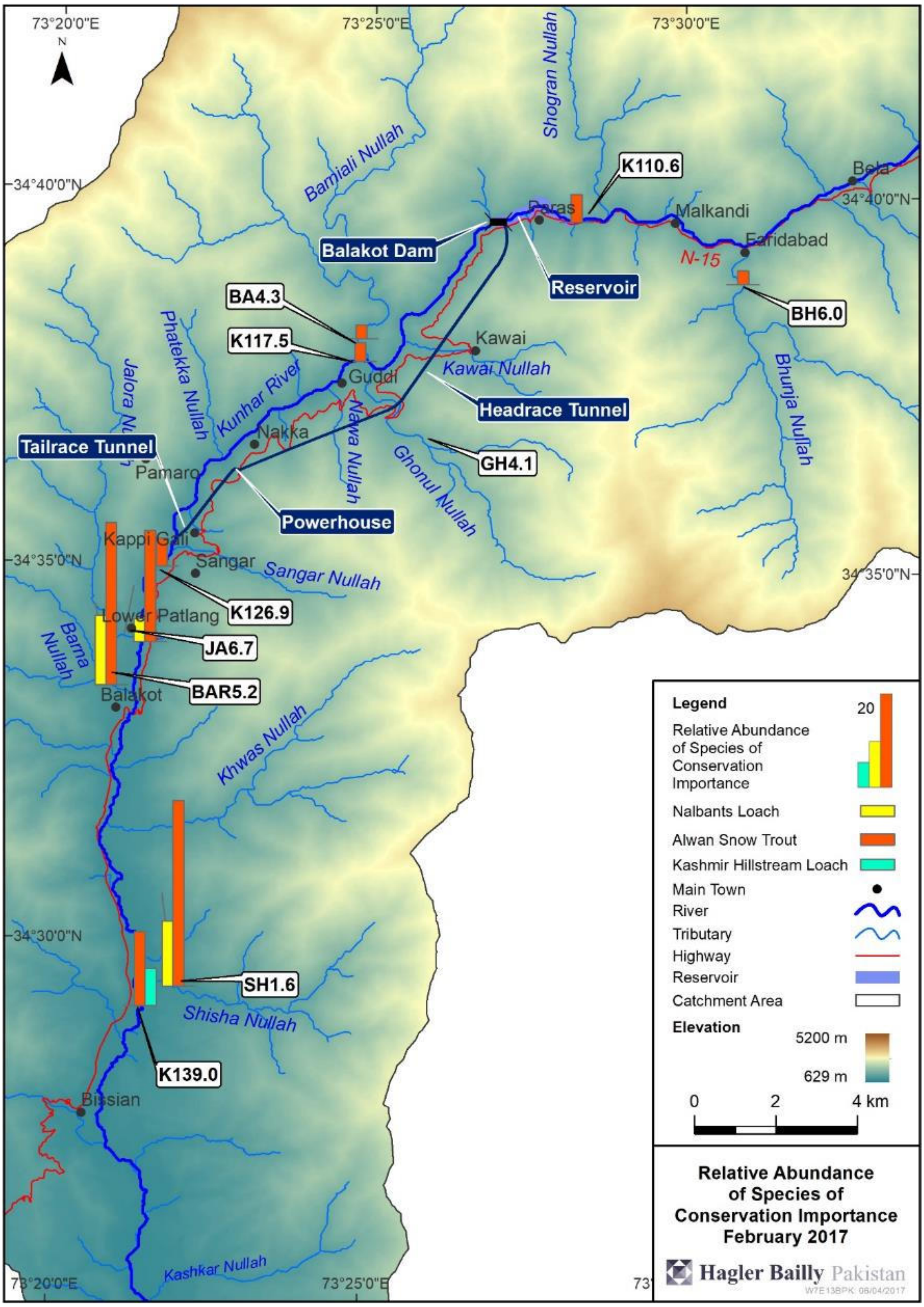
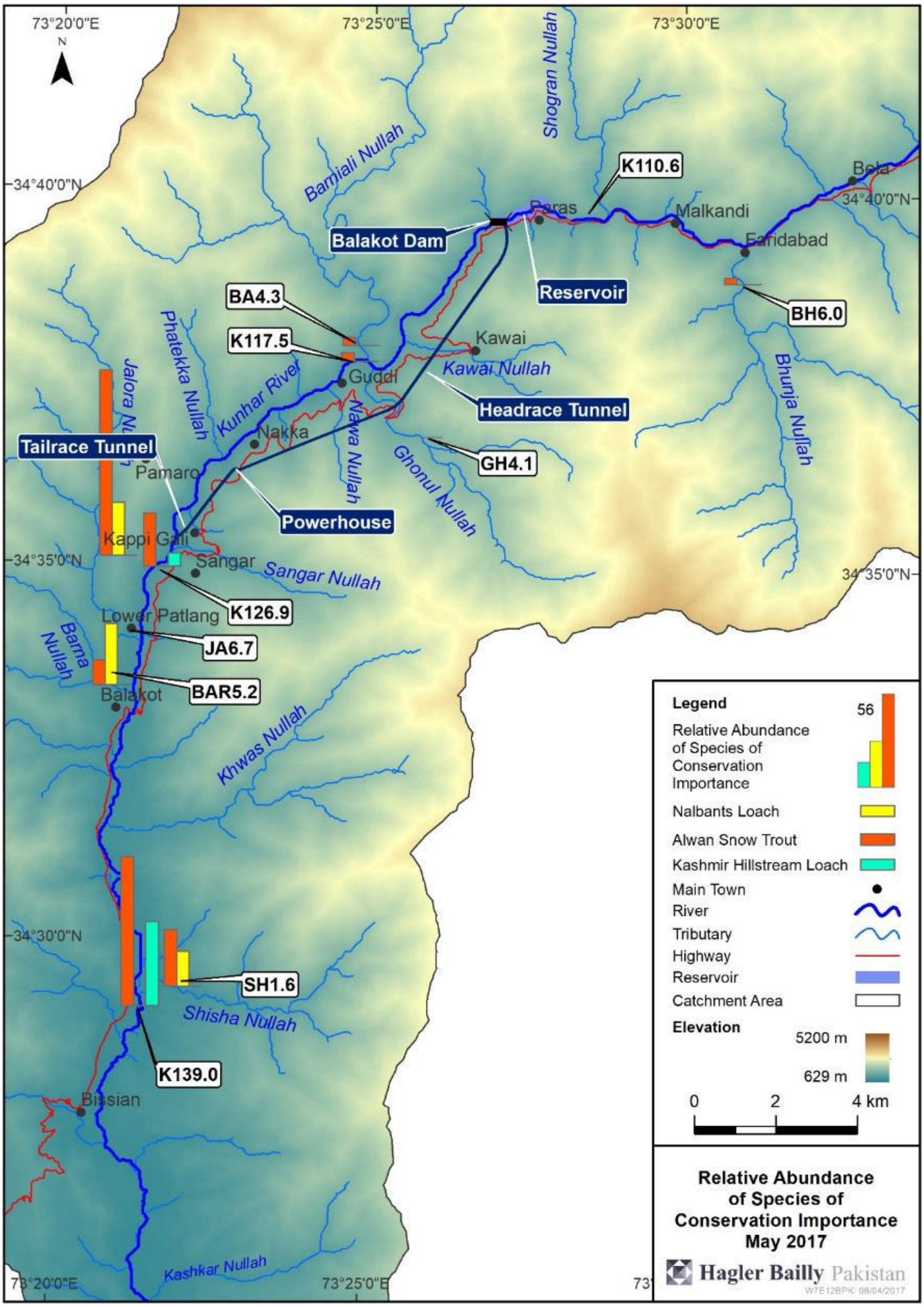


Exhibit 4.86: Relative Abundance of Fish Species of Conservation Importance May 2017 Survey



Catch per Unit Effort

Catch per unit effort is number of specimens captured with a particular sampling method applied in a given time or sampling unit at a particular location. **Exhibit 4.87** shows the catch per unit effort for various capture techniques used. The effort in case of cast nets (20 castings, fifteen each of two mesh sizes spread over a defined stretch of about 100 – 200 m), electrofishing (150 m^2 area) and gill nets (setting at evening and taking down in the morning means over-nightly adjusted) varied. To facilitate comparison, catch per unit effort at each site on the basis of combined catch from more than one capturing method is calculated and presented in **Exhibit 4.87**.

Exhibit 4.87: Catch per Unit Effort, July 2016, February 2017 and May 2017 Surveys

River/ Tributary	Sampling ID	Location	Cast Net	Gill Net			Electrofishing	Total
				50	62.5	75		
			Fish Captured/ 20 castings	Fish Captured/ Overnight netting	Fish Captured/ Overnight netting	Fish Captured/ Overnight netting	Fish Captured/ 150 sq. m	
July 2016 Survey								
Kunhar River	K138.9	Near Tranna Village at Kunhar River	13	N	N	N	N	**13**
Kunhar River	K143.9	Upstream Banda Balola Village at Kunhar River	19	N	N	N	27	**46**
Kunhar River	K145.4	Downstream Banda Balola at Kunhar River	40	N	N	N	N	**40**
Total			**72**	-	-	-	**27**	**99**
February 2017 Survey								
Kunhar River	K110.6	Upstream Paras Town	–	5	-	1	–	**6**
Kunhar River	K117.5	Kunhar River near Confluence of Barniali Nullah	–	1	3	1	–	**5**
Kunhar River	K126.9	Kunhar River near Sangar Town	3	2	1	-	–	**6**
Kunhar River	K139.0	Kunhar River near Confluence of Shisha Nullah	12	N	N	N	16	**28**
Barna Nullah	BAR5.2	Barna Nullah near Confluence of Kunhar River	–	N	N	N	60	**60**
Barniali Nullah	BA4.3	Barniali Nullah near Confluence of Kunhar River	–	N	N	N	3	**3**
Bhonja Nullah	BH6.0	Bhonja Nullah Near Bhonja Village	2	N	N	N	12	**14**
Ghanol Nullah	GH4.1	Ghanool Nullah near Ghanool Village	–	N	N	N	–	**0**
Jalora Nullah	JA6.7	Jalora Nullah	–	N	N	N	31	**31**
Shisha Nullah	SH1.6	Shisha Nullah near Confluence of Kunhar River	–	N	N	N	62	**62**
Total			**17**	**7**	**17**	**6**	**184**	**215**

River/ Tributary	Sampling ID	Location	Cast Net	Gill Net			Electrofishing	Total
				50	62.5	75		
			Fish Captured/ 20 castings	Fish Captured/ Overnight netting	Fish Captured/ Overnight netting	Fish Captured/ Overnight netting	Fish Captured/ 150 sq. m	
May 2017 Survey								
Kunhar River	K110.6	Upstream Paras Town	2	N	N	N	–	2
Kunhar River	K117.5	Kunhar River near Confluence of Barniali Nullah	5	N	N	N	–	**5**
Kunhar River	K126.9	Kunhar River near Sangar Town	41	N	N	N	–	**41**
Kunhar River	K139.0	Kunhar River near Confluence of Shisha Nullah	30	N	N	N	116	**146**
Barna Nullah	BAR5.2	Barna Nullah	–	N	N	N	77	**77**
Barniali Nullah	BA4.3	Barniali Nullah near Confluence of Kunhar River	–	N	N	N	5	**5**
Bhonja Nullah	BH6.0	Bhonja Nullah Near Bhonja Village	9	N	N	N	9	**18**
Ghanol Nullah	GH4.1	Ghanool Nullah near Ghanool Village	–	N	N	N	7	**7**
Jalora Nullah	JA6.7	Jalora Nullah	8	N	N	N	167	**175**
Shisha Nullah	SH1.6	Shisha Nullah near Confluence of Kunhar River	7	N	N	N	66	**73**
Total			**102**	N	N	N	**447**	**549**

N = Not Sampled

Fish Migration and Movement Patterns

During the low flow season (December and January), the main water channel contracts, but the flow in the river remains swift due to the steep river gradient. Thus, the oxygen concentration is high in winter and hence is not a limiting factor. However, the combination of low water temperature and the fast current make the river almost unfit for the survival of most of the fish species. This forces them to migrate and the species adopt different modes of migration to cope with the severe winters in the mountainous areas.

Three types of migration take place at the onset of winter season, longitudinal, lateral and local migration. Longitudinal migration is long distance migration, shown by fish which have strong pectoral fins and streamlined bodies such as Alwan Snow Trout *Schizothorax richardsonii* and Kunar Snow Trout *Schizothorax labiatus*. To avoid the extreme cold conditions, the Alwan Snow Trout migrate downstream in different parts of Kunhar River, side Nullahs which are comparatively warm and also take refuge in crevices and trenches in the slow moving areas of the river.

Lateral and local migration is demonstrated by fish which have no strong pectoral fins and their bodies are also not streamlined enough to cope with the flow of the river. Thus the species of the genera *Schistura* and *Triplophysa* show lateral migration as they move from the main river channel and nullah to side streams having comparatively higher temperature and slower water currents. They also occupy the crevices, boulder areas and trenches along the river bed. The species *Glyptosternum reticulatm* show local short migration and move to more suitable habitats occurring within the main river channel. These fish have adhesive apparatus in their thoracic region, which helps them to cling to the rock crevices and underneath large boulders where the water current is correspondingly lower.

During February – March, when the temperature of the Kunhar River starts to rise (7 °C – 9 °C), fish which have moved to side streams (lateral migration) return to the main river channel. The sub-mountainous fish fauna, that have a moderate temperature tolerance, now start their upstream migration which is of variable distances depending on their temperature preference.

During May and June, the variations that occur in water temperature becomes of primary importance in determining fish distribution within the Kunhar River. The water temperature rises up to 13-15°C. With the rise in temperature in June, the river upstream and downstream of Balakot is inhabited by Kashmir Hillstream Loach, which together with Alwan Snow Trout become amongst the most common species of the river during this season. This situation remains persistent during summer up to the advent of monsoon. With the onset of cold weather, the cool water fish fauna gradually start to migrate downstream to spend winter in suitable areas where they can find warm water habitats. However, some fish which are trapped in warmer side pools fed by springs and side streams/nullahs cannot migrate downstream and instead overwinter in these areas.

The fish species Brown Trout and Rainbow Trout (cold water species) which inhabit the upper reaches of river most of the year, also start downstream migration during end of November and start of December. The temperature at the upper reaches drops to 4-5°C and during this season these species can be found up to Balakot. They spend winter in these areas and then they start upstream migration during early springs when temperature is 7-8°C in the main river.

Fish Indicators and their Flow–related Needs

The following four species were selected as indicators for EFlow assessment using Downstream Response to Imposed Flow Transformations (DRIFT) model.

- Alwan Snow Trout *Schizothorax richardsonii*
- Kashmir Hill Stream Loach *Triplophysa kashmirensis*
- Nalbant's Loach *Schistura nalbanti*
- Rainbow Trout *Oncorhynchus mykiss*

All species selected as indicators demonstrate a comparatively higher degree of specialization in habitat preference in the Aquatic Study Area. In other words, the habitat range of these species was observed to terminate either moving upstream or downstream within the Aquatic Study Area. Changes in flow regime are therefore likely to have a comparatively higher level of impact on these species.

Alwan Snow Trout *Shizothorax richardsonii*

Preferences for flow dependent habitat, breeding, and migratory behavior of the *Schizothorax richardsonii* are summarized in **Exhibit 4.88. Exhibit 4.89** summarizes the annual cycle of breeding and growth of the *Schizothorax richardsonii.*

Exhibit 4.88: Preferences for Flow Dependent Habitat, Breeding, and Movement of the *Schizothorax richardsonii*

	Adults	*Juveniles*	*Spawning*
Depth	0. 5 – 1. 5 m	0. 1 – 0. 5m	0. 1 – 0. 3 m
Velocity	1 – 3 m/s	0 – 0. 5 m/s	1 – 2 m/s
Habitat	Swift running water with rocky beds	Quiet parts of the streams or in the side branches of the main streams	Spawns on gravelly / stony ground or on fine pebbles with gravel size of 50-60 mm
Substrate	Rocky/Cobbly/Gravely	Cobble/Gravel	Gravel
Temperature	14 – 20 °C	14 – 20 °C	18 – 22 °C
Dissolved O_2	6 – 8 mg/l and can survive 5-6 mg/l	6 – 8 mg/l	6 – 8 mg/l
Food	Insect larvae and eggs, Detritus	Micro-invertebrates	–
Breeding Period and Trigger	May-June in the Flood Season. Breeding is triggered by rise in temperature after the Dry Season. Spawning in side channels in shallow waters (10-30 cm) with boulders and low currents.		
Movement Pattern	Shows limited movement.		
Movement Timing	Limited movement to side channels for spawning.		

	Adults	*Juveniles*	*Spawning*
Movement Triggers	Availability of side pools with shallow waters, rise in temperature		
Other Flow-related Needs	Is sensitive to pollution. Can tolerate turbidity.		

Exhibit 4.89: Annual Cycle of Breeding and Growth of the *Schizothorax richardsonii*

Months	*Flow Conditions*	*Fish Behavior*
May – June	Flood Season	Breeding is triggered by snow melt and rise in turbidity. Fish move to breeding grounds in shallow side pools, and channels of the river with cobbles. Eggs hatch in this period, and fries and fingerlings remain in shallow waters in side channels under the cobbles.
July – October	Flood Season – Transition-2 and Dry Onset	Spent fish move to areas with boulders, cobbles in its general preferred habitat ranging from a depth of 0. 5 – 1. 0 m. Fries and fingerlings remain in the side channels. Both adult and young fish feed actively in this period to gain fat for wintering.
November – March	Dry Season	Fish move mainly to crevices under cobbles or in pools for overwintering. Food intake drops and also supplemented by fat reserves for survival.
April	Transition-1	Fish become active, takes maximum food and move to areas where it can get maximum food.

Kashmir Hillstream Loach *Triplophysa kashmirensis*

Preferences for flow dependent habitat, breeding, and migratory behavior of the *Triplophysa kashmirensis* are summarized in **Exhibit 4.90**. Annual Cycle of Breeding and Growth of the *Triplophysa kashmirensis* is shown in the **Exhibit 4.91** below.

Exhibit 4.90: Preferences for Flow–dependent Habitat, Breeding, and Movement of the *Triplophysa kashmirensis*

	Adults	*Juveniles*	*Spawning*
Depth of Water	Banks, shallow riffles (<0. 75 m)	Shallow side pools (<0. 75 m)	Shallow side channels and pools (<0. 30 m)
Velocity	Low to moderate (0 – 2 m/s)	Low to moderate (0 – 2 m/s)	Low to moderate (0 – 2 m/s)
Habitat	Pools, riffles, glides	Banks	Pools, riffles
Substrate	Rocky, stony	Cobbles	Stones, cobbles
Temperature	8 – 14 °C	10 – 12 °C	10 – 12 °C
Dissolved O_2	6–8 mg/l	6–8 mg/l	6–8 mg/l

	Adults	*Juveniles*	*Spawning*
Food	Earthworms, larvae, slime	Micro–invertebrates	–
Spawning Period	June–August		
Breeding Period and Trigger	May–August in the Flood Season. Breeding is triggered by rise in temperature after the Dry Season. Breeds both in river as well as in tributaries in suitable habitat.		
Movement Pattern	Does not show any significant movement except for breeding, when it moves to shallow side pools.		
Movement Triggers	Rise in water temperature, swollen river and expansion of habitat.		
Other Flow–related Needs	Is sensitive to pollution.		

Exhibit 4.91: Annual Cycle of Breeding and Growth of the *Triplophysa kashmirensis*

Months	*Flow Conditions*	*Fish Behavior*
June – August	Flood Season	Breeding is triggered by snow melt and rise in turbidity. Fish move to breeding grounds in shallow side pools, and channels of the river with cobbles and gravely beds. Eggs hatch in this season, and fries and fingerlings remain in shallow waters in side channels.
September – October	Transition–2 and Dry Onset	Spent fish move to banks of the mainstream. Fingerlings remain in shallow side channels. Both adult and young fish feed actively in this period.
November – March	Dry Season	Fish move mainly to crevices for overwintering. Food intake drops significantly as fish is inactive and also utilizes fat reserves for survival.
April – May	Transition–1 and Flood Season	Fish emerge and move to banks, avoiding fast flows, in search of food to get ready for the breeding season.

Nalbant's Loach *Schistura nalbanti*

Preferences for flow dependent habitat, breeding, and migratory behavior of the *Schistura nalbanti* are summarized in **Exhibit 4.92. Exhibit 4.93** summarizes annual cycle of breeding and growth of the *Schistura nalbanti.*

Exhibit 4.92: Preferences for Flow Dependent Habitat, Breeding, and Movement of the *Schistura nalbanti*

	Adults	*Juveniles*	*Spawning*
Depth of Water	Banks, shallow riffles (<0. 5 m)	Shallow side pools (<0. 5 m)	Shallow side channels and pools (<0. 30 m)
Velocity	Low to moderate (0–2 m/s)	Low to moderate (0–2 m/s)	Low to moderate (0–2 m/s)

	Adults	*Juveniles*	*Spawning*
Habitat	Pools, riffles, glides	Banks	Pools, riffles
Substrate	Rocky, stony	Cobbles	Stones, cobbles
Temperature	8 – 20 °C	10 – 20 °C	10 – 20 °C
Dissolved O2	6 – 8 mg/l	6 – 8 mg/l	6 – 8 mg/l
Food	Earthworms, larvae, slime	Micro–invertebrates	–
Spawning Period	June – August		
Breeding Period and Trigger	May – August in the Flood Season. Breeding is triggered by rise in temperature after the Dry Season. Breeds both in river as well as in tributaries in suitable habitat.		
Movement Pattern	Does not show any significant movement except for breeding, when it moves to shallow side pools.		
Movement Triggers	Rise in water temperature, swollen river and expansion of habitat.		
Other Flow–related Needs	Is sensitive to pollution.		

Exhibit 4.93: Annual Cycle of Breeding and Growth of the *Schistura nalbanti*

Months	*Flow Conditions*	*Fish Behavior*
June – August	Flood Season	Breeding is triggered by snow melt and rise in turbidity. Fish move to breeding grounds in shallow side pools, and channels of the river with cobbles and gravely beds. Eggs hatch in this season, and fries and fingerlings remain in shallow waters in side channels.
September – October	Transition–2 and Dry Onset	Spent fish move to banks of the mainstream. Fingerlings remain in shallow side channels. Both adult and young fish feed actively in this period.
November – March	Dry Season	Fish move mainly to crevices for overwintering. Food intake drops significantly as fish is inactive and also utilizes fat reserves for survival.
April – May	Transition–1 and Flood Season	Fish emerge and move to banks, avoiding fast flows, in search of food to get ready for the breeding season.

Rainbow Trout *Oncorhynchus mykiss*

Preferences for flow-dependent habitat, breeding, and migratory behaviour of the Rainbow Trout are summarized below in **Exhibit 4.94. Exhibit 4.95** summarizes the annual cycle of breeding and growth of the Rainbow Trout.

Exhibit 4.94: Preferences for Flow-dependent Habitat, Breeding, and Migratory Behavior of the Rainbow Trout *Oncorhynchus mykiss*

	Adults	*Juveniles*	*Spawning*
Depth of Water	Deep (>0.75 m)	Shallow (<0.75 m)	Shallow (0.15 - 0.75 m)
Velocity	Medium to high (>2 m/s)	Low to medium (0-2 m/s)	Low to medium (0-2 m/s)
Habitat	Riffles, pools, glides	Closer to the banks	Riffles
Substratum	Cobbles, also stony to gravely beds	Stony to gravely	Fine gravel
Temperature	6-12°C	6-12°C	<7°C
Dissolved O_2	8-10 mg/l	8-10 mg/l	10 mg/l
Food	Fish (Kashmir hill stream loach, high altitude loach), invertebrates	Invertebrates	–
Breeding Period and Trigger	Breeds in October through December in the Dry Season in continuous moderate flows. Breeding is triggered by drop in temperature below 6-7˚C, typically in October.		
Movement Pattern	Migrates to tributaries and travels to suitable breeding grounds in the river to avoid competition and to find shallow clear waters suitable for breeding. Migrates back to the main river for wintering.		
Movement Timings	October-November for breeding, November for wintering.		
Movement Triggers	Change in flow pattern, reduction in turbidity, fall or rise in water temperature.		
Other Flow-related Needs	Is sensitive to pollution and therefore to poorly diluted effluents.		

Exhibit 4.95: Annual Cycle of Breeding and Growth of the Rainbow Trout *Oncorhynchus mykiss*

Months	*Flow Conditions*	*Fish Behaviour*
October-December	Dry Season	Breeding is triggered by a drop in temperature below 7-8 °C. The fish move to breeding sites in the main river and the tributaries to lay eggs in beds of fine gravel (redds[18]) in riffle flow.
January-February	Dry Season	Fries emerge after about 70 days and stay in the nursery grounds, mainly in side streams and shallow water, where food is available and the current speed is low. Adult fish migrate back from tributaries into deeper water in the mainstream for survival in the Dry Season.

18 A spawning nest made by a fish, especially a salmon or trout.

Months	Flow Conditions	Fish Behaviour
March-April	Dry Season-Transition Season 1	Fingerlings/juveniles stay in shallow waters near the banks and avoid fast flowing water.
May-July	Flood Season, Snow Melt	Fish avoid turbid waters, and move to clear waters in side streams as well as tributaries.
August-September	Flood Season-Transition Season 2	Fish have relatively uniform distribution in the river and tributaries and concentrate on feeding areas

Threats to Fish Fauna

During the three surveys carried out in 2016 and 2017, a number of observations were made which were identified as threats to the fish fauna in the Aquatic Study Area. These threats were noted and have been stated for four indicators fish species (**Exhibit 4.96**) along with the locations at which they were observed. Data on river-dependent activities, including sand mining and fishing, within the Aquatic Study Area, was collected as part of the socioeconomic baseline for this study. The results of this are provided in **Section 4.3.4**, *River-Dependent Socioeconomic Activities*.

Exhibit 4.96: Threats to Fish Species

No.	Fish Species most Threatened	Locations	Threat
1.	Nalbant's Loach	Tributaries of Kunhar River Lower reaches of main Kunhar River	Sand Mining City Runoff
2.	Kashmir Hillstream Loach	Kunhar River Tributaries of Kunhar River	Sand Mining City Run-off
3.	Alwan Snow Trout	Kunhar River Tributaries of Kunhar River	Sand Mining Fishing City Run-off
4.	Himalayan Catfish	Kunhar River Tributaries of Kunhar River	Sand Mining Fishing City Run-off

Macro-Invertebrates

Benthic macro-invertebrates are an important part of the food chain in aquatic ecosystems, especially for fish. Many invertebrates feed on algae and bacteria, which are at the lower end of the food chain. Some shred and eat leaves and other organic matter that enters or is produced in the water. Because of their abundance and position as 'intermediaries' in the aquatic food chain, benthos plays a critical role in the natural flow of energy and nutrients.[19]

Stream regulation by damming of rivers and ensuing impoundment are one of the most frequent causes of depletion of biological diversity of aquatic ecosystems resulting in

[19] Williams D. D. and Feltmate, B. W. 1992. Aquatic Insects. CAB International Wallingford, Oxon. 360 pp.

interference with the natural process of dispersal.[20,21] Some authors have described several beneficial aspects of water regulation and impoundment, but the loss of aquatic habitat and the associated species and populations cannot be underestimated. Any variation in community structure of primary producers is reflected in subsequent changes in higher components of food chain e.g., benthic macro-invertebrates and fish fauna.[22]

The composition of invertebrate communities varies along and between rivers, with the main influences on distribution and abundance being current velocity, water temperature, substratum type, stability of both aquatic and riparian vegetation, dissolved substances, competition, and human practices. Large, stable substrata–such as boulders and cobbles–support larger, more productive invertebrate populations than do unstable gravels and sand. On mobile bottoms, such as gravel and sand, invertebrates are readily displaced and may be at risk through mechanical damage. A decrease in substratum size results in lower macro-invertebrate diversities and production.

Aubert, 1959[23] reported twenty species of stoneflies (extremely pollution intolerant organisms) belonging to seven genera from Pakistan (Hindukush including Gilgit-Baltistan and Chitral; Karakorum including Neelum valley, Kaghan valley; Rawalpindi including Murree). He reported six species of stoneflies species from Neelum Jhelum area which include *Nemoura* (*Amphinemura*) *mirabilis* (Muzaffarabad after the confluence of the Neelum and Jhelum Rivers), *Nemoura* (*Amphinemura*) *schmidi* (Kel, Neelum Valley), *Nemoura* (*Amphinemura*) *skardui* (Rampur Neelum Valley), *Nemoura* s. s. *lilami* (Kel, Neelum Valley), *Nemoura* s. s. *polystigma* (Lilam, Neelum Valley) and *Cholroperla kishanganga* (Kel, Neelum Valley).

Unpublished data collected[24] indicates that the benthic macro-invertebrate families observed in the study for the ecological baseline of NJHP also occur at the outlet zones of the lakes in the Kaghan Valley (Dudipatsar Lake, Gittidas wetland complex, and Lulusar Lake) and outlets of the lakes in the Neelum Valley (Patlian Lake and Rattigali Lake).

Based on a conversation with Mishkatullah, a macro-invertebrate specialist with the Pakistan Museum of Natural History, there is no peer reviewed information on benthic invertebrates of the Kunhar River. Unpublished research by Mishkahullah indicates that most of the benthic macro-invertebrate fauna of Kunhar river is similar to that of the outlet zone of the lakes of Kunhar watershed e.g., Dudipatsar Lake, Gettidas wetland complex, Lulusar Lake, Saif-ul-Maluk Lake.

During the May 2017 Survey a total of three locations were sampled to determine the abundance and diversity of macro-invertebrate fauna in the Aquatic Study Area. These Sampling Locations are located along the main Kunhar River. They are shown in **Exhibit 4.66**. The abundance and species diversity is shown in **Exhibit 4.97.** A map of the distribution of the abundance and species diversity is shown in **Exhibit 4.98**.

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20 Richter, B.D., Braun, D.P., Mendelson, M.A., Master, L. L. 1997. Threats to imperiled freshwater fauna. Conservation Biology. 11, 1081-1093.

21 Zalewski, M., Janauer, G. A., Jolankai, G., 1997. Ecohydrology. IHP-V, UNESCO. 7, 7-18.

22 Ibid

23 Aubert, J. 1959: Plécoptères du Pakistan. Memoires de la Societe vaudoise des Sciences naturelles, 75, Vol. 12, fasc. 3:65-91.

24 Personal communication with Mishkatullah, Macro-invertebrate specialist in Pakistan Museum of Natural History

Exhibit 4.97: Macro-invertebrate Abundance and Richness, April 2016 Survey

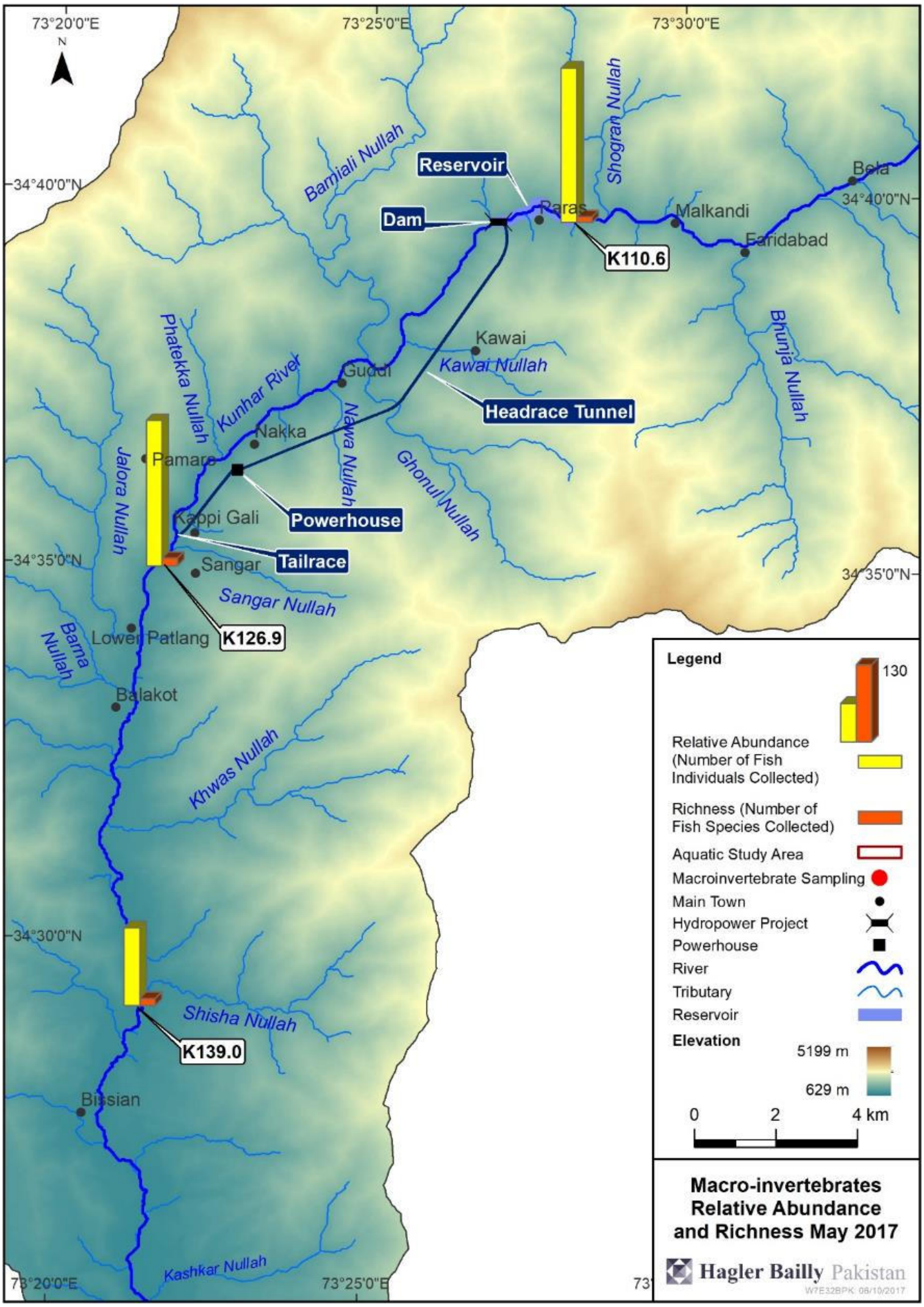
No	Taxa	K139.0 (Downstream of Balakot Town)	K126.9 (Upstream of Balakot Town)	K110.6 (Upstream of Paras)	Total
1	*Acentrella sp.*	5	3	10	18
2	*Amphinemoura sp.*	1			1
3	*Atherix sp.*	1	1		2
4	*Baetis sp.*	45	82	110	237
5	*Belpharicera sp.*		1	3	4
6	*Chironomidae sp.*	10	24	26	60
7	*Elmidae sp.*	1	2	2	5
8	*Epeorus sp.*			1	1
9	*Heptagenia sp.*	1	1		2
10	*Hydropsyche sp.*	2		3	5
11	*Indonemoura sp.*	1	6	35	42
12	*Lepidostomatidae sp.*	1	1		2
13	*Tipulidae sp.*		8		8
14	*Rhithrogena sp.*	52	105	65	222
15	*Rhyacophila sp.*		2		2
16	*Simuliidae sp.*	12	10	6	28
Abundance		132	246	261	**639**
Species Richness (No. of species per sampling location)		12	13	10	

Principal observations are summarized below.

1. A total of 16 macro-invertebrate taxa were identified during the May 2017 Survey. Identification was at the sub-family/family level.
2. Abundance was found to be higher at Sampling Locations upstream of Balakot Town.
3. Maximum macro-invertebrate abundance was found at Sampling Location K110.6, located upstream of Paras. Second highest abundance was observed at Sampling Location K126.9 located near Sangar, upstream of Balakot Town. Lowest abundance was observed at Sampling Location K139.0, located downstream of Balakot Town. The most abundant macro-invertebrate taxon was *Baetis sp* followed by and *Rhithrogena sp*, both of which were much higher in abundance compared to the third most abundant taxon, *Chironomidae*. This is a common observation around the world as these taxa can live in variety of habitat including running and standing water. Ten pollution intolerant taxa (*Rhithrogena sp., Epeorus sp., Acentrella sp., Rhyacophila sp., Lepidostomatidae, Belpharicera sp., Atherix sp., Elmidae, Amphinemoura sp. and Indonemoura sp.*) were observed indicating good water quality. Three of the taxa observed are moderately pollution tolerant including *Hydropsyche sp*., *Simuliidae* and *Tipulidae*.
4. Species richness was observed to be about the same across all Sampling Locations.
5. Maximum richness was seen at Sampling Location K126.9 located near Sangar. Based on a conversation with a macro-invertebrate expert[25] the abundance of the taxa more pollution tolerant taxa, such as *Chironomidae*, is low because of the absence of industry discharging into this stretch as well as the fast flow of the river during the summer season. The macro-invertebrate expert also noted that during summer the habitat is more suitable for macro-invertebrates compared to in winter. During winter the flow of water is lower and more waste accumulates. This leads to less-pollution tolerant taxa being adversely affected.

[25] Personal communication with Mishkatullah, Macro-invertebrate specialist in Pakistan Museum of Natural History

Exhibit 4.98: Distribution of Macro-invertebrate Abundance and Richness, May 2017 Survey



Riparian Habitat

The range of vegetation cover in the Riparian habitat type was observed to be between 1.48% and 0.52%. The average plant count was 27.50 per Sampling Location. Floral diversity in this habitat type was 3.25 species per Sampling Location. The dominant species include *Parthenium hysterophorus*. *Conyza Canadensis* and *Rumex dissectus*. Exceptionally high floods can cause extreme variations, with floodplain and bank vegetation completely removed, floodplains eradicated and new floodplains formed.

The vegetation cover, plant count and diversity by habitat type is provided in **Exhibit 4.99**. The phyto-sociological attributes are provided in **Exhibit 4.100**. Photographs of riparian vegetation are shown in **Exhibit 4.101.**

Average and maximum cover for riparian habitat type is relatively low compared to that for terrestrial habitat types. The riparian zone is generally well defined in the Study Area as the gradients along the river banks are steep, and impact of flood flow on the vegetation can be seen as a clearly defined line (see photograph at R1 in **Exhibit 4.101**). The riparian vegetation is naturally sparse as it is eroded by floods when the velocity of water is high. It is further degraded by extraction of wood and grazing along the banks that are easily accessible to the local community.

Exhibit 4.99: Vegetation Cover, Plant Count and Diversity in Riparian Habitat Type, May 2017 Survey

Habitat Types	*Plant Cover (%)*			*Plant Count (No. of Plants per Sampling Location)*			*Diversity (Average no of species per Sampling Location)*
	Avg	*Max*	*Min*	*Avg*	*Max*	*Min*	
Riparian	0.91%	1.48%	0.52%	27.50	58	14	3.25

Exhibit 4.100: Phyto-sociological Attributes of Plant Species in Habitats, May 2017 Survey

Species Name	*D1, Density*	*D3, Relative Density*	*C1, Average Cover*	*C3, Relative Cover*	*F1, Frequency*	*F3, Relative Frequency*	*IVI, Importance Value Index*
Riparian							
Conyza canadensis	1.92	20.91	0.01	10.99	0.50	15.00	15.63
Dalbergia sissoo	0.75	8.18	0.06	21.01	0.33	10.00	13.07
Dodonaea viscosa	0.08	0.91	0.05	1.80	0.08	2.50	1.74
Ficus carica	0.33	3.64	0.03	4.97	0.25	7.50	5.37
Mentha longifolia	0.33	3.64	0.01	1.69	0.08	2.50	2.61
Parthenium hysterophorus	1.58	17.27	0.02	17.10	0.75	22.50	18.96

Species Name	D1, Density	D3, Relative Density	C1, Average Cover	C3, Relative Cover	F1, Frequency	F3, Relative Frequency	IVI, Importance Value Index
Phragmites karka	0.67	7.27	0.02	5.07	0.08	2.50	4.95
Ricinus communis	0.08	0.91	0.02	0.83	0.08	2.50	1.41
Rumex dissectus	1.17	12.73	0.03	14.22	0.58	17.50	14.81
Solanum surrattense	0.08	0.91	0.02	0.91	0.08	2.50	1.44
Sonchus asper	0.33	3.64	0.02	2.48	0.25	7.50	4.54
Traxicum sp.	0.17	1.82	0.01	0.96	0.17	5.00	2.59
Typha elephantina	1.67	18.18	0.02	17.99	0.08	2.50	12.89
Total	**9**	**100**	**0.34**	**100**	**3.33**	**100**	**100**

D1: Density
The number of individuals of a species counted on a unit area.

D3: Relative density
The proportion of a density of a species to that of a stand as a whole.

C1: Average cover in sq m for a single species

C3: Relative cover
The proportion of the total cover of a species to sum of the cover of all the species in area.

F1: Frequency
Percentage of sampling plots in which a given species occurs.

F3: Relative frequency
The proportion of the total frequency of a species to the sum of the frequency of all the plants of all species in the area.

IVI: Importance value index
It can be obtained by adding the values of relative density, relative cover and relative frequency and dividing it by three will give the importance value IVI of the species

Exhibit 4.101: Riparian Habitat

Riparian Habitat at R1 (K110.6, upstream of Paras)

Riparian Habitat at R2 (R2 K117.5 near Gudd Villagei)

Riparian Habitat at R3 (R3 K126.9 near Sangar Village)

Riparian Habitat at R4 (R4 K139.0 downstream of Balakot town)

4.2.7 Terrestrial Ecology

Sampling was carried out within the Terrestrial Study Area to determine the presence of species and habitat of importance to biodiversity within it. A literature review was also carried out to determine the biodiversity of the wider area. The results of both the surveys and the literature review are reported in this section.

Terrestrial Flora

Overview

This area is mountainous and comprises the outer ranges of the Himalayas. The elevation within the region ranges from 600 m to 4,800 m. The Terrestrial Study Area has an elevation range of 1,000 m to 1,500 m.[26]

There is limited research available on the flora of Balakot. However, within Mansehra District, research has been carried out on the floristic diversity as well as ethnobotany.

Mansehra District is reported to have forest cover of 25%. It consists mainly of Himalayan Moist Temperate Forest, typical of the Lower Kaghan Valley and Shogran. It is a mix of deciduous and coniferous forest and has high rainfall during monsoon season. Plants species include Quercus *Quercus dilatata*, Acer *Acer caesium*, Poplar *Populus ciliate*, Taxus *Taxus baccata*, Kail *Pinus wallichiana* with under shrubs such as Berberis *Berberis lyceum*, Honeysuckle *Lonicera alpigena*, Viburnum *Viburnum nervosum*, Nazar Panra *Skimmia laureola*, as well as Fragaria, Viola and Impatiens species.[27]

The Himalayan forest grazing lands located within an elevation of 1,000 m to 2,000 m have a forage productivity of 200-2,000 kg/ha.[28]

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26 Nasir, Yasin J., and Rubina A. Rafiq. "Wild flowers of Pakistan." Karachi: Oxford University Press xxxiii, 298p., 104p. of plates-illus., col. illus. ISBN195775848 (1995).

27 United Nations Development Programme, Pakistan (UNDP), Forests & Biodiversity Information/Data Report, [not dated].

28 Hamid Sarfraz, Ashiq Ahmad Khan, Dr. Nasim Javed, Dr. Shahid Ahmad, Dr. Inam ur Rahim & Dr. M. Rafiq, Khyber Pakhtunkhwa Biodiversity Strategy & Action Plan, Final Draft, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Registered offices, Islamabad, June 26, 2016

A study to investigate the floristic diversity in Dilbori, located 30 km northwest of Balakot Town within the Mansehra District, was carried out in 2016.[29] The study reported a total of 104 species of plants belonging to 88 genera and 54 families. Of these 97 (93%) plant species belonged to angiosperms, 3 (3%) species to gymnosperms, 3 (3%) fungal species and 1 (1%) was a Pteridophytic species. None of the species are Endangered or Critically Endangered based on the IUCN Red List. One species, *Plantago lanceolata*, is listed as Vulnerable and two species, *Juglans regia* and *Lathyrus odoratus*, are listed as Near Threatened.

Habitat Types in the Terrestrial Study Area

Habitat classification approaches are subjective in nature, devised to assist in the understanding of ecological systems, the functions of those systems, and the interrelationship with species. Classically, wildlife habitat is described as containing three basic components: cover, food, and water (Morrison et al 2006)[30] with vegetation as the core descriptive component.

Habitats in the Terrestrial Study Area were classified relying primarily upon vegetation type. Following this classification approach, three types of habitats were defined: Scrub Forest, Pine Forest and Agricultural Land. Satellite imagery from ***Google Earth™*** was used to initially delineate spatial distribution of habitat types within the Terrestrial Study Area and this habitat characterization was confirmed during the field surveys. The use of the term Scrub Forest for a habitat type is appropriate because Scrubland is defined as a "diverse assortment of vegetation types sharing the common physical characteristics of dominance by shrub."[31] Most of the Terrestrial Study Area classified as Scrub Forest habitat type is covered by shrubs, with some herbaceous species and even fewer tree species. The relative percentages of each habitat type in the Terrestrial Study Area is provided in **Exhibit 4.102**. Photographs of different habitat types in the Terrestrial Study Area are shown in **Exhibit 4.103.**

Exhibit 4.102: Habitat Types for the Terrestrial Sampling Locations

Habitat Type	*Area (km²)*	*Percentage*
Agricultural Area	5.4	20
Scrub Forest	12.7	48
Pine Forest	6.7	26
River	1.4	6
Total	**26.2**	**100**

29 Junaid Ahmed, Inayat Ur Rahman1, Abbas Hussain Shah1, Farhana Ijaz, Zulfiqar Khan1, Niaz Ali, Said Muhammad, Zeeshan Ahmed and Muhammad Afzal, First Floristic Checklist of Dilbori (Oghi), District Mansehra, KP, Pakistan, J. Appl. Environ. Biol. Sci., 7(3)41-48, 2017

30 Morrison, M.L, Marcot, B., Mannan, W. 2006. *Wildlife–Habitat Relationships: Concepts and Applications*. Island Press, Washington, D.C.

31 Encyclopaedia Britannica, < https://www.britannica.com>, accessed October 27, 2016

The area acquired for the Project is calculated as 75 ha. Based on ***Google Earth***^{TM} satellite imagery, within this acquired area, the different types of habitat present include 18 ha of Agricultural Area habitat, 48 ha of Scrub Forest habitat and 9 ha of Pine Forest habitat.

Exhibit 4.103: Photographs of different habitat types in the Terrestrial Study Area, May 2017 Survey

Agricultural Area

Scrub Forest

Pine Forest

A total of 42 species of plants were observed in the Terrestrial Study Area. None of the species observed in the area around the Project site were found to be globally/nationally threatened species, endemic species or protected species, with the exception of Common Walnut *Juglans regia*, which is Near Threatened based on the IUCN Red List.[32]

The vegetation cover, plant count and diversity by habitat type is provided in **Exhibit 4.104**. The phyto-sociological attributes for the species in the two habitat types for the May 2017 Survey is provided in **Exhibit 4.105**.

[32] The IUCN Red List of Threatened Species. Version 2014.3. <http://www.iucnredlist.org>. Downloaded on 25 May 2017.

Exhibit 4.104: Vegetation Cover, Plant Count and Diversity by Habitat type, May 2017 Survey

No.	Habitat Types	Plant Cover (%)			Plant Count			Diversity (Average no of species per Sampling Location)
		Average	Maximum	Minimum	Average	Maximum	Minimum	
1.	Agricultural Area	5.3	6.6	4.0	42.50	61	24	7.50
2.	Scrub Forest	6.4	10.8	4.2	49.50	81	27	4.60
3.	Pine Forest	13.9	18.8	6.8	23.00	34	16	5.33

Exhibit 4.105: Phyto-sociological Attributes of Plant Species in Habitats, May 2017 Survey

Species Name	D1, Density	D3, Relative Density	C1, Average Cover	C3, Relative Cover	F1, Frequency	F3, Relative Frequency	IVI, Importance Value Index
Agricultural Area							
Ailanthus altissima	0.33	1.18	0.76	9.60	0.33	4.17	4.98
Berberis sp.	4.33	15.29	0.10	16.19	1.33	16.67	16.05
Cannabis sativa	1.33	4.71	0.01	0.75	0.33	4.17	3.21
Carissa opaca	1.00	3.53	0.00	0.01	0.33	4.17	2.57
Conyza canadensis	0.67	2.35	0.02	0.54	0.33	4.17	2.35
Ficus carica	0.33	1.18	0.49	6.19	0.33	4.17	3.85
Fragaria vesca	5.00	17.65	0.01	2.64	0.33	4.17	8.15
Indigofera sp.	2.00	7.06	0.08	6.25	0.67	8.33	7.21
Juglans regia	0.67	2.35	1.73	43.39	0.67	8.33	18.02
Launaea procumbens	1.33	4.71	0.02	0.89	0.67	8.33	4.64
Malvastrum coromandelianum	3.33	11.76	0.00	0.54	0.33	4.17	5.49
Oxalis corniculata	4.00	14.12	0.01	0.79	0.33	4.17	6.36
Punica granatum	1.00	3.53	0.22	8.12	0.67	8.33	6.66
Rumex dantatus	1.67	5.88	0.04	2.44	1.00	12.50	6.94
Rumex dissectus	1.33	4.71	0.03	1.67	0.33	4.17	3.51
Total	**28**	**100**	**3.53**	**100**	**8.00**	**100**	**100**

Species Name	D1, Density	D3, Relative Density	C1, Average Cover	C3, Relative Cover	F1, Frequency	F3, Relative Frequency	IVI, Importance Value Index
Scrub Forest							
Acacia modesta	0.47	2.36	0.37	9.04	0.27	4.82	5.41
Ailanthus altissima	0.87	4.38	0.20	9.00	0.40	7.23	6.87
Asparagus sp.	0.13	0.67	0.04	0.27	0.13	2.41	1.12
Berberis sp.	1.00	5.05	0.12	6.30	0.47	8.43	6.60
Cannabis sativa	3.60	18.18	0.01	1.41	0.33	6.02	8.54
Capsella bursa-pastoris	0.20	1.01	0.02	0.22	0.13	2.41	1.21
Conyza canadensis	1.07	5.39	0.01	0.52	0.27	4.82	3.58
Convolulus arvensis	0.53	2.69	0.01	0.31	0.07	1.20	1.40
Cotinus coggyria	0.20	1.01	0.06	0.58	0.07	1.20	0.93
Daphne mucronata	0.07	0.34	0.07	0.24	0.07	1.20	0.59
Dodonaea viscosa	0.07	0.34	0.09	0.33	0.07	1.20	0.62
Ficus carica	0.40	2.02	0.89	18.55	0.20	3.61	8.06
Fragaria vesca	1.00	5.05	0.01	0.37	0.13	2.41	2.61
Indigofera sp.	0.73	3.70	0.10	3.80	0.33	6.02	4.51
Juglans regia	0.07	0.34	3.55	12.29	0.07	1.20	4.61
Justicia adhatoda	0.33	1.68	0.08	1.46	0.07	1.20	1.45
Launaea procumbens	0.07	0.34	0.01	0.03	0.07	1.20	0.52
Malva parviflora	0.27	1.35	0.01	0.08	0.13	2.41	1.28
Melia azedarach	0.13	0.67	0.48	3.32	0.13	2.41	2.13
Mentha piperita	1.33	6.73	0.01	0.36	0.07	1.20	2.77
Morus nigra	0.20	1.01	0.28	2.92	0.13	2.41	2.11
Oxalis corniculata	2.67	13.47	0.00	0.30	0.20	3.61	5.79
Olea ferruginea	0.07	0.34	0.54	1.88	0.07	1.20	1.14
Pinus roxburghii	0.20	1.01	0.38	3.89	0.13	2.41	2.44
Populus ciliata	0.33	1.68	0.54	9.37	0.13	2.41	4.49
Robinia pseudoacacia	0.53	2.69	0.11	2.98	0.40	7.23	4.30
Rumex dantatus	0.13	0.67	0.02	0.16	0.13	2.41	1.08
Rumex dissectus	2.13	10.77	0.08	9.01	0.53	9.64	9.81
Lamium album	0.53	2.69	0.01	0.30	0.07	1.20	1.40
Solanum nigrum	0.07	0.34	0.04	0.15	0.07	1.20	0.56
Sonchus asper	0.07	0.34	0.03	0.12	0.07	1.20	0.55
Traxicum sp.	0.33	1.68	0.02	0.41	0.13	2.41	1.50

Species Name	D1, Density	D3, Relative Density	C1, Average Cover	C3, Relative Cover	F1, Frequency	F3, Relative Frequency	IVI, Importance Value Index
Total	**20**	**100**	**8.21**	**100**	**5.53**	**100**	**100**
Pine Forest							
Acer caesium	0.13	1.74	0.02	0.06	0.07	1.89	1.23
Ailanthus altissima	0.40	5.22	0.05	0.54	0.13	3.77	3.18
Berberis sp.	0.40	5.22	0.11	1.25	0.13	3.77	3.42
Capsella bursa-pastoris	0.07	0.87	0.03	0.06	0.07	1.89	0.94
Cedrus deodara	0.27	3.48	2.06	15.77	0.20	5.66	8.30
Conyza canadensis	0.20	2.61	0.02	0.09	0.07	1.89	1.53
Cotinus coggyria	0.07	0.87	0.21	0.40	0.07	1.89	1.05
Ficus carica	0.53	6.96	0.27	4.16	0.33	9.43	6.85
Fragaria vesca	0.33	4.35	0.02	0.15	0.07	1.89	2.13
Indigofera sp.	0.20	2.61	0.06	0.34	0.20	5.66	2.87
Launaea procumbens	0.27	3.48	0.01	0.11	0.07	1.89	1.82
Mallotus philippensis	0.07	0.87	0.43	0.83	0.07	1.89	1.20
Melia azedarach	0.13	1.74	0.89	3.42	0.13	3.77	2.98
Picea smithiana	0.07	0.87	0.64	1.23	0.07	1.89	1.33
Pinus roxburghii	0.93	12.17	1.45	38.78	0.53	15.09	22.02
Pinus wallichiana	0.47	6.09	1.83	24.44	0.27	7.55	12.69
Punica granatum	0.13	1.74	0.30	1.14	0.13	3.77	2.22
Robinia pseudoacacia	0.47	6.09	0.29	3.82	0.27	7.55	5.82
Rumex dissectus	0.93	12.17	0.08	2.01	0.27	7.55	7.24
Silybum marianum	0.20	2.61	0.02	0.13	0.07	1.89	1.54
Solanum nigrum	0.07	0.87	0.24	0.45	0.07	1.89	1.07
Sonchus asper	0.33	4.35	0.03	0.26	0.20	5.66	3.42
Urtica dioica	1.00	13.04	0.02	0.54	0.07	1.89	5.16
Total	**8**	**100**	**9.06**	**100**	**3.53**	**100**	**100**

D1: **Density**
The number of individuals of a species counted on a unit area.

D3: **Relative density**
The proportion of a density of a species to that of a stand as a whole.

C1: **Average cover** in sq m for a single species

C3: **Relative cover**
The proportion of the total cover of a species to sum of the cover of all the species in area.

F1: **Frequency**
Percentage of sampling plots in which a given species occurs.

F3: **Relative frequency**
The proportion of the total frequency of a species to the sum of the frequency of all the plants of all species in the area.

IVI: **Importance value index**
It can be obtained by adding the values of relative density, relative cover and relative frequency and dividing it by three will give the importance value IVI of the species

Agricultural Area

Agricultural Area habitat type constitutes 20% of the Terrestrial Study Area. The range of vegetation cover is between 6.6% and 4.0%. The average plant count is 42.50, which is the lowest of all habitat types. Floral diversity is 7.50 species per Sampling Location, which is the highest out of all habitat types.[33] The dominant species in include *Juglans regia*, *Berberis sp.*, and *Fragaria vesca*. Photographs of some plant species found in this habitat type are shown in **Exhibit 4.106**.

Exhibit 4.106: Plant Species in Agricultural Area**,** May 2017 Survey

Indigoferra spp. at T3

Convolvulus arvensis at T3

Asparagus spp. at T3

Scrub Forest

Scrub Forest habitat type is the dominant habitat in the Terrestrial Study Area, constituting 48%. The range of vegetation cover is between 10.8% and 4.2%. The average plant count is 49.50, which is the highest out of all habitat types. The floral diversity is 4.60 species per Sampling Location, which is lower than Agricultural Area habitat but more than that of Pine Forest habitat type. The dominant species include

33 Average number of species per Sampling Location with a single Sampling Location being three 5m by 5m quadrats on a 500m transect, making it an area of 300 m^2.

Rumex dissectus followed by *Cannabis sativa* and *Ficus carica*. Photographs of some plant species found in this habitat type are shown in **Exhibit 4.107**.

Exhibit 4.107: Plant Species in Scrub Forest**,** May 2017 Survey

Lamium album at T5

Populus ciliata at T5

Carissa opaca at T2

Juglans regia at T2

Rumex dissectus at T4

Daphne mucronata at T9

Oxalus corniculata at T12

Cannabis sativa at T12

Justicia adhatoda at T12

Mentha piperita at T12

Morus nigra at T12

Acacia modesta at T12

Ficus carica at T12 (not in quadrat)

Pine Forest

Pine Forest habitat type constitutes 26% of the Terrestrial Study Area. The range of vegetation cover is between 18.8% and 6.8%. The average plant count is 23.00, which is the lowest out of all habitat types. The floral diversity is 5.33 species per Sampling Location, which is lower than Agricultural Area habitat but higher than that of Scrub Forest habitat type. The dominant species in this habitat type include *Pinus roxburghii*, *Pinus wallichiana*, and *Cedrus deodara*. Photographs of some plant species found in this habitat type are shown in **Exhibit 4.108**.

Exhibit 4.108: Plant Species in Pine Forest**,** May 2017 Survey

Pinus Wallachiana at T7

Acer caesium at T1

Urtica dioica at T1

Cotinus coggyria at T8

Ailanthus altissima at T8

Discussion

The indicators, including plant cover, plant count and diversity per Sampling Location describe the floral conditions within each habitat type.

Within Pine Forest habitat the average and maximum plant cover is higher than in the other two habitat types. The plant count within Pine Forest habitat type is lower than in the other two habitat types indicating that the number of plants in this habitat type are fewer and the higher cover is provided by the more frequent presence of species with large canopies such as *Pinus roxburghii* and *Pinus wallichiana*. The species diversity per Sampling Location is highest for Agricultural Area habitat type indicating that within this habitat type there is greater species diversity as compared to the Pine Forest and Scrub Forest habitat types. The lowest species diversity is in the Pine Forest habitat type.

Invasive Species

An alien or non-native plant or animal species is one that is introduced beyond its original range of distribution. Invasive alien species are non-native species that may become invasive or spread rapidly by outcompeting other native plants and animals when they are introduced into a new habitat that lacks their controlling factors as determined by natural evolution.[34]

Studies have indicated that 700 alien species are found in Pakistan. Of these six are considered to have extreme invasive nature including Paper Mulberry *Broussonetia papyrifera*, Mesquite *Prosopis juliflora*, Common Water Hyacinth *Eichhornia crassipes*, Giant Salvinia *Salvinia molesta*, Parthenium Weed *Parthenium hystrophorus*, and Lantana *Lantana camara*.[35]

Paper Mulberry, having East Asian origin is an invasive species in the Himalayan foothills which not only threatens natural vegetation of Islamabad but has also become a prime source of pollen allergy to about 46% of people Islamabad.[36] The species

[34] International Finance Corporation, 2012, Guidance Note 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources

[35] Mohammad Niaz, May 4, 2009, Invasive alien species: A threat to biodiversity, Dawn News, accessed November 8, 2016

[36] Ibid

Parthenium Weed, originating in the Gulf of Mexico and Central South America, was introduced in India and later invaded Pakistan. It is an aggressive weed in wastelands, road sides, water courses, and plantations. It can thrive well in high temperature zones; global warming scenario will even favor this invader.[37] The species has replaced the native vegetation and shows vigorous growth by forming thick continuous mats along the roadsides in many cities of the country where the climatic conditions are favorable. It is also one of the major weeds of the disturbed areas causing allergy.[38] Other invasive species found in the northern Pakistan include Ailanthus *Ailanthus altissima*, Black Locust *Robinia pseudoacacia* and Lantana *Lantana camara*.[39]

A study conducted in District Manshera, Pakistan in 2006 identified 63 weed species belonging to 32 families as being common in agricultural areas.[40] Of these 23 weeds were perennial, 37 were annual and three were parasitic. In particular, two species C*uscuta reflexa* and *Viscum album* were found to be major parasitic weeds on trees. *Viscum album* was found to be damaging the Near Threatened species Common Walnut *Juglans regia* while C*uscuta reflexa* was found to be growing in all kinds of trees and bushes.

An analysis of invasive species in Riparian habitat and the habitat types in the Terrestrial Study Area was carried out. A total of seven invasive species were identified.

Riparian Vegetation

In the Riparian habitat a total of three invasive species were identified including Parthenium Weed *Parthenium hysterophorus*, Common Weed *Phragmites karka* and Castor Oil Plant *Ricinus communis*. Based on their IVI, Parthenium Weed (18.96) is the dominant species in the Riparian habitat.

Terrestrial Study Area

In the Terrestrial Study Area a total of four invasive species were identified, in all three habitat types. In the Agricultural Area habitat type, two invasive species were observed including Tree-of-heaven *Ailanthus altissima,* and Cannabis *Cannabis sativa* both with low IVIs of 4.98 and 3.21 respectively. This indicates that invasive species are not dominant in this habitat type. In Scrub Forest habitat all four invasive species were observed including Tree-of-heaven, Cannabis, Pink Cheeseweed *Malva parviflora* and Black Locust *Robinia pseudoacacia*. The species Cannabis and Tree-of-heaven have the second and fourth highest IVIs of 8.54 and 6.87 respectively in this habitat type indicating that they are dominant species in Scrub Forest habitat. The other two have lower IVIs. In Pine Forest habitat all four invasive species were observed. Both had relatively low IVI values in this habitat type with Black Locust having the sixth highest IVI of 5.82 and Tree-of-heaven having the tenth highest IVI of 3.18. This indicates invasive species are not dominant in this habitat type.

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37 Ibid

38 National Environment Information Management System (NEIMS), United Nations Development Program, May 4, 2010, Forests and Biodiversity Information/Data Report, National Environment Information Management System (NEIMS), United Nations Development Program

39 Ibid

40 Ghulam Mujtaba Shah, Mir Ajab Khan, Checklist of Noxious Weeds of Distract Mansehra, Pakistan, Pak. J. Weed Sci. Res. 12 (3): 213-219, 2006

The habitat types with the highest number of invasive species, totaling four, are Scrub Forest and Pine Forest. Two invasive species in these habitat types, Cannabis and Tree-of-heaven, are also amongst the dominant species in this plant community. In Riparian habitat, the invasive species Parthenium Weed is dominant, having the highest IVI in the plant community.

Risk Assessment

Most of the Project-related activities will take place on Scrub Forest habitat type, however, there will also be Project-related activity on Agricultural Area and Pine Forest habitat type. The invasive species already present on Scrub Forest habitat type include Tree-of-heaven, Cannabis, Pink Cheeseweed and Black Locust, of which the first two are dominant in that habitat type. Project-related activity in the Riparian habitat type will increase the risk of spread of Parthenium Weed, which is already dominant in that habitat type. Disturbance of areas covered within these habitat types increases the risk of spread of these invasive species, in particular. However, other invasive species can also spread and colonize the disturbed areas as Project-related activities such as transport of equipment and waste can facilitate their spread, along with natural modes of dispersion such as being carried on the bodies of birds and other animals, as well as through wind and water.

The risk of each species within the Terrestrial Study Area was assessed based on the following categories:

- Importance Value Index (IVI)
- Relative Cover

The invasive species were ranked based on IVI[41], in Riparian habitat and all other Terrestrial Habitats combined for the Terrestrial Study Area. The habitat types in Terrestrial Habitats include Scrub Forest, Pine Forest and Agricultural Area. The ranking is presented in **Exhibit 4.109**.

Exhibit 4.109: Importance Value Index (IVI)

Ranking	*Terrestrial Habitats (Agriculture Area, Scrub Forest and Pine Forest habitats)*	*Riparian Habitat*
1.	Cannabis *Cannabis sativa*	Parthenium Weed *Parthenium hysterophorus*
2.	Tree-of-heaven *Ailanthus altissima*	Common Weed *Phragmites karka*
3.	Black Locust *Robinia pseudoacacia*	Castor Oil Plant *Ricinus communis*
4.	Pink Cheeseweed *Malva parviflora*	

41 A composite index calculated using relative frequency, density and cover

The results of the ranking show that in Riparian habitat, Parthenium Weed is dominant followed by Common Weed and Castor Oil Plant. In Terrestrial Habitats the dominant species is Cannabis followed by Tree-of-heaven, Black Locust and Pink Cheeseweed.

The ranking based on relative cover is presented in **Exhibit 4.110.** The overall relative cover of all invasive species compared to that of all the plant species was 7.85% in Terrestrial Habitats and 23.00% in Riparian habitat.

Exhibit 4.110: Relative Cover (C3)

Ranking	*Terrestrial Habitats (Agriculture Area, Scrub Forest, and Pine Forest habitats)*	*Riparian Habitat*
1.	Tree-of-heaven *Ailanthus altissima*	Parthenium Weed *Parthenium hysterophorus*
2.	Black Locust *Robinia pseudoacacia*	Common Weed *Phragmites karka*
3.	Cannabis *Cannabis sativa*	Castor Oil Plant *Ricinus communis*
4.	Pink Cheeseweed *Malva parviflora*	

The results of the ranking based on relative cover show that in Terrestrial Habitats the highest relative cover is for Tree-of-heaven followed by Black Locust, Cannabis and Pink Cheeseweed. In Riparian habitat the highest cover is for Parthernium Weed followed by Common Weed and Castor Oil Plant.

The habitat most at risk is Riparian Habitat. This is because species cover for invasive species is higher in this than in Terrestrial Habitats. The dominant species in this habitat type is Parthenium Weed (based on IVI) which spreads as a result of disturbance. This indicates that Riparian habitat type is more disturbed than other habitat types.

Ethnobotany

Ethnobotany is the systematic study of the relationships between plants and people.[42] The popularity of herbal drugs is on the rise in many developed countries of the world, while in developing countries like Pakistan; medicinal plants contribute significantly to the income sources of people living in remote areas.[43]

Pakistan is among the top eight exporting countries of medicinal and aromatic plants in the world, exporting plants worth US$ 5.45 million per year. Over 60% of the total export originates from the Hindukush-Himalayas regions of the country.[44]

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42 New World Encyclopedia, http://www.newworldencyclopedia.org/entry/Ethnobotany, accessed April 13, 2017

43 Hassan Sher, Haidar Ali And Shafiqur Rehman, Identification And Conservation of Important Plant Areas (IPAS) For The Distribution Of Medicinal, Aromatic And Economic Plants In The Hindukush-Himalaya Mountain Range, Pak. J. Bot., 44: 187-194, Special Issue May 2012

44 Hassan Sher, Haidar Ali And Shafiqur Rehman, Identification And Conservation of Important Plant Areas (IPAS) For The Distribution Of Medicinal, Aromatic And Economic Plants In The Hindukush-Himalaya Mountain Range, Pak. J. Bot., 44: 187-194, Special Issue May 2012

The country on the whole has serious problem with the loss of floral richness and diversity. Deforestation, followed by heavy grazing/browsing by domestic livestock; and unsustainable uses of various forms are the major factors behind the rapid loss of floral resources.[45]

Studies have been carried out on the ethnobotanical value of plants in the Mansehra District. The areas selected for the studies that are closest to the Terrestrial Study Area and representative of the fauna include Siran, Shogran and Kaghan Valleys.

Studies have shown that Siran has about 123 species, while Shogran hosts 117 species having high ethno botanical and medicinal importance.[46]

Within Siran Valley, a study carried out in 2006 reported the ethno-medicinal uses of 80 plant species belonging to 49 families. Of these, cultivated medicinal plants consist of 21 species with the rest being wild plants.[47]

Within Shogran Valley 50 plant species were selected to observe their pharmacological values. The study found that the plants were used for medicinal applications in skin treatment, as diuretics, expectorant, digestive, anti-inflammatory and for respiratory disorders. The species *Abies pindrow*, *Achillea millefolium*, *Cedrus deodara*, *Stellaria media*, *Trigonella foenumgraecum* and *Urtica dioica* have therapeutic application for treatment of variety of ailments.[48]

Within Kaghan Valley, studies were conducted in 2009 and 2010. These found 102 important plant species belonging to 93 genera and 61 families. Many of these plants were found to have more than one local use. These included use as fuel wood, forage/fodder, medicinal, edible, shelter making, timber wood and furniture wood.[49]

Mammals

The forests of the area provide habitat for mammal species including Yellow-throated Marten *Martes flavigula*, Giant Red Flying Squirrel *Petaurista petaurista*, Flying Squirrel *Hylopetes fimbriatus*, Leopard Cat *Prionailurus bergalensis*. Grey Langur *Semnopithecus entellus*, Rhesus Macaque *Macaca mulatta*, Common Leopard *Panthera pardus*, Himalayan Black Bear *Ursus thibetanus*, Grey Goral *Nemorhaedus goral*, Porcupine *Hystrix indica*. Murree Vole *Hyperacrius wynnei*. Turkestan Rat *Rattus*

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[45] Ibid

[46] Ibid

[47] Ghulam Mujtaba Shah and Mir Ajab Khan, Check List of Medicinal Plants of Siran Valley Mansehra-Pakistan, Ethnobotanical Leaflets 10: 63-71. 2006.

[48] Ume Ummara, Tasveer Zahra Bokhari, Adeela Altaf, Uzma Younis, Altaf Ahmed Dasti, Pharmacological Study of Shogran Valley Flora, Pakistan, International Journal of Scientific & Engineering Research, Volume 4, Issue 9, September, 2013

[49] Muhammad Rashid Awan, Zafar Iqbal, Syed Muqarab Shah, Zafar Jamal, Gul Jan, Muhammad Afzal, Abdul Majid and Alia Gul, Studies on traditional knowledge of economically important plants of Kaghan Valley, Mansehra District, Pakistan, Journal of Medicinal Plants Research Vol. 5(16), pp. 3958-3967, 18 August, 2011

turkestanicus, Long-tailed Field Mouse *Apodemus sylvaticus*. Whiskered Bat *Myotis muricola* and Grey Long-eared Bat *Plecotus austriacus*.[50,51]

Some of the species reported are included in the IUCN Red List 2014.[52] The Musk Deer *Moschus leucogaster* and Himalayan Grey Langur *Semnopithecus ajaxlis* are listed as Endangered, Black Bear *Ursus thibetanus* is listed as Vulnerable while the Common Leopard *Panthera pardus* and Grey Goral *Naemorhedus goral* are listed as Near Threatened.[53]

Sampling was carried out at 17 Sampling Locations during the May 2017 Survey to study the mammalian species abundance and diversity within the Terrestrial Study Area and Riparian habitat. The locations of these are shown in **Exhibit 4.64**. The results of the surveys, based on the sightings or signs of the mammals observed during the survey carried for this study are provided in **Exhibit 4.111**. A summary of the results by habitat type is provided in **Exhibit 4.112** which presents data on the signs and sightings for mammals (excluding rodents), abundance and diversity for the May 2017 Survey. Photographs of the signs of the Asiatic Jackal are shown in **Exhibit 4.113**. An Asiatic Jackal was sighted between Sampling Location T8 and T10 at night time (34°35’32.8”N, 73°22’41.9”E).

50 United Nations Development Programme, Pakistan (UNDP), Forests & Biodiversity Information/Data Report, [not dated].

51 Hamid Sarfraz, Ashiq Ahmad Khan, Dr. Nasim Javed, Dr. Shahid Ahmad, Dr. Inam ur Rahim & Dr. M. Rafiq, Khyber Pakhtunkhwa Biodiversity Strategy & Action Plan, Final Draft, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Registered offices, Islamabad, June 26, 2016

52 The IUCN Red List of Threatened Species. Version 2014.3. <http://www.iucnredlist.org>. Downloaded on 25 May 2017.

53 Ibid

Exhibit 4.111: Abundance of Mammal Signs and Sightings, May 2017 Survey

No	Scientific Name	Common Name	IUCN Status[54]	Agricultural Area		Scrub Forest		Pine Forest		Riparian	
				Sightings	Signs	Sightings	Signs	Sightings	Signs	Sightings	Signs
	Canidae										
1.	*Canis aureus*	Asiatic Jackal	Least Concern		2				3	1	1
2.	*Vulpes vulpes*	Red Fox	Least Concern			1					
	Hystricidae										
3.	*Hystrix indica*	Indian Crested Porcupine	Least Concern						1		1
	Herpestidae										
4.	*Herpestes javanicus*	Small Asian Mongoose	Least Concern					1			

54 The IUCN Red List of Threatened Species. Version 2014.3. <http://www.iucnredlist.org>. Downloaded on 25 May 2017.

Exhibit 4.112: Signs/Sightings Data for Mammals (excluding Rodents) Abundance and Diversity by Habitat Type, May 2017 Survey

Habitat	*No. of Sampling Locations*	*Total Signs/ Sightings*	*Average Signs/Sightings per Sampling Locations (Density)*	*No. of Species*
Agricultural Area	2	2	1.00	1
Scrub Forest	6	1	0.17	1
Pine Forest	5	5	1.00	3
Riparian	4	2	0.50	2
Total	**17**	**10**	**0.59**	**4**

Exhibit 4.113: Signs of Mammals, May 2017 Survey


Scat of Jackal at T11

The locals in the Terrestrial Study Area were questioned about the sighting of wildlife species in the vicinity of the Terrestrial Study Area. They stated that the Asiatic Jackal, Red Fox, Common Leopard and Wild Boar are very common in the area. They emphasized the fact that Wild Boar is damaging for crops. The mammals reported to be harmful to livestock included the Asiatic Jackal, and Common Leopard. The SFDO, Balakot, Sarmad Shah stated that the Black Bear is also common in the area.

Small Mammals

Trapping for small mammals was carried out at three Sampling Locations, one in each of the habitat types. The locations and coordinates are provided in **Exhibit 4.114.** Photographs of small mammal traps are shown in **Exhibit 4.115**. No small mammals were captured.

Exhibit 4.114: Small Mammal Trapping Locations, May 2017 Survey

Habitat	*Closest Sampling Location*	*Latitude*	*Longitude*
Agricultural Area	T11	34°34'54.30"	73°22'7.90"
Scrub Forest	T12	34°35'20.60"	73°22'11.5"
Pine Forest	T8	34°36'04.79"	73°22'54.25"

Exhibit 4.115: Small Mammal Traps**,** May 2017 Survey

Avifauna

Surveys for bird diversity and abundance were carried in the Terrestrial Study Area in May 2017. A total of 17 Sampling Locations were visited with 13 in terrestrial habitat types and four in Riparian habitat type. A summary of the results by habitat type including the bird abundance and diversity is provided in **Exhibit 4.116**. The field data is provided in **Appendix J**.

Exhibit 4.116: Total Sightings, Density and Diversity by Habitat Type, May 2017 Survey

Habitat	*No. of Sampling Points*	*Total Sightings*	*Density (Average no of species per Sampling Location)*	*No. of Species*
Agricultural Area	2	370	165	15
Scrub Forest	6	981	164	25
Pine Forest	5	675	135	22
Riparian	4	785	196	16
Total	**17**	**2,771**	**163**	**48**

A total of 2,771 individuals belonging to 48 species were observed. Maximum abundance was observed at Sampling Location T4, located in Scrub Forest habitat. Abundant bird species observed at this Sampling Location included the Common Chiffchaff, the Common Kestrel, and the Indian Golden Oriole.

Maximum diversity was observed at Sampling Location T13, located in Pine Forest habitat. A total of 15 bird species were observed at this Sampling Location.

Abundant bird species in the Terrestrial Study Area included the Common Raven *Corvus corax*, the Bank Myna *Acridotheres ginginianus*, the White-cheeked Bulbul *Pycnonotus leucotis*, Black Drongo *Dicrurus macrocercus*, and Great Tit *Parus major*.

Of the bird species observed, none are Endangered or Critically Endangered based on the IUCN Red List of Threatened Species.[55] One species, the Rufous-vented Prinia P*rinia burnesii*, observed during the May 2017 Survey is listed as Near Threatened. Also, four species observed during the May 2017 Survey are listed on the CITES Species Appendices[56] including the Black Kite *Milvus migrans*, the Common Kestrel *Falco tinnunculus*, the Common Crane *Grus grus* and the European Honey Buzzard *Pernis apivorus*, all listed on Appendix II. All four species show migratory behavior and congregatory behavior based on the IUCN Red List of Threatened Species database.[57]

Some of the bird species photographed within the Terrestrial Study Area and Riparian habitat are shown in **Exhibit 4.117** and **Exhibit 4.118**, respectively.

A list of bird species reported from Terrestrial Study Area is provided in **Appendix K**. Information about the species listed as Near Threatened, the Rufous-vented Prinia is provided below.

The locals reported the presence of Vultures in the area, however, none were observed during the May 2017 Survey.

Rufous-vented Prinia *Prinia burnesii*

Adults of this species have streaked upper parts, whitish lores/eye-rings with a broad tail and rufous vent. Residents occur frequently along margins of larger rivers/lakes and especially in irrigation-barrage seepage zones. The species favors extensive tracts of reeds and cane grass.[58] The global population has not been quantified but the species is described as locally numerous in the Indus floodplain in Pakistan and locally frequent in parts of India. A moderately rapid and on-going decline is suspected, owning to habitat loss and degradation.[59]

Pheasants and Western Tragopan

There are three pheasant species of importance reported from the Terrestrial Study Area which include the Cheer Pheasant, the Kokhlass Pheasant, and the Kalij Pheasant. The Western Tragopan is also reported from here. Of these the Cheer Pheasant and the Western Tragopan are listed as Vulnerable while the Kokhlass and Kalij are listed as Least Concern.[60] None of these species were observed during the May 2017 Survey.

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[55] IUCN 2015. *The IUCN Red List of Threatened Species. Version 2015-4*. <http://www.iucnredlist.org>, accessed May 29, 2017.

[56] UNEP-WCMC. SPECIES+ CITES database. <http://www.speciesplus.net/species>, accessed May 29, 2017

[57] IUCN 2015. *The IUCN Red List of Threatened Species. Version 2015-4*. <http://www.iucnredlist.org>, accessed May 29, 2017.

[58] Grimmett, R., Roberts, T., and Inskipp, T. 2008. Birds of Pakistan, Yale University Press.

[59] BirdLife International. 2017. Laticilla burnesii. The IUCN Red List of Threatened Species 2017: e.T22735835A111367374. Downloaded on 01 June 2017.

[60] IUCN 2015. *The IUCN Red List of Threatened Species. Version 2015-4*. <http://www.iucnredlist.org>, accessed May 29, 2017.

Exhibit 4.117: Bird Species in the Terrestrial Study Area, May 2017 Survey

Jungle Myna near T2

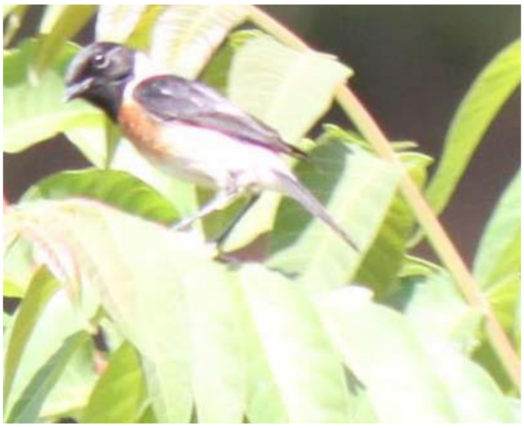
Black Drongo at T2

Long-tailed Shrike at T3

Striated Laughing Thrush at T3

Oriental Magpie Robin at T3

Great Tit at T3


Siberian Stonechat at T8


Himalayan Bulbul near T13


Long-tailed Minivet at T13


Yellow-crowned Woodpecker at T13

Exhibit 4.118: Bird Species in Riparian Habitat**,** May 2017 Survey

Blue Whistling Thrush at R1

Grey Bushchat near R2

Asian Black Bulbul at R2

Black Drongos at R2

White Wagtail at R3

Little Egret at R4

Herpetofauna

A total of 17 Sampling Locations were sampled during the May 2017 Survey. The locations of these Sampling Locations have been shown in **Exhibit 4.64**.

A summary of the Sampling Locations by habitat type, number of sightings, density and number of species is shown in **Exhibit 4.119.**

Exhibit 4.119: Herpetofauna Abundance and Diversity by Habitat Type, May 2017 Survey

Habitat	*No. of Sampling Locations*	*Total Signs/ Sightings*	*Average Signs/Sightings per Sampling Location (Density)*	*No. of Species*
Agricultural Area	2	7	3.50	3
Scrub Forest	6	23	3.83	2
Pine Forest	5	26	5.20	4
Riparian	4	7	1.75	3
Total	**17**	**63**	**3.71**	**6**

A total of 63 reptile and amphibian specimens belonging to six species were observed in the combined Terrestrial Study Area and Riparian habitat. The highest density of herpetofauna was observed in the Pine Forest habitat (average of 5.20 signs/sightings per Sampling Location). The greatest diversity was also observed in the Pine Forest habitat with a total of four species. The highest abundance was observed at Sampling Location T1 in Pine Forest habitat with 20 individuals sighted. The second highest abundance was observed at Sampling Location T4 in Scrub Forest habitat with 16 individuals sighted.

Of the species observed in May 2017 Survey none are of conservation importance based on the IUCN Red List and three are listed on the CITES Appendices. These include the Jan's Cliff Racer *Platyceps rhodorachis* (I), the Caspian Cobra *Naja oxiana* (II) and Checkered Keelback *Xenochrophis piscator* (III). None of the species observed are endemic. Photographs of some of reptile species observed are shown in **Exhibit 4.120**.

A complete list of herpetofauna species reported from the Terrestrial Study Area, based on information from Rafaqat Masroor, a herpetofauna specialist with the Pakistan Museum of Natural History (PMNH), is provided in **Appendix K**.

Exhibit 4.120: Herpetofauna Species, May 2017 Survey

Agrore Valley Rock Agamas *Laudakia agrorensis* at T1

Asian Garden Lizard Calotes versicolor and its burrows at T4

Agrore Valley Rock Agama *Laudakia agrorensis* at T5

Asian Garden Lizard *Calotes versicolor* at T12

4.2.8 Habitat Assessment

Habitats can be classified as either natural or modified; ranging from pristine, undisturbed natural habitat at one end of the scale, through different degrees of modification or disturbance, up to highly modified or degraded areas that support an artificial assemblage of plants and animals. Despite a habitat being modified, it may support valuable biodiversity, including endemic or threatened species. Subsets of these habitat types are critical habitats and legally protected areas, both of which more commonly consist of natural or slightly modified habitat.[61]

Natural and Modified Habitats

ADB guidelines require the classification of the Study Area into Natural and Modified Habitats based on the definitions provided below.[62]

Natural Habitat: Land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions.[63]

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61 Asian Development Bank (ADB), Environment Safeguards, A Good Practice Sourcebook Draft Working Document, December 2012.

62 Ibid

63 Ibid

Modified Habitat: Natural habitat that has been altered as a result of human activities such as agricultural, forestry or urban development, or through the introduction of alien species.[64]

The Aquatic Study Area is considered a Modified Habitat because of the changes in environmental flows as a result of regulation of the river. This is due to development of the under-construction Sukki Kinari HPP upstream of the Project and presence of the Patrind HPP downstream of the Project.

The Terrestrial Study Area is considered Modified Habitat because human activity has modified the land use and vegetation within most of it, even at higher elevations. There are patches of forests, mainly on very steep slopes, where access by people is limited. The locals report that wild animals such as the Common Leopard and Black Bear are common in the area, especially at higher elevations.

Critical Habitat

Critical habitat is an area that has high biodiversity value and may include sites that are legally protected or officially proposed for protection e.g. areas that meet the International Union for Conservation of Nature (IUCN) classification criteria, the Ramsar List of Wetlands of International Importance, and United Nations Educational, Scientific, and Cultural Organization (UNESCO) world natural heritage sites. Critical habitat includes:[65]

- habitat required for the survival of critically endangered or endangered species
- areas with special significance for endemic or restricted-range species
- sites that are critical for the survival of migratory species
- areas supporting globally significant concentrations or numbers of individuals of congregatory species
- areas with unique assemblages of species that are associated with key evolutionary processes or provide key ecosystem services
- areas with biodiversity that has significant social, cultural or economic importance to local communities

Critical Habitat is also a requirement under the International Finance Corporation’s (IFC) Performance Standards (PS).[66] The IFC is financing the development of a number of HPPs in the Jhelum-Poonch Basin including the Gulpur HPP, Karot HPP, and Kohala HPP. It is also involved in a basin-wide assessment of the impact of HPP development and is planning on carrying out a Strategic Environmental Assessment (SEA) in the basin. Therefore, in order to maintain consistency with the criteria used for Critical Habitat Assessment, IFC PS6 has been applied. There is not conflict between IFC PS6

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64 Ibid

65 Ibid

66 International Finance Corporation (IFC). January 2012. Policy on Social and Environmental Sustainability, Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources, The World Bank Group.

and ADB guidelines. The two are similar in their criteria with the IFC providing thresholds for assessment.

Critical Habitat Assessment as per IFC PS6 requires the defining of a Discrete Management Unit (DMU). This is based on the following:

"For Criteria 1 through 3, the project should determine a sensible boundary (ecological or political) which defines the area of habitat to be considered for the Critical Habitat Assessment. This is called the "discrete management unit," an area with a definable boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas (adapted from the definition of discreteness by the Alliance for Zero Extinction). A discrete management unit may or may not have an actual management boundary (e.g., legally protected areas, World Heritage sites, KBAs, IBAs, community reserves) but could also be defined by some other sensible ecologically definable boundary (e.g., watershed, interfluvial zone, intact forest patch within patchy modified habitat, seagrass habitat, coral reef, concentrated upwelling area, etc.). The delineation of the management unit will depend on the species (and, at times, subspecies) of concern."[67]

DMUs has been defined for each species under consideration in Criteria 1 through 3.

The criteria for Critical Habitat Assessment based on IFC PS6 along with their application to the biodiversity within the Aquatic Study Area is provided below:

1. Habitat of significant importance to Critically Endangered and/or Endangered species:

According to IFC's Guidance Note 6, Tier 1 sub-criteria for Criterion 1 are defined as follows[68]:

- Habitat required to sustain ≥ 10 percent of the global population of an IUCN Red-listed Critically Endangered (CR) or Endangered (EN) species where these are known, regular occurrences of the species and where the habitat could be considered a discrete management unit for that species.
- Habitat with known, regular occurrences of CR or EN species where the habitat is one of 10 or fewer discrete management sites globally for that species.

Tier 2 sub-criteria for Criterion 1 are defined as follows:

- Habitat that supports the regular occurrence of a single individual of an IUCN Red-listed CR species and/or habitat containing regionally-important concentrations of an IUCN Red-listed EN species where the habitat could be considered a discrete management unit for that species.
- Habitat of significant importance to CR or EN species that are wide-ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species.

67 Biodiversity Conservation and Sustainable Management of Living Natural Resources, Criterion 3, Guidance Note 6, International Finance Corporation, 1 January 2012

68 Ibid

- As appropriate, habitat containing nationally/regionally-important concentrations of an EN, CR or equivalent national/regional listing.

Species that are listed as Critically Endangered or Endangered on the IUCN Red List were not reported from the Aquatic Study Area or the Terrestrial Study Area based on the surveys carried out in July 2016, February 2017 and May 2017. Therefore, this criteria does not trigger Critical Habitat.

2. Habitat of significant importance to endemic and/or restricted-range species:

According to IFC's GN6, Tier 1 sub-criteria for Criterion 2 are defined as follows:

- Habitat known to sustain ≥ 95 percent of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species (e.g. a single-site endemic[69]).

Tier 2 sub-criteria for Criterion 2 are defined as follows:

- Habitat known to sustain ≥ 1 percent but < 95 percent of the global population of an endemic or restricted-range species where the habitat could be considered a discrete management unit for that species, where data are available and/or based on expert judgement.

The Aquatic Study Area is of significant importance to endemic species and restricted range species. There are two endemic fish species found here including the Kashmir Hillstream Loach and the Nalbant's Loach, both of which were reported during the surveys carried out in February 2017. These species are also restricted range species, as defined by Guidance Note (GN) 6[70] for IFC 6. GN 6 states that for freshwater systems, a guideline for extent of occurrence is 20,000 sq km. Species in freshwater systems with an extent of occurrence less than 20,000 sq km are considered restricted range species. The extent of occurrence for the Kashmir Hillstream Loach and the Nalbant's Loach is less than 20,000 sq km, therefore, each species can be considered a restricted range species. The DMU for Nalbant's Loach and Kashmir Hillstream Loach is shown in **Exhibit 4.121**. It has been determined based on the maximum range of the species upstream of the Project, and from there to the dam of the existing Patrind HPP. The ranges of both species extends into the Jhelum River as well, however, the presence of the dam of the Patrind HPP has created a barrier. Based on expert judgement, the habitat in the DMU is known to sustain ≥ 1 percent but < 95 percent of the global population of both species, therefore, Tier 2 sub-criteria for Criterion 2 is triggered, making this a Critical Habitat. The distributions of the two species are shown in **Exhibit 4.122** and **Exhibit 4.123**, along with their extent of occurrence and its area. The area for the extent of occurrence of the Nalbant's Loach is 13,635 sq km and that of the Kashmir Hillstream Loach is 13,475 sq km. No endemic and/or restricted range species were observed in the Terrestrial Study Area.

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69 An endemic species is defined as "one that has ≥ 95 percent of its global range inside the country or region of analysis" as stated in GN79 of Guidance Note 6, Biodiversity Conservation and Sustainable Management of Living Natural Resources. International Finance Corporation, January 2012

70 Biodiversity Conservation and Sustainable Management of Living Natural Resources, Guidance Note 6, International Finance Corporation, 1 January 2012

Exhibit 4.121: Discrete Management Unit for the Nalbant's Loach and Kashmir Hillstream Loach

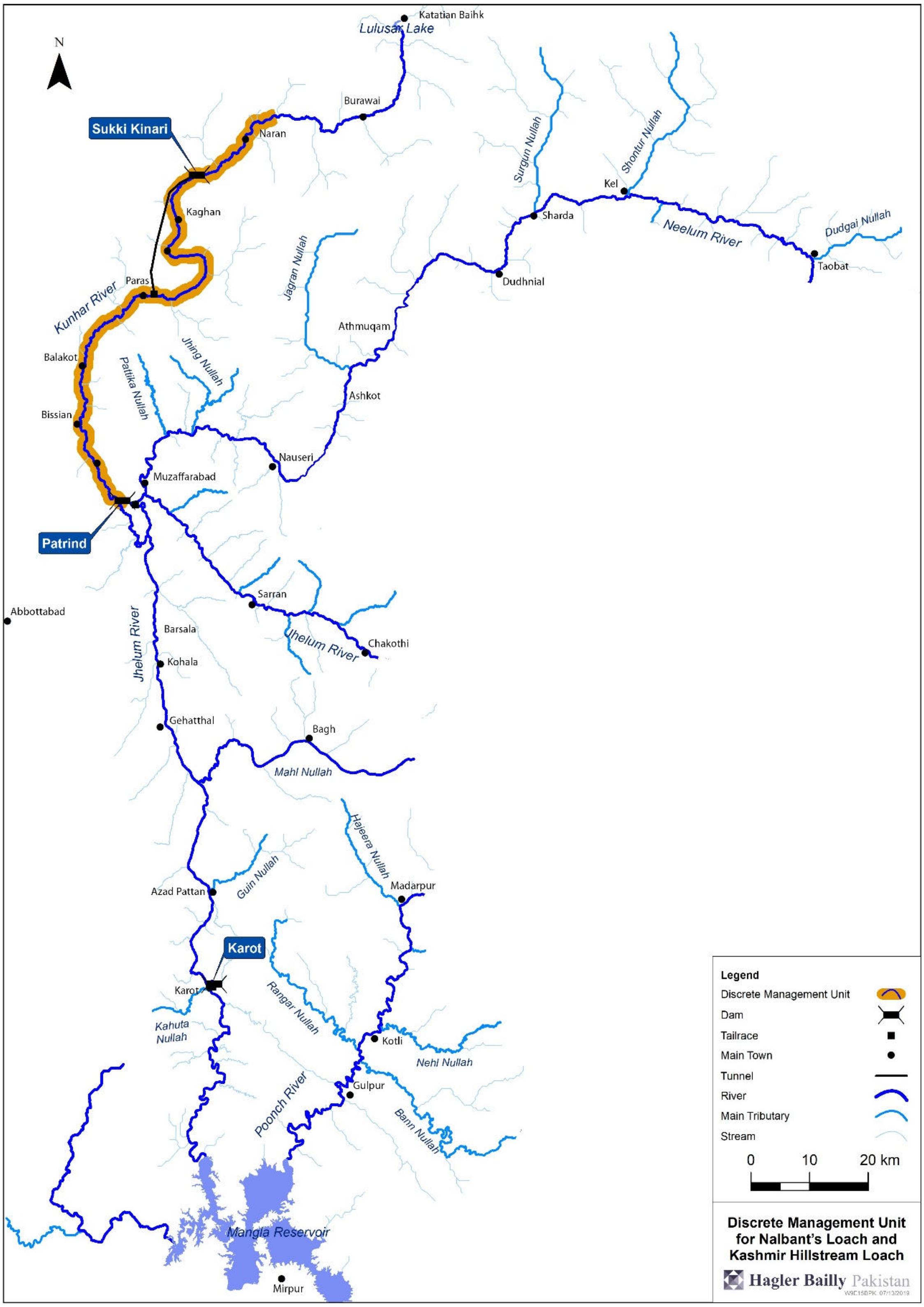


Exhibit 4.122: Distribution of the Nalbant's Loach

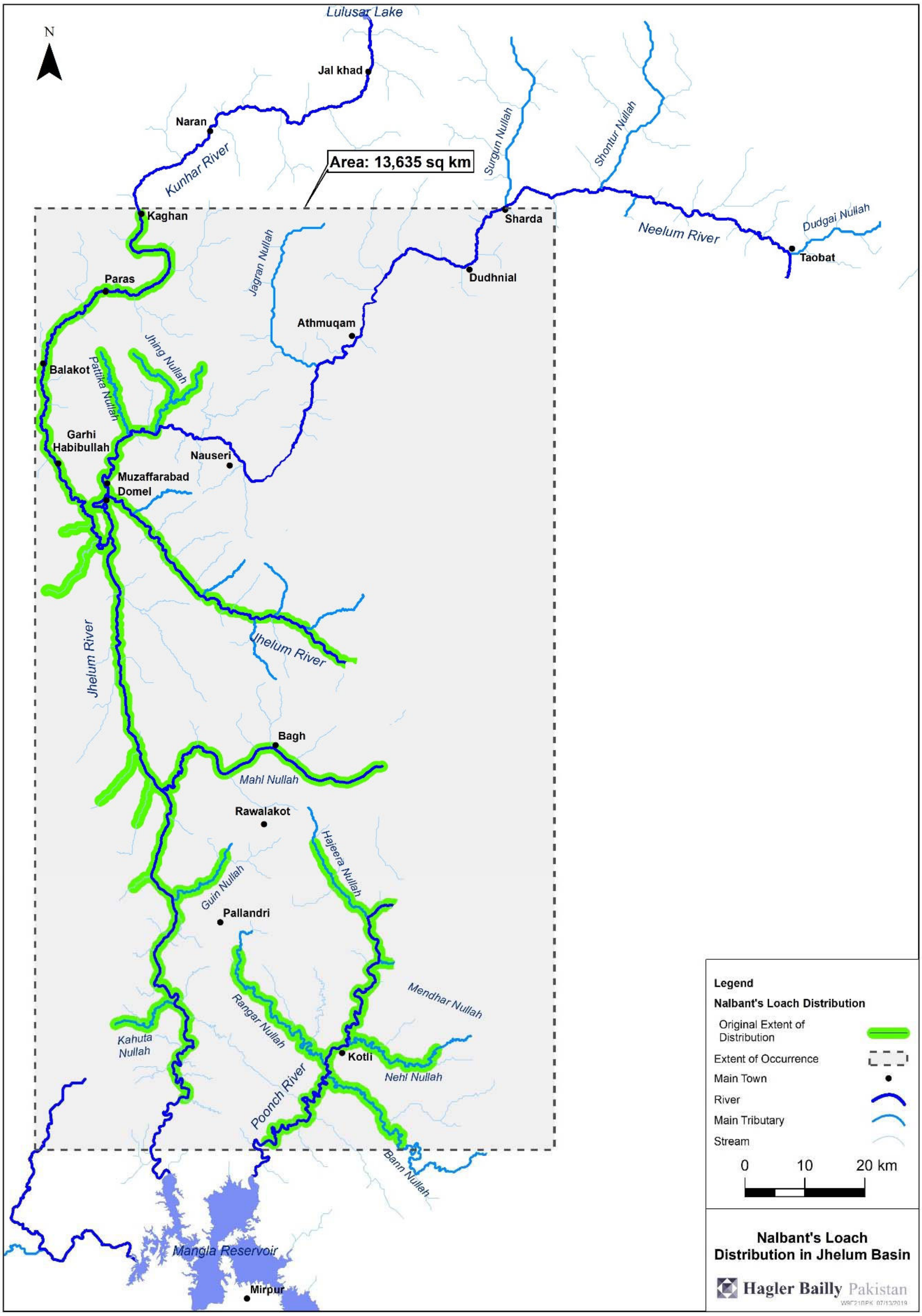
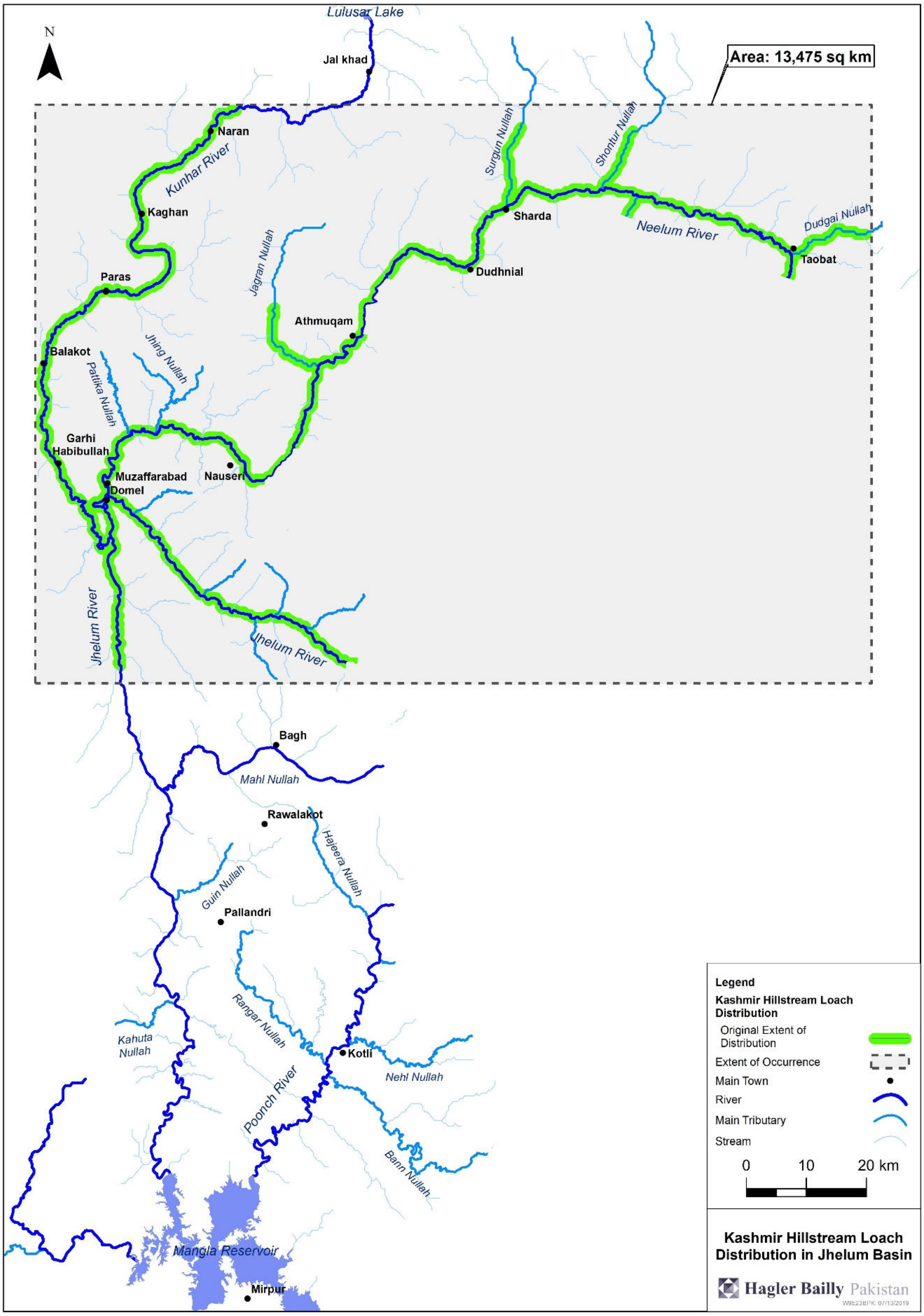


Exhibit 4.123: Distribution of the Kashmir Hillstream Loach



3. Habitat supporting globally significant concentrations of migratory species and/or congregatory species:

According to IFC's GN6, Tier 1 sub-criteria for Criterion 3 are defined as follows:

- Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 95 of the global population of a migratory or congregatory species at any point of the species lifecycle where that habitat could be considered a discrete management unit for that species.

Tier 2 sub-criteria for Criterion 3 are defined as follows:

- Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent but < 95 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle and where that habitat could be considered a discrete management unit for that species, where adequate data are available and/or based on expert judgment.
- For birds, habitat that meets BirdLife International's Criterion A4 for congregations and/or Ramsar Criteria 5 or 6 for Identifying Wetlands of International Importance.
- For species with large but clumped distributions, a provisional threshold is set at ≥5 percent of the global population for both terrestrial and marine species.
- Source sites that contribute ≥ 1 percent of the global population of recruits.

The Aquatic Study Area is not home to significant concentrations of migratory species and/or congregatory species. No congregatory species were reported to be present in the Aquatic Study Area. A migratory fish species, Alwan Snow Trout, was found during the February 2017 and May 2017 Surveys. The DMU for the Alwan Snow Trout is shown in **Exhibit 4.124**. It extends from the maximum range of the Alwan Snow Trout upstream of the Project, to the dam of the Patrind HPP. The DMU for this species has been chosen based on its distribution in the Kunhar River. The species is migratory and moves into Jhelum River as well. However, the presence of the dam of the Patrind HPP has blocked its migratory route in the Jhelum River. This species is also found in India, Nepal and Bhutan.[71] Based on expert judgement, the habitat within the DMU consists of less than 1% of the global population of the species. As a result, it does not trigger Tier 1 or Tier 2 criteria, therefore, this species does not trigger Critical Habitat.

Within the Terrestrial Study Area five migratory bird species were found including the Common Chiffchaff, Common Kestrel, Laughing Dove, Little Egret, and White Wagtail. Of these two are congregatory including the Common Kestrel and Little Egret. However, all five bird species are widespread and their populations do not trigger Tier 1 or Tier 2 sub-criteria for Criterion 3. As a result, they do not trigger Critical Habitat.

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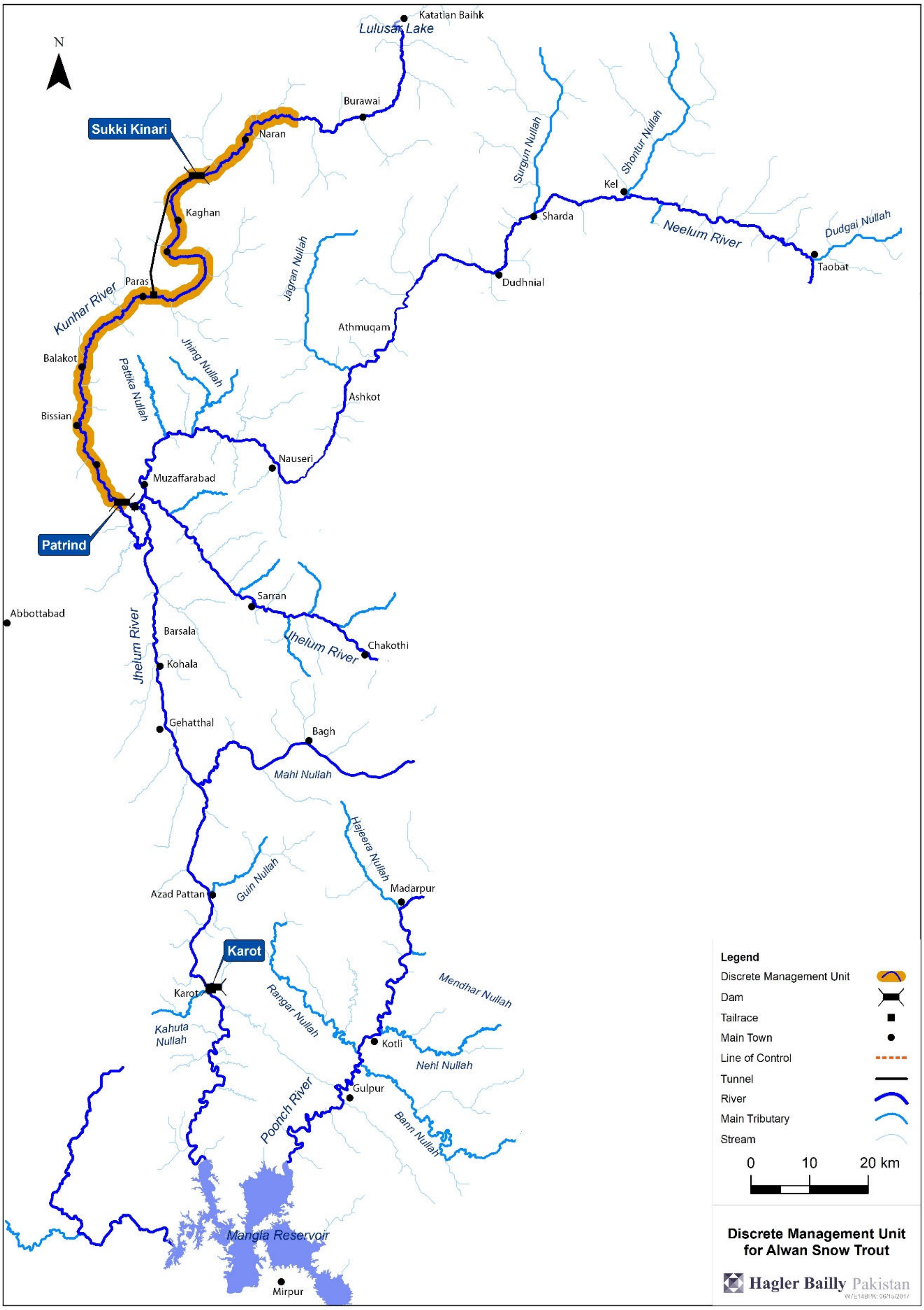
[71] Vishwanath, W. 2010. Schizothorax richardsonii. The IUCN Red List of Threatened Species 2010: e.T166525A6228314. http://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T166525A6228314.en. Downloaded on 07 June 2017.

Exhibit 4.124: Discrete Management Unit for Alwan Snow Trout



4. Highly threatened and/or unique ecosystems:

There is no information which indicates the Study Areas, or any part of them, are a highly threatened and/or unique ecosystem. Furthermore, there is no information which indicates the Study Areas are a part of a threatened or unique ecosystem.

5. Areas with unique assemblages of species or which are associated with key evolutionary processes or provide key ecosystem services:

There is no information which indicates the Study Areas, or any part of them, are associated with key evolutionary processes or provide key ecosystem services. While the species are functioning components of ecosystems, there are no unique assemblages of species or association of key evolutionary processes in the Study Areas.

ADB's Guideline for Critical Habitat Assessment not covered by IFC PS6

6. Areas with biodiversity that has significant social, cultural or economic importance to local communities

The last criteria provided in the ADB guidelines on Critical Habitat Assessment is not covered by the criteria under IFC PS6. The stretch of the Kunhar River within the Aquatic Study Area is part of the wider area that is important for sports fishing. Based on a conversation with Mohammad Tanvir, Assistant Director, Fisheries, District Manshera, this stretch of the Kunhar River is stocked with fish and over 100 permits, called Daily Trout Angling (DTA) licenses, are issued annually. The fishing season is from March to October after which fishing is not allowed due to the breeding season. This activity contributes to the local economy. However, data collected as part of the socioeconomic baseline indicates that sports fishing in the Aquatic Study Area is not of social, cultural or economic importance to the local communities. Therefore, this criteria does not trigger Critical Habitat.

4.2.9 Conclusion

The February 2017 and May 2017 Survey have revealed the presence of two endemic and restricted range fish species within the Aquatic Study Area which include the Kashmir Hillstream Loach and the Nalbant's Loach. In addition to these, a long distance migratory fish species, the Alwan Snow Trout, has also been reported. Five bird species that are migratory have also been observed during these surveys, with two of them being congregatory. No Critically Endangered or Endangered species were observed. Based on expert judgement, it has been determined that the Aquatic Study Area is of special significance for endemic and restricted range fish species, therefore, the DMUs for these fish species, shown in **Exhibit 4.124**, is designated as Critical Habitat under IFC PS6. The migratory and congregatory bird species are widespread globally and their populations do not trigger Critical Habitat. This determination is consistent with the criteria for Critical Habitat under ADB's Environmental Safeguards, 2012.

4.3 Socioeconomic Environment

This section provides a description of the existing socioeconomic conditions in settlements located in the socioeconomic Study Area of the Project.

4.3.1 Study Area

The Study Area is delineated using the following buffers and extents:

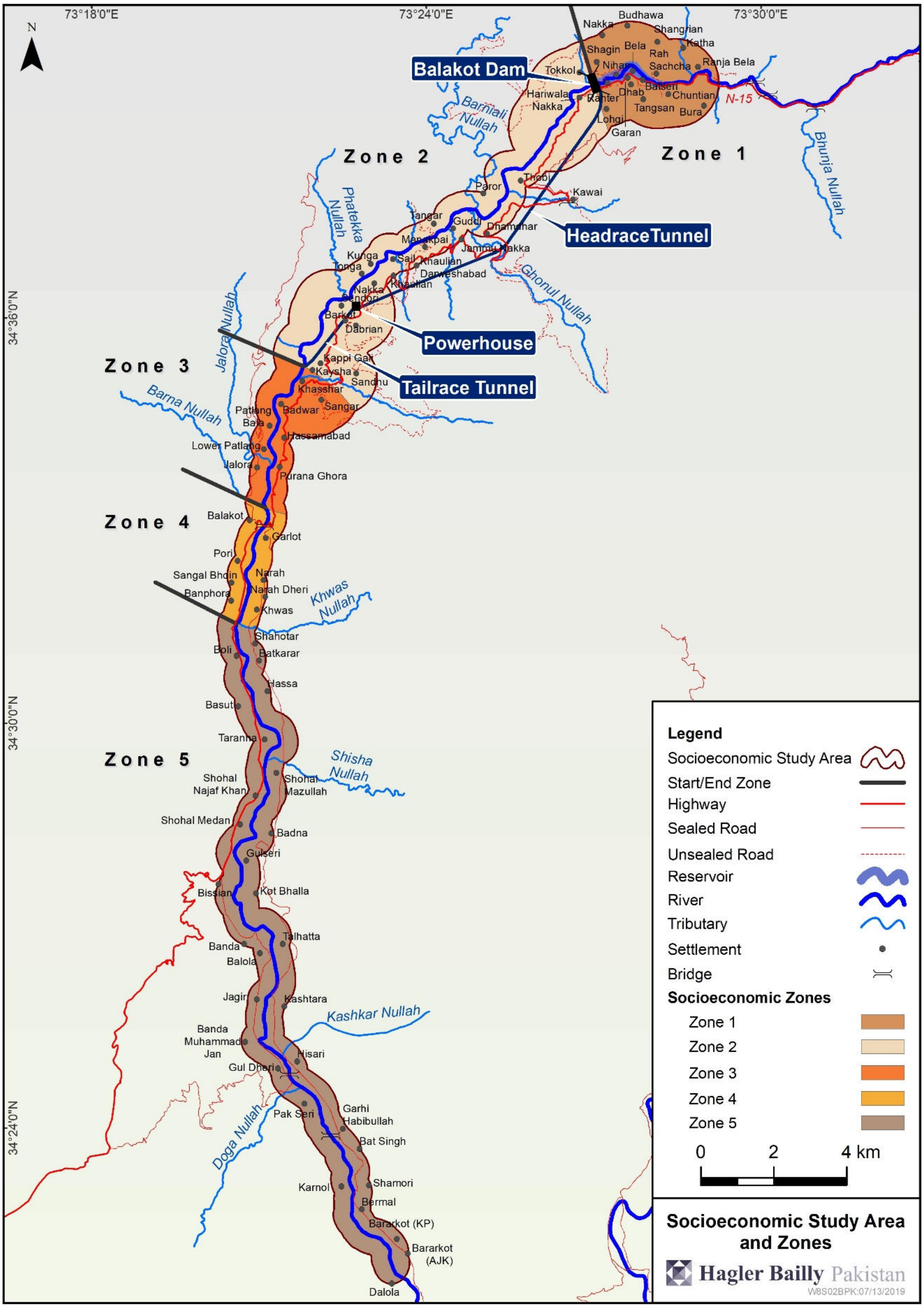
- **500 m buffer on each side of river**: along reaches that may be impacted due to the Project, and the zone where there is river dependence (either through use of drift wood, use of sediment as building materials) is a zone of 500 m of the river.
  - All settlements with a center within the 500 m buffer is included.
  - All settlements with more than 50% of their land area within the 500 m buffer are also included.
- **1 km buffer around Project facilities:** for coverage of communities that will be directly impacted through either resettlement, or construction related impacts. However, spoil disposal areas are not included in the study area as at the time of socioeconomic survey spoil disposal areas were not identified.
- **Upstream Extent:** selected as tailrace tunnel of Sukki Kinari HPP, upstream of the dam, as the dam as barrier may affect communities reliant on ecological resources (such as fish).
- **Downstream Extent:** The downstream extent of the Study Area is at the start of reservoir of the Patrind HPP.

Keeping in view expected variation between rural and urban areas, impact due to the Project, flow variations along different reaches of the Kunhar River due to tributaries, as well as changes due to other hydropower projects, the Study Area is divided into different zones along the Kunhar River:

- **Zone 1:** Upstream of Balakot Dam (including Balakot Reservoir Area)
- **Zone 2:** Downstream of Balakot Dam up to Upstream of Balakot Tailrace Outlet
- **Zone 3:** Downstream of Balakot Tailrace Outlet up to Upstream of Balakot City
- **Zone 4:** Balakot City along Kunhar River
- **Zone 5:** Downstream of Balakot City up to the reservoir of Patrind Hydropower Project
- **Zone 6:** 1 km buffer around Project facilities

Exhibit 4.125 shows the socioeconomic Study Area and Zones.

Exhibit 4.125: Socioeconomic Study Area and Zones



4.3.2 Methods of Data Collection

Primary data was collected at the settlement level by administering settlement level questionnaires and specific questionnaires for other aspects of interest.

Socioeconomic Aspects of Interest

Socioeconomic aspects of interest include the following:

- **Demography:** a description of the sample population and its characteristics, such as dependency ratio, population pyramid and sex ratio.
- **Infrastructure:** information on existing social and physical infrastructure, such as roads, police facilities, electricity availability, water and sanitation and postal services.
- **Health:** information on key health issues prevailing in the area and access to health facilities.
- **Education:** information on educational institutions and their accessibility.
- **Livelihood:** information on key occupations and income sources.
- **Income and poverty:** discussion on incomes, use of natural resources, expenditures and debts.
- **Dependence on ecosystems services:** such as dependence on ecological/natural resources, including the river, of the area as source of livelihood, enjoyment or to meet day to day requirements.
- **Gender:** All the socioeconomic information was gathered disaggregated by gender and vulnerability.

Surveys

The settlement level survey was completed by a social development expert appointed by HBP, in view of the complex and qualitative nature of information to be obtained in a semi-literate environment. Information was obtained in discussion with a group of 4 to 5 key informants including, but not limited to, the following:

- Union Council (local government) heads
- Educated persons (with Higher School Certificate as minimum level of education attained)
- School teachers
- Local government representatives and leaders
- Community based organization active in the area

The levels at which the survey was conducted are as follows:

- **Rural settlement survey:** was undertaken in selected settlements within each socioeconomic zone, excluding the Balakot zone. A pilot survey was carried out prior to start of the rural settlement survey. Based on the pilot survey results, settlements for rural settlement surveys were selected based on their use of the river (fishing, sand mining, domestic uses, and irrigation) and potential impacts of the Project. Detailed interviews were conducted with key informants (male and female) to gather information on selected settlement's social and economic setup including gender issues, with focus on infrastructure and livelihoods;

- **Business owner survey:** was implemented to obtain information on the costs and benefits of the river-dependent businesses, such as sand mining;
- **Urban focus group discussions:** were implemented in Balakot city. Information on the livelihoods, incomes, household demographics and household recreational activities was obtained through discussions with local government representatives and community groups.

The socioeconomic survey plan is provided in **Appendix L.**

4.3.3 Socioeconomic Conditions in the Study Area

Rural Settlements

The word "settlement" is the term used to describe the unit studied based on the assumption that a settlement is a cluster of houses where residents share a geographic area, and commute with the resources through a cultured pattern that they have developed in due course of time for the purpose. Settlements are "a city, town, village ghost or other agglomeration of buildings where people live and work."[72] The word village is usually used for similar social concepts but is intentionally avoided because it refers to a more permanent residential pattern with the major concentration of the population sharing a heritage as well as structured pattern of life for longer periods. "A village is a small settlement usually found in a rural setting. It is generally larger than a "hamlet" but smaller than a "town". Some geographers specifically define a village as having between 500 and 2,500 inhabitants."[73] Ideally a settlement usually is of 5 to 30 houses whereas a village begins when settlements are merged or create a common identity in due course of time. In this study the neighborhoods are termed settlements, to create a unit of similar size and bring homogeneity in the study unit. **Exhibit 4.126** shows the average size of surveyed settlements by zones.

Exhibit 4.126: Average Size of Surveyed Settlements by Zones

Zone	*Number of Surveyed Settlements*	*Minimum Number of Households*	*Maximum Number of Households*	*Average Number of Households*
1	8	8	120	46
2	7	4	75	21
3	4	3	37	23
4	0	0	0	0
5	11	17	1500	301
6	1	59	59	59
Total	**31**			**128**

Source: Field Survey March–April 2017 and June–July 2018

72 Dutta, Biswanath; Fausto Giunchiglia; Vincenzo Maltese (2010). "A Facet-Based Methodology for Geo-Spatial Modeling". GeoSpatial Semantics: 4th International Conference, GeoS 2011, Brest, France (PDF). p. 143

73 Accessed on June 03, 2017 2215PST and retrieved from https://www.nationalgeographic.org/encyclopedia/village/

Based on **Exhibit 4.126**, it can be seen that the reservoir area falling in Zone 1 is inhabited by smaller settlements with the average number of houses in a settlement as 46, ranging from 8 households at Chuntian to 120 households at Barian Paras. A common trend observed in the Study Area is that on right side of the river most settlements are small, having few houses with most settlers being recent. Zone 2, studied through 7 settlements, had a similar pattern of a minimum of four houses to a maximum of 75 households in a settlement with an average of 24 houses per settlement. Zone 3 has a settlement with only three households. The maximum number of households in any settlement of the Zone was found to be 37, making the average number of households 23 for the four settlements visited. Zone 4 includes Balakot city where a settlement survey was not conducted. However, consultation and river dependent surveys were conducted. No rural settlements were visited or found in this Zone, falling within the parameters set for the study.

Zones 5 comprises settlements downstream of Balakot city. The 11 settlements visited were inhabited by a minimum of 17 households and a maximum of 1,500 households. The settlement with 1,500 households was exceptional as it was the urban center of Balakot. In Zone 6 only one settlement was studied, where the labor colony is to be established. It is inhabited by 59 households.

Household Size

The term 'household' is used for a structure wherein one or more than one family is residing. A household in most of these cases was owned by more than one family but practically resided by single family as other owners such as siblings of the same parent were living away from the household mainly in cities for their businesses and jobs. However, they were claiming residential rights as inherited through kinship.

As provided in **Exhibit 4.127**, the average household size in the Study Area was 6.2 individuals, with a minimum of 3.5 and a maximum of 10. Out of all the rural settlements, Zone 5 had the highest average household size followed by Zone 3. The average household size in rural areas was found to be smaller than that in the urban area of Balakot. The reasons could be multiple as not explored yet but we can assume, the destruction of the irrigation system in 2005 earthquake is one, if not the only, cause of this shift of residential pattern.

Exhibit 4.127: Average Household Size

Zone	*Number of Surveyed Settlements*	*Minimum Household Size*	*Maximum Household Size*	*Average Household Size*
1	8	5.0	7.5	6.1
2	7	3.5	8.0	6.1
3	4	3.8	10.0	6.4
4	0	-	-	-
5	11	4.3	10.0	6.5
6	1	5.5	5.5	5.5
Total	**31**			**6.2**

Source: Field Survey March–April 2017 and June–July 2018

Note: Zone 4 is Balakot city. As it is an urban area, rural settlement surveys were not conducted here.

Migration Trends

People in the pastoral communities within the Study Area have a trend of seasonal migration, with one home close to the river and one at higher elevations. They move their herds to the mountains for grazing.

In and out migration was observed to be insignificant over the past 7 years. The majority of out-migration took place after the earthquake in 2005 initially on a temporary basis but later with more permanent settlers.

Exhibit 4.128 shows migration trends and patterns in the Study Area. Overall out-migration was higher than in-migration. In Zone 3 in-migration is highest compared to all other zones (7.7%) followed by Zone 2 (3.0%).

Exhibit 4.128: Migration Trends and Patterns

Zone	*In Migration %*	*Out Migration %*
1	0.9%	0.4%
2	3.0%	0.1%
3	7.7%	0.0%
4	0.0%	0.0%
5	0.2%	1.4%
6	1.5%	0.0%
Total	**0.59%**	**1.15%**

Source: Field Survey March–April 2017 and June–July 2018

Castes

A caste is a social group identity which individuals get through their status as close class separated from other classes by distinctions of hereditary status or profession. It is different from the open class system for the reason that in the open class system one may change identity through wealth but in a caste it is forever and hereditary. In Balakot and adjoining Project settlements, it not only represents an individual's familial ties, but also political affiliations and social standing.

Exhibit 4.129 shows distribution of the population in the Study Area on the basis of caste. Within the Study Area Gujjars (30%) make up the highest proportion followed by Syed (12%) while other small groups comprise 29%.

Exhibit 4.129: Distribution of Population on Caste Basis

Castes	Percent in Zone						
	1	2	3	4	5	6	Study Area
Syed	71%	1%	0%	0%	11%	0%	12%
Awan	7%	7%	0%	0%	7%	0%	6%
Gujjar	5%	87%	52%	0%	26%	57%	30%
Raja	1%	0%	0%	0%	1%	0%	1%
Mughal	4%	1%	24%	0%	6%	27%	7%
Qureshi	1%	3%	8%	0%	10%	0%	9%
Pathan	1%	0%	0%	0%	5%	16%	5%
Other	10%	1%	17%	0%	34%	0%	29%
	100%	**100%**	**100%**	**0%**	**100%**	**100%**	**100%**

Source: Field Survey March–April 2017 and June–July 2018

Languages Spoken

Exhibit 4.130 shows the main languages spoken in the Study Area by zone, as a percentage. The predominant language is Hindko, however, Gojri is also widely spoken. Urdu, the language of communication is also understood everywhere especially amongst the youth. Based on observations from consultations, the Syed families have Hindko as their primary language; the professional workers have Pashto whereas the pastoral inhabitants speak Gojri. The youth of non-Hindko opt for Urdu as secondary language.

Exhibit 4.130: Main Languages Spoken in Study Area by Zones %

Language	1	2	3	4	5	6
Primary						
Urdu	0%	0%	0%	0%	4%	0%
Pashto	1%	0%	0%	0%	0%	10%
Punjabi	0%	0%	0%	0%	0%	0%
Pahari	0%	0%	0%	0%	0%	0%
Hindko	99%	27%	46%	0%	71%	30%
Gojri	0%	73%	54%	0%	25%	60%
Other	0%	0%	0%	0%	0%	0%
Secondary						
Urdu	100%	45%	66%	0%	97%	60%
Pashto	0%	0%	0%	0%	0%	0%
Punjabi	0%	0%	0%	0%	0%	0%
Pahari	0%	0%	0%	0%	0%	0%

Language	1	2	3	4	5	6
Hindko	0%	38%	34%	0%	0%	40%
Gojri	0%	17%	0%	0%	3%	0%
Other	0%	0%	0%	0%	0%	0%

Source: Field Survey March–April 2017 and June–July 2018

Exhibit 4.131 shows the distribution of the enrolled population by education levels.

Exhibit 4.131: Distribution of Enrolled Population by Education Levels by Zones

No	Education Level	1	2	3	4	5	6
1	Primary (Nursery to Class V) for Boys	284	250	0	0	1,342	0
2	Primary (Nursery to Class V) for Girls or Co-Ed	203	25	68	0	250	27
3	Middle (Class VI to VIII) for Boys	126	83	6	0	898	21
4	Middle (Class VI to VIII) for Girls or Co-Ed	71	0	23	0	130	0
5	Secondary (Class IX to X) for Boys	72	50	27	0	675	15
6	Secondary (Class IX to X) for Girls	31	2	1	0	48	0
7	Intermediate College for Boys/Girls	59	56	17	0	553	3
8	Degree College for Boys	40	25	0	0	192	0
9	Degree College for Girls	32	0	0	0	105	0
10	Technical and Vocational Training Institutes for Boys	5	0	1	0	21	0
11	Technical and Vocational Training Institutes for Girls	2	0	0	0	12	0
12	Madrassah	44	16	0	0	232	0

Source: Field Survey March–April 2017 and June–July 2018

Exhibit 4.132 shows the distribution of the enrolled population by gender, education levels and zones.

Exhibit 4.132: Distribution of Enrolled Population by Gender, Education Levels and Zones

No	*Zone*	*1*		*2*		*3*		*4*		*5*		*6*	
	Gender	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
1	Primary (Nursery to Class V) for Boys	213	71	149	101	–	–	–	–	635	707	–	–
2	Primary (Nursery to Class V) for Girls or Co–Ed	–	203	3	22	28	40	–	–	132	118	12	15
3	Middle (Class VI to VIII) for Boys	90	36	44	39	6	–	–	–	414	484	8	13
4	Middle (Class VI to VIII) for Girls or Co–Ed	10	61	–	–	7	16	–	–	85	45	–	–
5	Secondary (Class IX to X) for Boys	50	22	25	25	14	13	–	–	327	348	6	9
6	Secondary (Class IX to X) for Girls	8	23	–	2	–	1	–	–	10	38	–	–
7	Intermediate College for Boys/Girls	36	23	30	26	12	5	–	–	243	310	2	1
8	Degree College for Boys	32	8	13	12	–	–	–	–	126	66	–	–
9	Degree College for Girls	–	32	–	–	–	–	–	–	20	85	–	–
10	Technical and Vocational Training Institutes for Boys	5	–	–	–	1	–	–	–	21	–	–	–
11	Technical and Vocational Training Institutes for Girls	2	–	–	–	–	–	–	–	12	–	–	–
12	Madrassah	14	30	10	6	–	–	–	–	125	107	–	–
13	Other	–	–	–	–	–	–	–	–	–	–	–	–

Source: Field Survey March–April 2017 and June–July 2018

Exhibit 4.133 shows the percent of surveyed settlements reporting access to healthcare facilities by zone.

Exhibit 4.133: Percent of Surveyed Settlements Reporting Access to Health Facilities by Zones

No	Facilities	1	2	3	4	5	6
1	Dispensary	0%	14%	0%	0%	64%	0%
2	BHU	63%	57%	0%	0%	73%	0%
3	Health Center	0%	0%	0%	0%	9%	0%
4	Rural Health Center (RHC)	38%	14%	25%	0%	55%	0%
5	Hospital	75%	57%	75%	0%	55%	100%
6	Immunization (e.g. Polio drops)	25%	0%	50%	0%	55%	0%
7	LHV/LHW (Lady Health Visitors/Lady Health Workers)	25%	0%	50%	0%	55%	0%
8	Trained Midwife (dai)	0%	0%	0%	0%	18%	0%
9	Untrained Midwife (dai)	0%	0%	0%	0%	0%	0%
10	Pharmacy	50%	0%	0%	0%	45%	0%

Source: Field Survey March–April 2017 and June–July 2018

No disease was reported as an epidemic. The most common diseases reported in the adult male and female populations included flu/fever followed by tuberculosis, diabetes and goiter. The prevalence of these is within a negligible proportion of the population. In children, ages 15 and under, the most common disease was reported as typhoid, goiter and jaundice followed by flu/fever. Typhoid was reported across all settlements among adults and children. **Exhibit 4.134** shows the reported incidence of common diseases in the Study Area, as a percentage.

Exhibit 4.134: Reported Incidences of Diseases %

No	*Zones*	*1*			*2*			*3*			*4*			*5*			*6*
		M	*F*	*C U 15*	*M*	*F*	*C U 15*	*M*	*F*	*C U 15*	*M*	*F*	*C U 15*	*M*	*F*	*C U 15*	*M*
1	Flu/Fever	50%	30%	70%	100%	100%	100%	25%	25%	25%	0%	0%	0%	100%	100%	100%	10%
2	Malaria	1%	1%	0%	5%	5%	8%	0%	0%	0%	0%	0%	0%	5%	3%	7%	0%
3	Chicken Pox	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4	Typhoid	12%	18%	18%	12%	11%	9%	10%	10%	10%	0%	0%	0%	4%	4%	7%	0%
5	Diarrhea/ Dysentery	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
6	Tuberculosis	5%	8%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%
7	Goiter	5%	7%	13%	5%	5%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8	Jaundice	6%	3%	7%	6%	3%	0%	5%	5%	0%	0%	0%	0%	5%	3%	1%	0%
9	Diabetes	5%	4%	0%	9%	4%	0%	0%	0%	0%	0%	0%	0%	14%	11%	0%	0%
10	Other	5%	5%	0%	7%	10%	0%	0%	5%	0%	0%	0%	0%	50%	50%	0%	0%

Source: Field Survey March–April 2017 and June–July 2018

Physical Infrastructure

Presence of roads, communication networks and other infrastructure are indicators of development in a region. The survey determined that there is much scope for development in the Study Area, as access to various infrastructures is low in most parts.

Roads and Transportation

The settlements situated on the left bank of Kunhar River in the Study Area are well connected to the rest of Pakistan through the carpeted Kaghan-Balakot highway. No road is available on the right bank, however, at some points there are jeepable tracks. The communities residing on the right bank are connected to the left bank through suspension bridges and unsealed roads. In most cases, people have to walk a maximum of 2 km to reach the Kaghan-Balakot highway. **Exhibit 4.135** shows the percentage of each type of road, blacktop and unsealed, by zone.

Exhibit 4.135: Roads in Transport Services %

No	*Nature of Facility*	*1*	*2*	*3*	*4*	*5*	*6*
1	Blacktop Road	13%	29%	0%	0%	55%	100%
2	Unsealed Road	25%	14%	0%	0%	9%	100%

Source: Field Survey March–April 2017 and June–July 2018

Water Supply Sources

All surveyed settlements in Zones 1, 2, 3, 5 and 6, reported having access to a public potable water supply system comprising of a central water storage system, where water collects from a mountain spring and is supplied to the community via a pipeline up to a central point in the community. Distances of the settlements to sources of water ranges from 500 m to 2 km.

The irrigation system collapsed in the earthquake in 2005, after which it could not be rehabilitated. Agricultural has shifted towards being rain fed. Previously the area was known for rice production.[74] Most communities in all zones identified water supply infrastructure as a need especially the revival of their irrigation channels to reduce dependency on rain fed agriculture.

The dependence on the main Kunhar River for drinking is negligible in all zones. The river water is used for agriculture and feeding animals as reported in some settlements. **Exhibit 4.136** shows the water supply source by zone.

[74] Rice production needs flow of water in reasonable amounts and it was reported from all most all settlements in deep valleys on river banks that they had the practice of rice production before the earthquake in 2005.

Exhibit 4.136: Zone-wise Water Supply by Source %

No	Zone wise Source of Water Supply	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
1	Public water supply (government/municipal)	75%	29%	75%	0%	73%	100%
2	Spring/s	88%	100%	100%	0%	73%	100%
3	Well/s	0%	14%	0%	0%	55%	0%
4	Kunhar River	25%	0%	0%	0%	18%	0%
5	Tributaries of Kunhar River	0%	0%	25%	0%	0%	0%

Source: Field Survey March–April 2017 and June–July 2018

Sanitation and Waste Disposal

The Study Area with all settlements visited reports the availability of septic tanks for disposal of human waste. Pit latrine system was available in very few settlements, especially in Zones 1 and 2. The fields in respective settlements currently serves as the ultimate drain for wastewater and contaminated seepage associated with the household water use in the area. However, in Zone 1 at some points and almost all settlements in Zone 5 were observed using Kunhar River, for the purpose of drainage. This has increased contamination levels (see **Section 4.1.7**, *Water Resources*), presumably more in the winter, as the capacity of the river to flush the contaminants reduces in that season. There was no municipality sewerage system observed with proper drainage to save the river from contamination. **Exhibit 4.137** shows the type of sanitation by zone, as a percentage.

Exhibit 4.137: Type of Sanitation by Zone %

No	Type of Sanitation	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
1	Pit Latrine	0%	14%	0%	0%	0%	0%
2	Pit Latrine with Slabs	50%	14%	0%	0%	0%	0%
3	Septic Tanks	50%	71%	100%	0%	91%	100%
4	Open Latrine	0%	14%	0%	0%	9%	0%
5	Municipal Sewage System	0%	0%	0%	0%	9%	0%
6	Open Drains	0%	0%	0%	0%	0%	0%
7	Other	0%	0%	0%	0%	0%	0%

Source: Field Survey March–April 2017 and June–July 2018

Power and Fuel Source

As shown in **Exhibit 4.138**, the three major fuel sources in the Study Area include electricity, fuelwood and liquefied petroleum gas (LPG). Natural gas is not supplied in entire Kaghan Valley.

All settlements in the Study Area are connected to the main grid. Electricity is mainly used for lighting purposes and running household electrical appliances. For cooking and, water and space heating purposes, fuelwood and LPG are interchangeably used, depending on the availability and whichever is more economical.

Fuelwood is commonly used as a source of fuel. Communities source fuelwood from communal forests, paying only for the transportation cost. In urban areas fuelwood comes through markets. The suppliers source it from the communal forests but charge cutting, gathering and other labor charges, in addition to transportation. In Balakot and Garhi Habibullah supply of fuelwood is monitored by the government and managed through permits, in other zones this is informal communal activity. The local government discourages collection of fuelwood from forests to prevent deforestation.

Exhibit 4.138: Fuel Sources by Zone %

No	Fuel Source	1	2	3	4	5	6
1	Electricity	75%	71%	75%	0%	91%	100%
2	Fuelwood (Gathered)	100%	86%	75%	0%	27%	100%
3	Fuelwood (Market)	13%	0%	25%	0%	100%	0%
4	LPG	100%	14%	75%	0%	91%	100%
5	Kerosene	0%	0%	0%	0%	0%	0%
6	Diesel	0%	0%	0%	0%	0%	0%
7	Other (Solar)	13%	0%	25%	0%	0%	0%

Source: Field Survey March–April 2017 and June–July 2018

Exhibit 4.139 shows access to communication infrastructure by zone, as a percentage.

Exhibit 4.139: Zone-wise Access to Communication Infrastructure %

No	Types of Communication Facilities	1	2	3	4	5	6
1	Telephone	0%	0%	0%	0%	18%	0%
2	Mobile Phone Service	100%	100%	100%	0%	73%	100%
3	Post Office	33%	14%	0%	0%	73%	0%

Source: Field Survey March–April 2017 and June–July 2018

The peaceful law and order situation in the Study Area, prevalence of law enforcement agencies and related services is poor. In all zones except Zone 5, the majority of settlements did not have access to a police facility. Police check posts are only present on main Kaghan Highway. Police check posts monitor incoming traffic to tourist areas, to determine purpose of visitors to the valley. **Exhibit 4.140** shows the provision of police facilities by zone, as a percentage.

Exhibit 4.140: Provision of Police Facilities %

No	Police Facility	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
1	Police Station	38%	0%	0%	0%	73%	0%
2	Police Check post	0%	14%	0%	0%	36%	0%

Source: Field Survey March–April 2017 and June–July 2018

Banks and markets are available mainly in Balakot city. Shops are present on main Kaghan Highway. The shops provide for the day to day needs of the local communities or to supply travelers and tourists. For major purchases all settlements in the survey area depends mainly on Balakot city, which is the hub of economic activity in the region. There were one or two shops of basic groceries found in each settlement mostly belonging to household having transportation facility or jeep owners of the respective settlement. **Exhibit 4.141** shows the access to other facilities by zone, including banking and markets, as a percentage.

Exhibit 4.141: Access to Other Facilities %

No	Other facility	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
1	Bank	0%	0%	0%	0%	73%	0%
2	Market	0%	14%	25%	0%	91%	0%

Source: Field Survey March–April 2017 and June–July 2018

Exhibit 4.142 shows the employment within the Study Area. More than 50% of the total employable population is employed while 25% are unemployed. The remaining are students, retired and others (such as labor and small business operators).

Exhibit 4.142: Employment within the Study Area %

No	Employment Status	1	2	3	4	5	6	Overall
1	Employed	56%	54%	61%	0%	51%	80%	55%
2	Unemployed	19%	30%	25%	0%	26%	10%	25%
3	Student	8%	5%	10%	0%	17%	0%	11%
4	Retired	11%	10%	7%	0%	6%	10%	8%
5	Other	30%	13%	0%	0%	5%	0%	18%

Source: Field Survey March–April 2017 and June–July 2018

Sources of Livelihood

Exhibit 4.143 shows the sources of livelihood as a percentage, by zone in the Study Area. The major source of income for the settlements in Zones 1 to 5 was dependency of its members living in major cities of the country. The local livelihood reported shows main sources are agriculture, wage labor, private and government services, and skilled workers. A number of households have more than one source of income.

Subsistence agriculture, collection of wood, sand for construction, and seasonal services in tourism based hotel industry was the major contributor to the economy. People are also engaged in wood carving, driving, and services in security agencies.

Exhibit 4.143: Sources of Livelihood %

No	Livelihood Sources	1	2	3	4	5	6	Overall
1	Private Service	10%	19%	31%	0%	17%	30%	18%
2	Agriculture (Land owner)	13%	19%	8%	0%	43%	5%	25%
3	Agriculture (Wage laborer)	18%	21%	5%	0%	8%	10%	14%
4	Agriculture (Share Cropper)	11%	7%	13%	0%	7%	30%	9%
5	Fishing (Own business)	0%	0%	0%	0%	0%	0%	0%
6	Fishing (Labor)	0%	0%	0%	0%	0%	0%	0%
7	Sediment mining (wage Laborer)	8%	0%	9%	0%	4%	0%	5%
8	Other wage laborer	20%	13%	10%	0%	26%	0%	18%
9	Livestock (owner)	0%	50%	0%	0%	3%	10%	11%
10	Livestock (herder)	0%	15%	0%	0%	0%	0%	5%
11	Business (Hotel/restaurant)	9%	5%	0%	0%	7%	0%	5%
12	Trade/business	11%	5%	8%	0%	15%	5%	11%
13	Skilled workers	8%	28%	8%	0%	12%	5%	14%
14	Skilled artisans	21%	11%	10%	0%	4%	0%	10%
15	Government service (Health)	1%	2%	1%	0%	3%	0%	2%
16	Government service (Education)	7%	5%	5%	0%	7%	5%	6%
17	Government service (Other)	19%	8%	3%	0%	9%	0%	8%
18	Other	15%	0%	0%	0%	4%	0%	8%

Source: Field Survey March–April 2017 and June–July 2018

Household income

Exhibit 4.144 show the distribution of households in surveyed settlements by level of income. More than half of the households earn less than PKR 25,000 per month but more than PKR 10,000. A slight departure is observed in Zone 6, where 50% of the households were earning up to PKR 50,000 per month.

Exhibit 4.144: Household Income Levels by Zones (PKR/month) %

No	Income Level	1	2	3	4	5	6	Total average
1	Less than 10,000	17%	14%	12%	0%	17%	0%	12
2	10,000 – 25,000	57%	74%	63%	0%	36%	50%	56
3	25,000 - 50,000	19%	11%	26%	0%	20%	50%	25

No	Income Level	1	2	3	4	5	6	Total average
4	50,000 – 75,000	5%	1%	0%	0%	19%	0%	5
5	More than 75,000	3%	1%	0%	0%	8%	0%	2

Source: Field Survey March–April 2017 and June–July 2018

Exhibit 4.145 shows the average land holding by zone in the Study Area. The average landholding in all settlements ranges from 4 to 7 kanals per household. The urban settlements or settlements near the main Kaghan Road both in Zone 3 and 5 had an average of 3 kanals per household. The maximum landholding was reported as 7.67 kanal per household, found in Zone 2.

Exhibit 4.145: Average Land holding by Zones (Kanal)

Landholding	1	2	3	4	5	6
Average Land holding (Kanal)	3.94	6.71	3.31	-	3.23	5.00

Source: Field Survey March–April 2017 and June–July 2018

Farming

Exhibit 4.146 shows the crops grown by season in the Study Area. The agricultural economy is purely of subsistence in nature. Almost all people own farmlands both as personal property or as share croppers, produce from which is however 100% self-consumed. Rice is produced commercially in Zone 5. The crops grown in the Study Area are season specific. The data in **Exhibit 4.146** shows that maize/corn is the product of summer while wheat is cultivated in winter across the Study Area. Farming is mainly rain fed, with almost no dependence on river water for irrigation.

Exhibit 4.146: Crops Grown by Season Zone-wise

No	Seasonal Crops	1	2	3	4	5	6
	Summer						
1	Wheat	Yes	No	Yes	No	Yes	No
2	Maize/Corn	Yes	Yes	Yes	No	Yes	Yes
3	Grass	No	Yes	No	No	No	No
4	Rice	No	No	No	No	Yes	No
5	Other (Vegetables)	Yes	Yes	No	No	Yes	No
	Winter						
1	Wheat	Yes	Yes	Yes	No	Yes	Yes
2	Maize/Corn	Yes	No	Yes	No	No	No
3	Grass	No	No	No	No	No	No
4	Rice	No	No	No	No	No	No
5	Other (Vegetables)	No	No	No	No	Yes	No

Source: Field Survey March–April 2017 and June–July 2018

Exhibit 4.147 shows the proportion of crop sold in the Study Area. As discussed elsewhere, the local agricultural production is mainly for domestic consumption and only maize/corn or vegetable are reported as being sold (mostly in local market or in neighborhood).

Exhibit 4.147: Proportion Sold by Crop by Zone

No	*Nature of Crop*	*1*	*2*	*3*	*4*	*5*	*6*
1	Wheat	0%	0%	0%	0%	0%	0%
2	Maize/Corn	9%	3%	0%	0%	8%	0%
4	Rice	0%	0%	0%	0%	0%	0%
5	Other (Vegetables)	5%	0%	0%	0%	0%	0%

Source: Field Survey March–April 2017 and June–July 2018

Exhibit 4.148 shows the average yield by type of crop in the Study Area. Average yield is reported to be highest in Zone 1 followed by Zone 2 and Zone 5.

Exhibit 4.148: Average Yield by Type of Crop by zone (Mound/Kanal)

No	*Yield Type*	*1*	*2*	*3*	*4*	*5*	*6*
1	Wheat	5.9	3.6	2.3	-	4.3	4.0
2	Maize/Corn	7.0	3.7	2.7	-	4.3	6.0
4	Rice	-	-	-	-	5.0	-
5	Other (Vegetables)	7.8	6.5	-	-	5.0	-

Source: Field Survey March–April 2017 and June–July 2018

Livestock Rearing

As can be seen in **Exhibit 4.143**, more than half of the employed population is engaged in livestock rearing. Trends in livestock rearing were found to be consistent across zones. Most of the animals owned are poultry and cattle. The average value per animal is given in **Exhibit 4.149**. Livestock owners engage herders to rear goats and sheep, whereas poultry, cows and buffalo are reared at home.

Exhibit 4.149: Distribution of Livestock by Animal Type

No	*Livestock Type*	*1*	*2*	*3*	*4*	*5*	*6*	*Total*
1	Bullock/Buffalo	30	42	7	-	923	2	1,004
2	Cow	269	231	54	-	534	80	1,168
3	Goat	493	481	170	-	878	280	2,302
4	Sheep	-	8	-	-	16	-	24
5	Donkey	-	1	6	-	58	-	65
6	Horse	-	-	-	-	-	-	-
7	Camel	-	-	-	-	-	-	-

Source: Field Survey March–April 2017 and June–July 2018

Exhibit 4.150 shows the average value of livestock by type of animal in the Study Area.

Exhibit 4.150: Average Value of Livestock by Type of Animal, PKR

No	*Type of Animal*	*1*	*2*	*3*	*4*	*5*	*6*	*Mean*
1	Bullock/Buffalo	75,714	90,000	95,000	-	131,818	80,000	102,586
2	Cow	52,000	49,286	53,750	-	60,455	65,000	55,032
3	Goat	11,500	12,857	15,500	-	14,300	18,000	13,500
4	Sheep	-	12,000	-	-	22,500	-	19,00
5	Donkey	13,500	13,000	120,000	-	27,500	-	33,750
6	Horse	60,000	-	-	-	150,000	-	105,000

Source: Field Survey March–April 2017 and June–July 2018

Exhibit 4.151 shows the average time spent by livestock by the river-side in the Study Area. The dependency for livestock on Kunhar River was found to small, on average 1.6 hours out of 24 hours in all zones.

Exhibit 4.151: Average time Spent by Livestock by the River-side by Zone (hours/day)

	1	*2*	*3*	*4*	*5*	*6*	*Total*
Average Time (Hours)	0.6	2.8	2.0	-	1.6	-	1.6

Source: Field Survey March–April 2017 and June–July 2018

4.3.4 River-Dependent Socioeconomic Activities

Rural settlement surveys were undertaken in selected settlements with river dependence or within 1 km of Project facilities. Detailed consultations and village profiling were conducted in each settlement to collect data on livelihood and dependency on natural resources including on the Kunhar River for the settlements residing on both sides of the river. The slopes on the right side are steep and there is no access along the river especially from Zone 1 to 3. On the left bank of the river there is a road parallel to the river. This suits people to collect sediment. Even if the same is practiced on right side of the river, the same is transported through local indigenous system of “pulley” through a lifter to the roadside first and then onward transportation to other settlements. River dependent socioeconomic activities are however, limited in the Study Area.

Sediment Mining

Sediment (sand, gravel and cobble) mining is carried out throughout the Study Area. The mineable sediment resource is being extracted to meet small-scale construction demand, involving construction and maintenance of local residential and commercial buildings as well as for roads. Miners in the Balakot area reported that the import of sediment varies from year-to-year depending on the status of construction industry.

The mining techniques are crude, involving use of labor for dredging. No mechanical extraction was observed anywhere in the Study Area except Jagir (Thanda Mor) where sand is extracted through an excavator. The sand and gravel is mined using shovels and spades and is loaded onto animals and vehicles, from where it is transported to the roadside.

Exhibit 4.152 shows the transportation means and their typical capacities. The sediment is then piled up along the road and sold to the trucks that are passing by to collect sand for larger supply orders or in some cases loaded on a jeep and sold in nearby villages. The cable trollies are operated by electric motor (powered by diesel electric generators) or diesel engines. Miners in most cases undertake sand mining on their own lands along the riverbank.

Exhibit 4.152: Modes of Transportation of Sediment

Means	*Capacity (m^3/trip)*
Donkey	0.03
Horse	0.14
Jeep	1.42
Mini-truck	2.83
Tractor Trolley	2.8-4.2
Truck	8.5-11
Cable trolley	0.3

Source: Field Survey March–April 2017 and June–July 2018

Photographs of mining activities are shown in **Exhibit 4.153**.

Exhibit 4.153: Sand Mining Methods

Sand transportation by Jeep

Transporting sand and gravel using tractor trolleys

Sand Mining Trough at Bararkot

Sand mining with excavator

Sand Deposit near Jagir (Tanda Mor)

Chak dam to collect sand near Jalora

The extraction operation is carried out in areas where the flow of the river is gentle, the width is wide or where due to meandering of the river, sand bars are created. The operation continues throughout the year except in the flood season.

The mining operations are of different sizes ranging from 100 m^3/year to 2,080 m^3/year. Small- and medium-scale operations are typically family businesses. Families from nearby villages' set-up the sediment extraction which are usually run by family members. The land on the river bank, in most of the cases, is also owned by the family. However, in some cases it is rented. In most cases the labor is hired locally but at times it is also provided by the family. In this way, earnings from sediment mining operations remain primarily within the local economy. The reported selling price of the sediment varies considerably, from as low as PKR 500/secra to as much as PKR 2,000/secra.[75] To ensure even comparison, the roadside price is considered for the economic analysis.

Exhibit 4.154 summarizes the estimates for sediment mined along the main Kunhar River in the Study Area. Amounts of sediment extracted per km stretch of the river is highest in Zone 5, followed by Zone 4. Of the total sediment mined annually, the majority (98%) is extracted in Zone 5, between the stretch from Shahator Village (2.5 km downstream of Balakot Town) to Dalola Village, located at the upstream end of the reservoir of Patrind HPP.

Based on an analysis of data collected as part of the environmental and social impact assessment (ESIA) of Kohala HPP, sediment extraction is expected to increase as has been observed along other rivers in the basin, including Jhelum and Neelum Rivers, from 2013 to 2016.

Exhibit 4.154: Sand Mining Statistics

	Zone 1	*Zone 2*	*Zone 3*	*Zone 4*	*Zone 5*	***Total***
Number of HH	548	334	161	1500	9038	11569
River stretch (km)	4.2	13.5	4.6	3.5	22.1	47.9
Estimated number of mining businesses (Nos)	20	-	5	40	221	286
Volume extracted annually per business (m^3)	130	-	150	100	2,080	2,460

75 A *secra* or *sekra* is equal to 100 cubic feet or about 2.83 cubic meter.

	Zone 1	*Zone 2*	*Zone 3*	*Zone 4*	*Zone 5*	***Total***
Total extracted annually in the zone (m^3)	2,600	0	750	4,000	459,680	467,030
Sand mined m^3/per km stretch of river	619	0	163	1,143	20,800	9,750
Estimated number of persons involved	20	-	15	40	444	519
Percentage of HHs involved in sand mining	4%	0%	9%	3%	5%	4%
Estimate value (million Rs)	4.2	-	1.6	6.2	156.8	168.7
Payment to labor (million Rs)	-	-	2.0	-	18.5	20.5
Total annual income from all sources (million Rs)	158.04	76.88	41.37	607.42	3,809.29	4,693.0
Income as percent of total income	2.63%	0.00%	3.77%	1.03%	4.12%	3.60%

Source: Field Survey March–April 2017 and June–July 2018

The sand mining intensity map is shown in **Exhibit 4.155.**

Fishing

Fishing for self-consumption was observed in the Study Area. Fishing as a business was not observed in any of the six zones except in Zone 5 at Balakot. Even here it was on a small scale to meet the local restaurant clientage. The fishing season lasts between six months through the year, depending on the fish species caught. Seasonal permits for fishing using rods and cast nets are issued by the Tehsil administration or Fisheries and Wildlife Departments at Mansehra. However, most of the fish caught for self-consumption and business is caught without permits as enforcement is very weak. The most common fish species caught include the Alwan Snow Trout, Rainbow Trout and Brown Trout. Fishing activities are shown in **Exhibit 4.156.**

Based on the data collected for this Study, about 88% of the fish is self-consumed whereas the rest is sold commercially. As fishing is carried out illegally, i.e. without obtaining permits from the Fisheries Department, KP, fishermen are reluctant to share information on the fishing activities and volume of fish caught. The statistics presented in **Exhibit 4.157** are based on the analysis of information gathered from the sampled fishermen in the Study Area. During informal discussions with locals it was observed that some people also use illegal practices like blasting and poisoning to catch fish which means fishing is higher than reported.

Based on an analysis of data collected as part of the ESIA of Kohala HPP, fishing pressure is expected to increase as has been observed along other rivers in the basin, including Jhelum and Neelum Rivers, from 2013 to 2017. An increasing trend in fishing pressure was also highlighted by Mohammad Tanvir, Assistant Director, Manshera of the Fisheries Department, KP.

Exhibit 4.155: Sand Mining Intensity

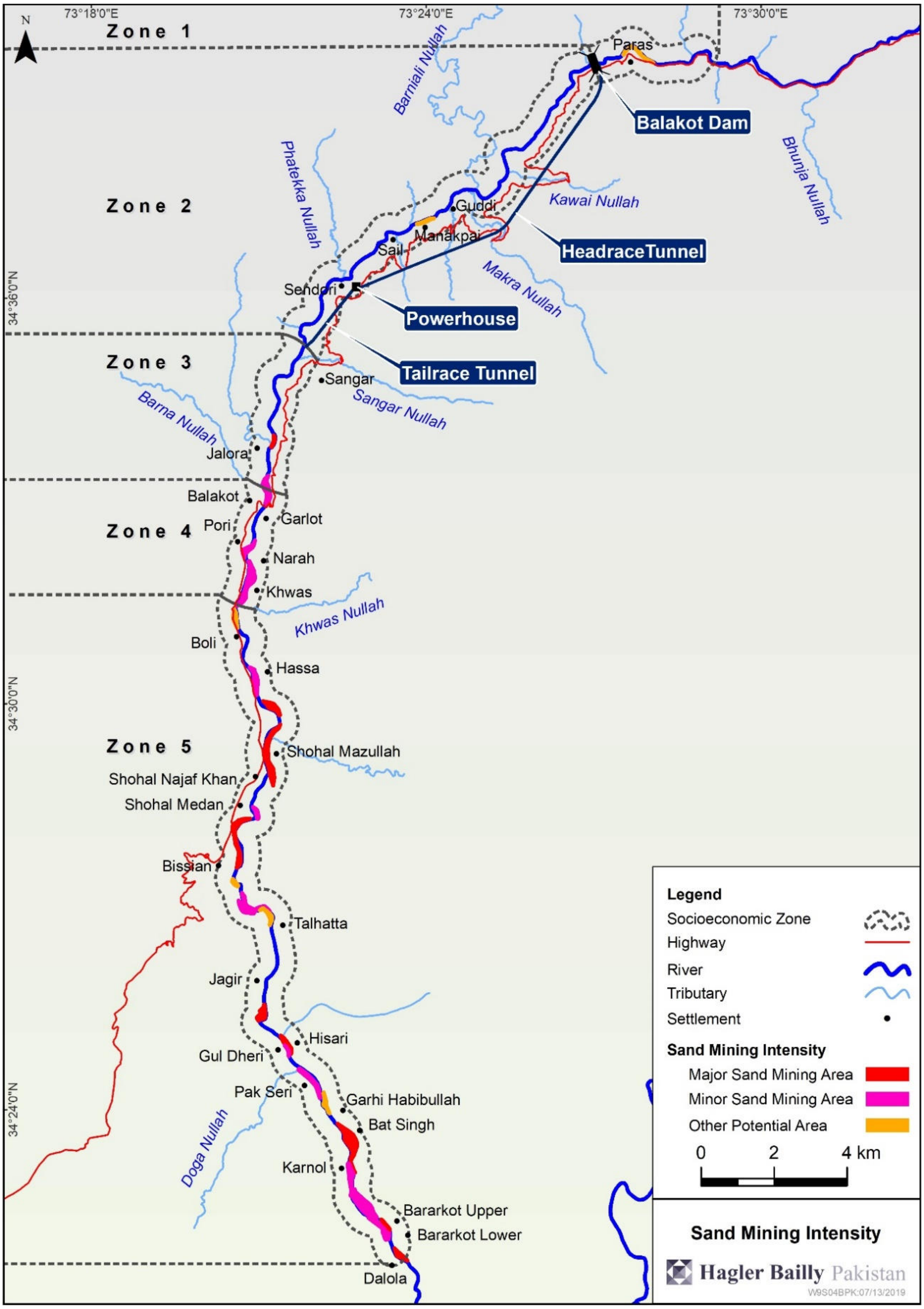
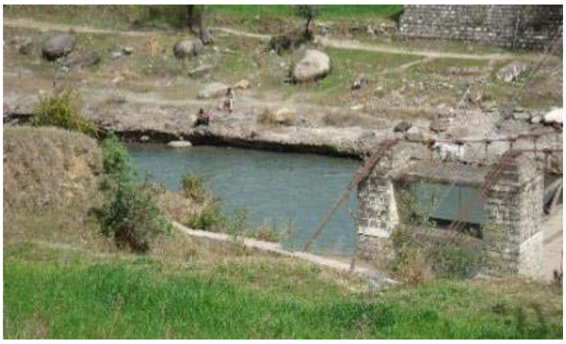


Exhibit 4.156: Fishing

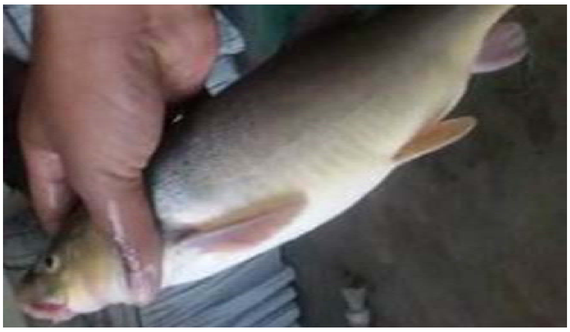
Gill Netting downstream of Bissian

Cast Netting upstream of Bissian



Fishing with Rod at Talhatta

Fishing at Karnol



Alwan Snow Trout Caught at upstream Bissian

Fishing at upstream Garhi Habibullah

Exhibit 4.157: Fishing Statistics

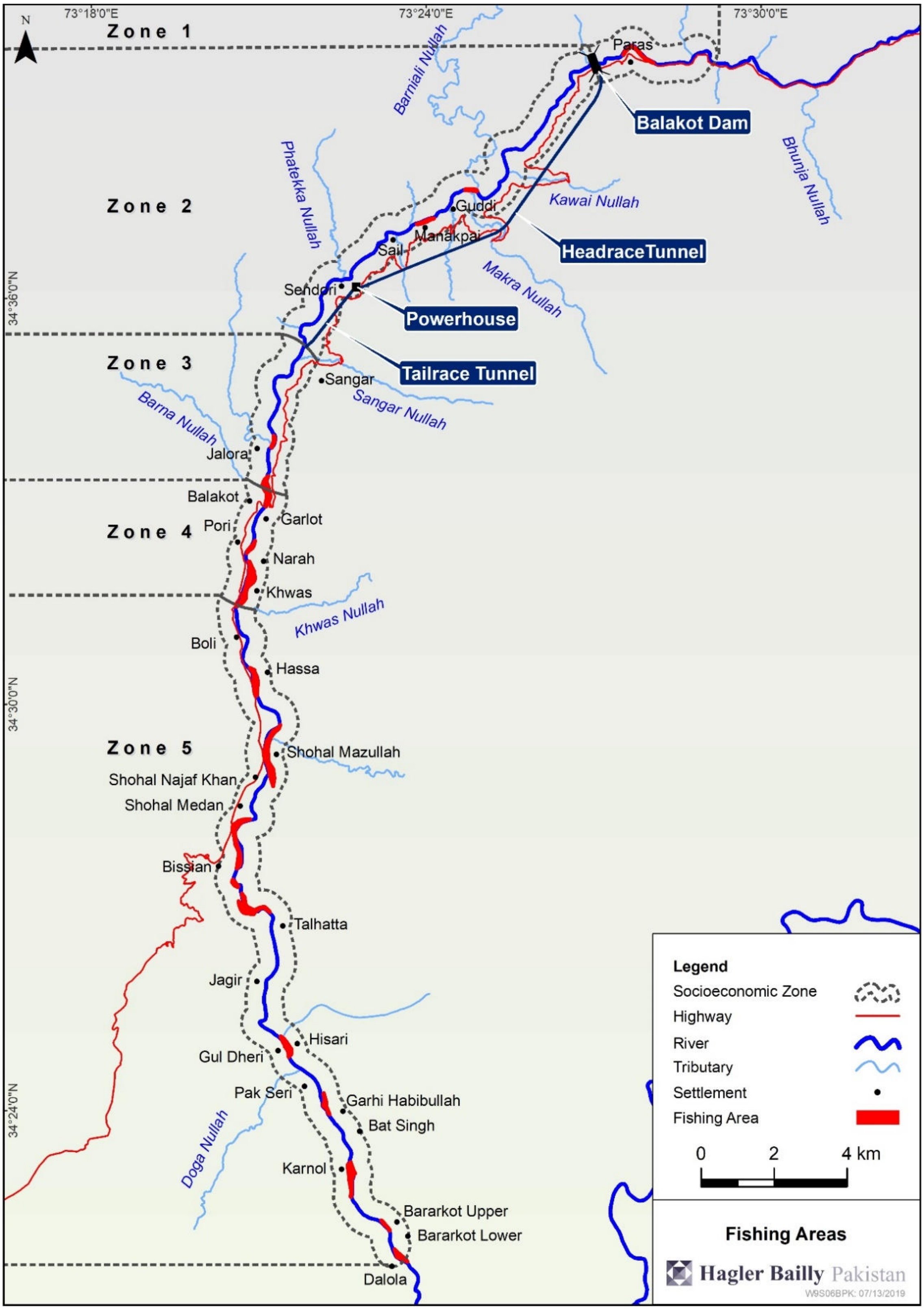
	Zone 1	*Zone 2*	*Zone 3*	*Zone 4*	*Zone 5*	***Total***
Number of HH	548	334	161	1500	9038	11569
Number of fishermen	13	3	4	33	181	234
Total fish catch per year (Maund)	2	2	1	20	51	76
River stretch km	4.2	13.5	4.6	3.5	22.1	47.9
Average fish catch per year per capita, kg	0.1	0.4	0.1	0.1	0.2	0.2
Fish catch kg/per km stretch of river	19.0	5.9	4.3	228.6	92.3	63.0
Self-consumed	100%	100%	100%	80%	85%	88%

	Zone 1	*Zone 2*	*Zone 3*	*Zone 4*	*Zone 5*	***Total***
Percentage of households engaged in fish catching (Entire Zone)	2%	1%	2%	2%	2%	2%
Percentage of households engaged in fish catching (Fishing Settlements)	9%	8%	13%	2%	5%	4%
Estimated total income from fishing (Rs)	-	-	-	88,000	400,400	488,400
Total annual income from all sources (million Rs)	158.04	76.88	41.37	607.42	3,809.29	4,684.6
Income as percent of total income	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%

Source: Field Survey March–April 2017 and June–July 2018

A map showing intensity of fishing on Kunhar River in the Study Area is shown in **Exhibit 4.158.**

Exhibit 4.158: Fishing Areas



Driftwood Used as Fuel

Fuel wood is the main source of energy for domestic cooking and heating. Respondents reported that fuel wood is collected from the farmlands and dead-fallen trees in the forests. There is limited dependence on driftwood collected from the riverbanks as source of fuel wood except in settlements at the peripheries of Balakot where the river flows through more plain areas creating room for such activities.

Tourism and Recreational Activities

Recreational dependence on the river was reportedly low in all the zones. During the survey the respondents did not cite riverside fishing, boating or picnics as a major recreational activity. However, the roadside hotel owners reported that riverside recreation was popular to certain extent among the tourists from other areas.

4.3.5 Profile of the Affected Villages

By the Project execution, four settlements of revenue village Paras; Bela Balseri, Nihan, Rahter and Dhab, one settlement Takool of revenue village Bela Sacha, one settlement Sangar of revenue village Sangar and one settlement Sendori of revenue village Kappi Gali will be affected. All the settlements are included in tehsil Balakot of district Mansehra. The socioeconomic profile is based on the survey carried out in six affected villages; five at the dam site (Bela Balseri, Nihan, Rahter and Dhab) and one at staff colony site (Sanger and Kapi Gali). Socioeconomic data collection could not be conducted in the settlement of Sendori as the ownership status of this settlement is not clear. Land records will be updated in all these settlements before land acquisition and all the affected households (AHs) will be compensated and resettled accordingly.

4.3.6 Socioeconomic Conditions of Affected Households

This section presents socioeconomic information and a profile of affected people based on a survey of all available AHs from six settlements i.e. Bela Balseri, Nihan, Dhab, Rahter, Sangar and Kappi Gali of district Mansehra.

Infrastructure in the Affected Villages

Most of the affected settlements are along the national highway N-15 and linked through unsealed roads. Electricity and communication services are available in all the affected settlements. Schools and health facilities (BHUs) are available within or along the affected villages. Sources of drinking water in all the affected villages is water springs. Communities have installed pipes to bring water to their houses. Services like hospitals, police stations and markets and banks are available in tehsil headquarter Balakot.

Distribution and Demography of Affected Households

As shown in **Exhibit 4.159,** of the total 165 AHs surveyed, 74 households belong to Bela Balseri village, 21 households belong to Nihan village, 5 households belong to Dhab village, 31 households belong to Rahter village, 16 households belong to Sangar village and 18 households belong to Kappi Gali village.

Exhibit 4.159: Village-wise Distribution of Affected Households

Settlement	*Affected Households*	*Parentage*
Bela Balseri	74	*44.8%*
Nihan	21	*12.7%*
Dhab	5	*3.0%*
Rahter	31	*18.8%*
Sangar	16	*9.7%*
Kappi Gali	*18*	*10.9%*
Total	**165**	*100.0%*

Source: Field Survey Mar–Apr 2017 and June–July 2018

Total population of surveyed households is 887 of which 53.2% are male and 46.8 % are female and on average, each household comprises 5.38 members (**Exhibit 4.160**). The female to male ratio of the AHs is 1:0.87.

Exhibit 4.160: Settlement-wise Distribution of surveyed AHs and Sex Ratio

Location	*Affected Households*	*Estimated % of AHs to total HHs of the Village*	*Sex*				*Population*	
			Male	*%*	*Female*	*%*	***Total***	*Average*
Bela Balseri	74	44.8%	201	53.9%	172	46.1%	373	5.04
Nihan	21	12.7%	55	45.8%	65	54.2%	120	5.71
Dhab	5	3.0%	12	41.4%	17	58.6%	29	5.80
Rahter	31	18.8%	90	54.9%	74	45.1%	164	5.29
Sangar	16	9.7%	54	55.7%	43	44.3%	97	6.06
Kappi Gali	18	10.9%	60	57.7%	44	42.3%	104	5.78
Total	**165**		**472**	53.2%	**415**	46.8%	**887**	**5.38**

Source: Field Survey March–April 2017 and June–July 2018

4.3.7 Social Profile of the Affected Households

The major castes of the affected households are Syed (66 %), Akhund Khel (15 %), Gujjar (7 %), Mughal (3 %), Qureshi (2 %) and Awan (2%) as presented in **Exhibit 4.161.**

Exhibit 4.161: Castes of Affected Households

Social Groups/Caste	*No. of HH*	*Percentage*
Syed	108	65.5%
Mughal	5	3.0%

Social Groups/Caste	No. of HH	Percentage
Gujjar	11	6.7%
Awan	3	1.8%
Raja	1	0.6%
Akund khek	25	15.2%
Bhatti	1	0.6%
Qureshi	4	2.4%
Surmi Khel	1	0.6%
Others	6	3.6%
Total	165	100.0%

Source: Field Survey March–April 2017 and June–July 2018

Educational Level and Literacy Rate

The socioeconomic survey conducted in the Project area revealed that the literacy rate among the surveyed population above the age of fifteen years is 72%, which is higher than the overall literacy rate of 50% and 59% of KP and Pakistan, respectively.[76] **Exhibit 4.162** further shows that the literacy rate for males is 83%, which is higher than that for females (59%).

Exhibit 4.162: Literacy Rate of Affected Population

Literacy level	Total Number of Persons		
	Male	Female	Total
Illiterate	77	160	**237**
Literate	369	234	**603**
Total	446	394	**840**
Literacy Ratio %	83%	59%	72%

Source: Field Survey March–April 2017 and June–July 2018

As provided in **Exhibit 4.163**, among literate people 1% are having education from a Madrassah, 24% have studied less than primary, 22% have education up to primary level, 10% have education up to matric level, 7% have education up to intermediate level, 7% have education up to graduate level and less than 1% have other education.

76 http://www.sciencedirect.com/science/article/pii/S2405883116300247

Exhibit 4.163: Education Level of Affected Population

Education Level	Total Number of Persons			
	Male	Female	**Total**	**Percentage**
Illiterate	77	160	**237**	**28.2%**
Madrassah	1	7	**8**	**1.0%**
No or Less than Primary	123	76	**199**	**23.7%**
Primary (Class 5 to Class 9)	106	78	**184**	**21.9%**
Matric (Class 10)	52	33	**85**	**10.1%**
Intermediate (FA/FSc)	40	16	**56**	**6.7%**
Graduate (BA/BSc)	41	20	**61**	**7.3%**
Other	6	4	**10**	**1.2%**
Total	**446**	**394**	**840**	**100.0%**

Source: Field Survey March–April 2017 and June–July 2018

Culture, Religion, Ethnic Minority and Indigenous Structures

No minority, in terms of culture, religion, ethnicity and indigenous household is being affected by the Project.

Gender

Eleven woman-headed households will be affected by the Project. Taking into account the socioeconomic vulnerabilities of the AHs, vulnerable allowance as discussed in Entitlement Matrix (see **Land Acquisition and Resettlement Plan** in **Volume 8**) will be provided to AHs to ensure that they are not marginalized in the process of land acquisition and Project implementation.

Land Ownership and Land Holding Size

As provided in **Exhibit 4.164**, minimum cultivated land of a household is 0.2 kanals and maximum is 4.25 kanals with an average of 1.73 kanals per household. While, minimum uncultivated land of a household is 0.25 kanals and maximum is 5 kanals with an average of 1.33 kanals per household.

Exhibit 4.164: Land Holding Size of Affected Households

Nature of Land	Minimum (Kanal)	Maximum (Kanal)	Average (Kanal)
Cultivated Land	0.2	4.25	1.73
Uncultivated Land	0.25	5	1.33

Source: Field Survey March–April 2017 and June–July 2018

Occupation and Production System

A majority of the working–age population surveyed were without any gainful employment. As shown in **Exhibit 4.165** of the people with gainful employment, about 41% were employed in private sector, about 24% were working as skilled and unskilled labor, almost 18% were employed in public sector, about 24% were doing trade or involved in their own business, almost 11% were generating their income from agriculture and 5% were working as artisans. Out of the total income earning population about 9% are female and 91% are male.

Exhibit 4.165: Occupational Profiles of Affected Population

Livelihood Sector	*No. of Persons*			
	Male	*Female*	*Total*	*% of Total working Population*
Employed in private Sector	32	8	40	18.10
Working as skilled or unskilled laborer	81	9	90	40.72
Employed in government Sector	5	-	5	2.26
Self–Owned trade and business	52	-	52	23.53
Income generating farming	24	-	24	10.86
Self–employed, working as artisans	6	4	10	4.52
Total	**200**	**21**	**221**	100.00
Gender %	**90.5%**	**9.5%**	**100.00**	

Source: Field Survey March–April 2017 and June–July 2018

Source of Household Income

During analysis of household income earned from different sources, income from agriculture was also included. Income from fruit trees and consumed crops by the households themselves (in terms of monetary value) was included in agricultural income.

The private and Public sector (Salaried jobs) sector is the main income producing sector which accounts for 53% of the entire income followed by labor (18 %) and business (17 %). Agriculture sector is producing 8% income which also includes self–consumed crops and fruits. While 4% income is coming from other sources like Rent, charity and livestock. The annual income of affected households is presented in **Exhibit 4.166**.

Exhibit 4.166: Annual Income of Affected Households

Livelihood Sector	*Annual Income*	*Percentage*
Salaried	29,218,000	52.6%
Labor	10,033,000	18.1%
Business	9,517,000	17.1%
Farming	4,332,000	7.8%
Other (Rent, Charity and Livestock)	2,442,400	4.4%
Total	**55,542,400**	**100.0%**

Source: Field Survey March–April 2017 and June–July 2018

Average Income and Expenditure

As provided in **Exhibit 4.167** the average income of one household is Pakistani Rupee (PKR) 372,397 per annum and average expenditures of one household are PKR 257,161 per annum. While on average one household is saving PKR 115,237 per annum.

Exhibit 4.167: Income and Expenditures of Affected Households

Income and Expenditures	*Income and Expenditures in PKR/Annum*		
	Minimum	*Maximum*	*Average*
Income	60,000	1,560,000	372,397
Expenditures	24,800	911,000	257,161
Savings	200	1,147,200	115,237

Source: Field Survey March–April 2017 and June–July 2018

Poverty Level

Poverty is usually measured as an index of income inequality. In Pakistan poverty line is PKR 3,030[77] per person per month. Of the surveyed AHs, the proportion of households living under the estimated national poverty line is 13% (19 households) while, households earning more than PKR 10,000 per person per month are also 14% (23 households), which can be considered as higher income level as given in **Exhibit 4.168**.

Exhibit 4.168: Income Level and Percentage of Affected Households Above and Below Poverty Line

Income Level PKR/Person/Month	*Number of HH*	*Percentage*
Up to 3,030 (national poverty line)	19	11.5%
3,030 to 5,000	68	41.2%
5,001 to 10,000	55	33.3%
10,001 and above	23	13.9%
Total	**165**	**100.0%**

Source: Field Survey March–April 2017 and June–July 2018

Housing

Exhibit 4.169 shows that the majority of the houses are having brick built construction with tin roof (semi–*pucca*) (87%) while only one house is *katcha* (made of wood with mud walls) houses.

77 <http://www.dawn.com/news/1250694>

Exhibit 4.169: Construction Type of Houses

Village	*Construction Type (No. of Houses)*			
	Pucca	*Semi Pucca*	*Katcha*	***Total***
Bela Balseri	12	62	0	**74**
Nihan	0	21	0	**21**
Dhab	0	5	0	**5**
Rahter	1	29	1	**31**
Sangar	2	14	0	**16**
Kappi Gali	6	12	0	**18**
Total	**21**	**143**	**1**	**165**
Percentage	**12.7%**	**86.7%**	**0.6%**	**100.0%**

Source: Field Survey March–April 2017 and June–July 2018

On average, one house has four rooms, one kitchen and one bathroom. As given in **Exhibit 4.170**, 24% of the houses are small (less than 5 Marla), 58% of the houses are medium (5 Marla–10 Marla) and 30% of the houses are large (more than 10 Marla).

Exhibit 4.170: Number of Houses by Size

Village	*No. of Houses*			
	Small	*Medium*	*Large*	***Total***
Bela Balseri	13	45	16	74
Nihan	2	13	6	21
Dhab	1	4	0	5
Rahter	12	18	1	31
Sangar	1	9	6	16
Kappi Gali	11	6	1	18
Total	**40**	**95**	**30**	**165**
Percentage	**24.2%**	**57.6%**	**18.2%**	**100%**

Source: Field Survey March–April 2017 and June–July 2018

Household Assets

Appliances

Exhibit 4.171 shows the number of households having different home appliances.

Exhibit 4.171: Appliances Owned by Affected Households

Appliances	*No. of Appliances*	*No. of HH*
Television	84	72
Radio	34	32
Refrigerator	29	29
Freezer	17	17
Washing Machine	103	97
Electric Iron	133	122
Electric Fan	238	50
Electric Room Heater	22	20
Electric Water Heater	47	43
Sewing Machine	74	68
Computer	20	15
Generator	4	4

Source: Field Survey March–April 2017 and June–July 2018

Livestock

As provided in the **Exhibit 4.172** type of livestock found in the Project area includes buffaloes, cows, calves, goats, sheep, oxen and chicken. More than 99% of households keep livestock for self–consumption and less than 1% of the households keep livestock for both the purposes like commercial and self–consumption. As most of the people will remain in the same area and most grazing lands will remain available for them, AHs can keep their livestock. There will be no impact on livelihood of AHs regarding livestock due to land acquisition.

Exhibit 4.172: Livestock Owned by Affected Households

Livestock	*No. of Livestock and Use*				
	Self	*Commercial*	*Both*	*Total*	*Percentage*
Buffaloes	11	-	-	**11**	2.8%
Cows	85	-	1	**86**	22.1%
Oxen	2	-	2	**4**	1.0%
Calf	10	-	-	**10**	2.6%
Goats/Sheep	110	-	-	**110**	28.2%
Chickens	169	–	–	**169**	43.3%
Total	**387**	**-**	**3**	**390**	
Percentage	**99.2%**	**0.0%**	**0.8%**	**100.0%**	

Source: Field Survey March–April 2017 and June–July 2018

Vehicles

As provided in the **Exhibit 4.173** type of vehicles owned by affected households include motorcycles, cars, jeeps, buses, truck and pickup, motorcycles. Some people use cars and jeeps for personal use and some use cars and jeeps for commercial use. While bus, truck and pickups are commercially used.

Exhibit 4.173: Vehicles Owned by Affected Households

Type	*Number of Vehicles*			
	Personal	*Commercial*	*Both*	***Total***
Car	14	-	3	**17**
Motorcycle	6	-	-	**6**
Trucks	-	1	-	**1**
Pick-up	-	1	-	**1**
Other	2	-	-	**2**
Total	**22**	**2**	**3**	**27**

Source: Field Survey March–April 2017 and June–July 2018

Water and Sanitation

The main source of drinking water for affected households is the spring water. Most of the households have installed pipe line from water springs to bring water to their houses however. All the land owners rely on rain water to irrigate their lands.

There is no proper sanitation system in the Project area. Some people discharge their sewerage on the land to the agricultural fields or to the streams. In few cases, soak pits are used for sewerage discharge. All the affected 165 surveyed households have a pit latrine.

Fuel Sources

The fuel sources commonly used by AHs are electricity, fuel wood, liquefied petroleum gas (LPG) as given in **Exhibit 4.174**.

Exhibit 4.174: Fuel Sources used by Affected Households

Fuel Sources	*No. of HHs*			
	Lighting	*Space heating*	*Water heating*	*Cooking*
Electricity	150	16	35	14
Fuel Wood (Gathered)	0	22	22	22
Fuel Wood (Market)	25	94	128	131
LPG	22	11	49	87
Kerosene	1	-	-	-

Source: Field Survey March–April 2017 and June–July 2018

Family Health

Births and Deaths

During the last two years in the affected households 45 live births and 4 still births took place. During last two years a total of 17 persons died in the affected households. Out of total 17 died persons 4 were infants under the age of 2 years, 1 was between the age of 2 to 15 years age, 7 were between the age of 15 to 60 years and 5 persons were above the age of 60 years.

Serious illnesses

The serious illnesses in the AHs in last two years were asthma, cancer, diabetes, heart disease, hepatitis, jaundice, paralysis and tuberculosis (**Exhibit 4.175**). Analysis of the data shows that 47% of the persons that suffered from serious illnesses were treated while 53% were still under treatment.

Exhibit 4.175: Serious Illness and Outcome

Illness	*No. of Persons and Outcome*					
	Treated	*Persisting*	*Disability*	*Lost job or occupation*	*Death*	***Total***
Tuberculosis	2	1	-	-	-	**3**
Hepatitis	-	-	-	-	-	**-**
Asthma	-	2	-	-	-	**2**
Jaundice	-	1	-	-	-	**1**
Tetanus	-	-	-	-	-	**-**
Paralysis	1	-	-	-	-	**1**
Diabetes	1	1	-	-	-	**2**
Cancer	-	1	-	-	-	**1**
Heart disease	3	6	-	-	-	**9**
Typhoid	5	-	-	-	-	**5**
Other	7	9	-	-	-	**16**
Total	**19**	**21**	**0**	**-**	**-**	**40**
Percentage	**47.5%**	**52.5%**	**0.0%**	**0.0%**	**0.0%**	**100.0%**

Source: Field Survey March–April 2017 and June–July 2018

Accidents

Exhibit 4.176 shows the type of accidents that occurred in last two years in AHs.

Exhibit 4.176: Accidents and Outcome

Type of Accident	*No. of Persons and Outcome*						*Percentage*
	Treated	*Persisting*	*Disability*	*Lost Job or Occupation*	*Death*	***Total***	
Fall from height	-	-	-	-	-	**-**	0%
Snake Bite	-	-	-	-	-	**-**	0%
Road accident	2	-	-	-	-	**2**	50%
Burns	-	-	-	-	-	**-**	0%
Electrocution	-	-	-	-	-	**-**	0%
Accident at work	2	-	-	-	-	**2**	50%
Other	-	-	-	-	-	**-**	0%
Total	**4**	**-**	**-**	**-**	**-**	**4**	
Percentage	**100%**	**0%**	**0%**	**0%**	**0%**	**100%**	

Source: Field Survey March–April 2017 and June–July 2018

Common Illnesses

As provided in the **Exhibit 4.177** common illnesses reported by the surveyed households were cold and flu, stomach ache and joint aches.

Exhibit 4.177: Common Illness

Common Illness	*Age Group*				*Total*	*% of Common Illness*
	Adult Men	*Adult Women*	*Children (6 to 14)*	*Infants (0 to 5)*		
Cold and flu	110	117	90	72	389	64.19
Diabetes	1	-	1	-	2	0.33
Stomach diseases	9	16	-	-	25	4.13
Skin diseases	22	28	4	1	55	9.08
Breathing problems	2	3	2	1	8	1.32
Joint aches	3	2	-	-	5	0.83
Heart Problem	15	28	-	-	43	7.10
Paralysis	7	6	-	1	14	2.31
Jaundice	1	1	-	-	2	0.33
Tuberculosis	3	2	-	-	5	0.83
Other	-	2	-	-	2	0.33
Total	**190**	**231**	**98**	**87**	**606**	9.24
Percentage	**31.35**	**38.12**	**16.17**	**14.36**	**100.00**	-

Source: Field Survey March–April 2017 and June–July 2018

5. Analysis of Alternatives

A key component in the EIA process is the consideration of alternatives. Most guidelines use terms such as 'reasonable', 'practicable', 'feasible' or 'viable' to define the range of alternatives that should be considered. Essentially there are two types of alternatives:

- incrementally different (modifications) alternatives to the Project; and
- fundamentally (totally) different alternatives to the Project.

Alternatives are essentially, different ways in which the developer can feasibly meet the Project's objectives, for example by carrying out a different type of action, choosing an alternative location or adopting a different technology or design for the project. At the more detailed level, alternatives merge into mitigating measure where specific changes are made to the project design or to methods of construction or operation to avoid, reduce or remedy environmental effects. All EIA systems also require developers to consider mitigation (i.e. measures to avoid, reduce and remedy significant adverse effects).

Alternatives and mitigation therefore cover a spectrum ranging from a high level to very detailed aspects of Project design. The "No Project" scenario must also be considered as the baseline against which the environmental effects of the Project should be considered.

This section presents an analysis of the following alternatives from the perspective of economic and environmental considerations:

1. No project option
2. Alternative options for power generation
3. Environmental flow and management alternatives
4. Options for transportation of equipment to project site

5.1 No Project Option

The No Project alternative will have the following economic and environmental consequences:

- KP and Pakistan are going through an acute power shortage. In KP there is a gap between supply and demand of over 2,600 MW.[1] The proposed Project will contribute to the supply of much needed power to reduce the current gap. Thus in the absence of this project, the gap in power supply and demand will continue to grow.
- Environmentally, this Project will contribute towards improving the air quality as in the long run it will displace fossil fuels used in power generation such as coal and fuel oil which increase the concentrations of pollutants in the air in the

[1] Pakhtunkhwa Energy Development Organization (PEDO), 2016, Investment Opportunities Hydropower Projects

surrounding areas. The Project will also reduce greenhouse gas emissions in the atmosphere due to this reason.

- The EFlow assessment conducted for the Project (see **Volume 2C** of **EIA**) indicates that under the Business-as-Usual (BAU) management scenario fish populations over a 31 year period are expected to reach a fraction of Present Day levels with Nalbant's Loach and Kashmir Hillstream Loach populations declining to over 50% and 70% of Present Day level, respectively even without the construction of new HPP, given the present level of pressures on the ecosystem related to economic uses of river resources.
- The Wildlife and Fisheries Departments presently have very limited numbers of watchers available to patrol the entire stretch of the river and associated tributaries.
- Illegal fishing is widely prevalent, and unregulated mining of sediment mining is on the increase. In absence of the Project and without a sustainable resource base for protection as envisioned under the Project, the ecology of the Kunhar River runs a high risk of decline corresponding to a BAU management scenario as discussed above.
- Under the BAU management scenario with poor protection as at present, the ecosystem integrity of the river will deteriorate significantly over the next 31 years (**Section 7.2**, *Impact Assessment: Aquatic Ecology*). As discussed in **Section 7** of the **Environmental Flow Assessment Report** in **Volume 2C**, the Project aims to achieve 'net gain' for Nalbant's Loach and Kashmir Hillstream Loach consistent with ADB and IFC guidelines for management of biodiversity when projects are located in Critical Habitats (**Section 4.2.8,** *Habitat Assessment*). A Biodiversity Action Plan (see **Volume 2C** of **EIA**) has been prepared and will be implemented as a part of the Project to achieve this objective.

Therefore, unless an economically and environmentally more viable option can be found, which appears unlikely, the 'no project' option will have a negative impact on the economy as well as on the environment in the Kunhar River.

5.2 Alternative Technologies and Scale for Power Generation

The alternatives to the proposed run-of-the-river (RoR) hydropower project include power generation from LNG/imported natural gas based combined cycle gas turbines (CCGTs), coal fired steam plants, and fuel oil based diesel engines. In addition, other technologies such as nuclear, and wind and solar renewable energy power plants could also be considered as alternatives. An analysis of the life cycle average cost of generation from the competing technologies was carried out to assess the least cost generation alternative of the project.

Exhibit 5.1 illustrates the calculation of life cycle average cost for the competing technologies for power generation in Pakistan. The analysis was carried out at the Brent crude oil price of USD 50/BBL, coal price ex mine of USD 40/ton, and delivered price of

LNG indexed to Brent Crude at USD 9.86/MMBTU[2]. The cost data of alternatives for thermal power generation were taken from recent industry experience in Pakistan.

Exhibit 5.2 shows the comparison of cost of generation from various technology alternatives. Cost of power generation for the proposed large size RoR hydropower project is presently comparable to that for LNG and coal based options based on cost of power generation. Cost of power generation for the large hydropower projects is also lower than that for wind energy and solar PV projects where power generation is intermittent and weather dependent, and requires back up fossil fuel based power generation capacity to maintain supply in the grid. Larger hydropower projects such as Diamer-Basha Dam that have also capacity for water storage can produce power at a slightly lower cost than the smaller RoR hydropower projects. Such large projects, however, generally involve extensive resettlement and technical studies, tend to be delayed for these reasons and can take 7-12 years to complete, and frequently face cost overruns[3]. In addition, investment is difficult to mobilize in Pakistan at present due to risk rating of the country. Given the risk of delays and cost over runs in larger dams, shortage of power in the country, and investment constraints, the Project as a large capacity RoR that can be completed in five years is an acceptable option amongst currently available alternatives in terms of technology and scale of projects.

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[2] MMBTU stands for one million British Thermal Units (BTU). A BTU is a measure of the energy content in fuel. One BTU is equivalent to 1.06 Joules.

[3] Should we build more large dams? The actual costs of hydropower megaproject development, Atif Ansara, Bent Flyvbjergb, Alexander Budzierb, Daniel Lunnc, Energy Policy, Volume 69, June 2014

Exhibit 5.1: Life Cycle Average Cost of Power Generation from the Project Alternatives

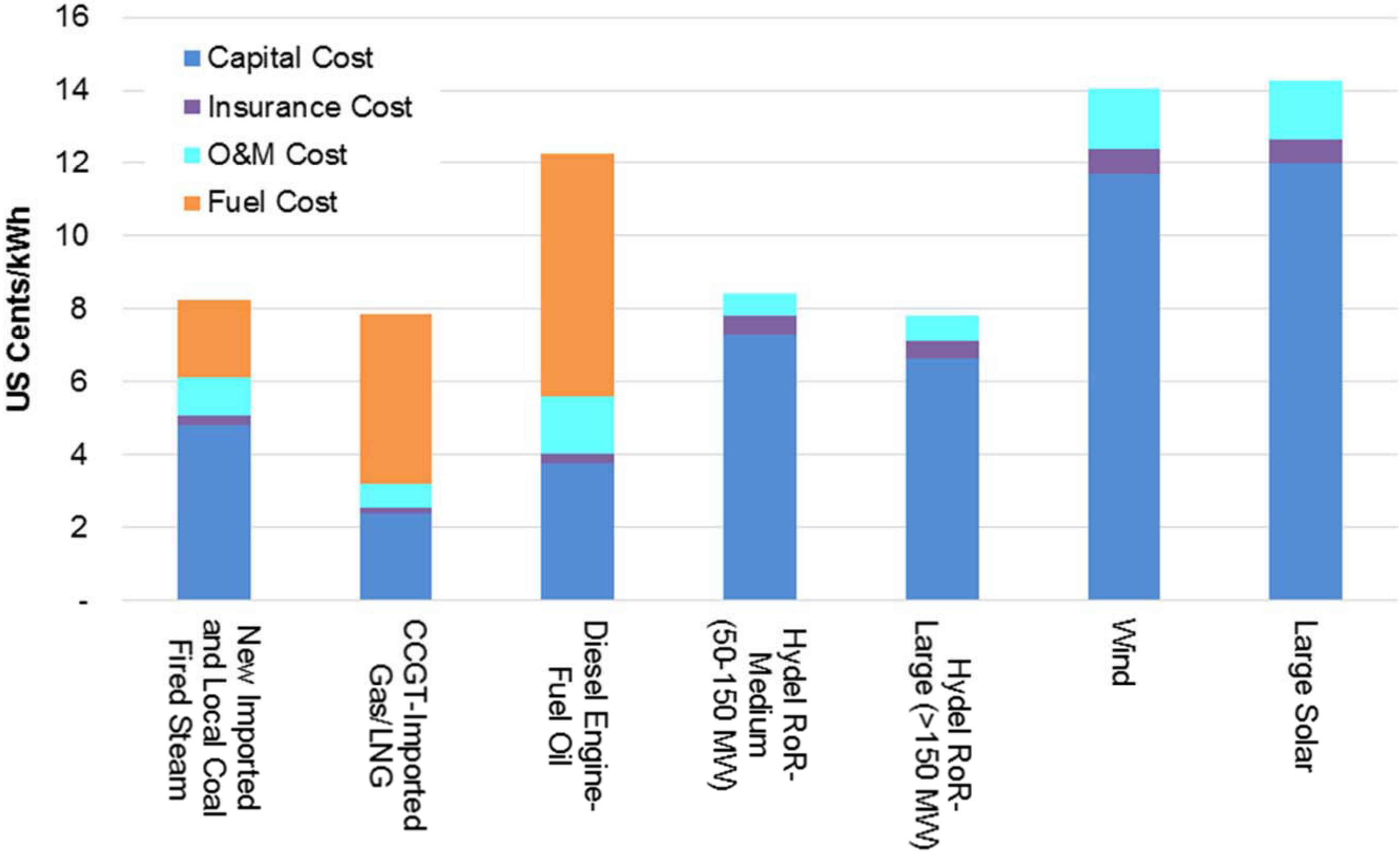
Cost Parameters	*Cost Units*	*New Imported and Local Coal Fired Steam*	*CCGT-LNG/Imported Gas*	*Diesel Engine-Fuel Oil*	*Hydel RoR-Medium (50-150 MW)*	*Hydel RoR-Large (>150 MW)*	*Wind*	*Solar*
Assumptions								
Project Life	Years	30	30	25	30	30	20	20
WACC/IRR		17%	15%	15%	14%	14%	16%	17%
Plant Factor		60%	60%	60%	51%	53%	30%	19%
Plant Efficiency		39.50%	60%	44%				
Insurance (% of Capital Cost)		1%	1%	1%	1%	1%	1%	1%
Fuel Price	$/MMBtu	2.46	9.86	8.62	-	-	-	-
Power Plant Capital Cost	$/kW	1,473	826	1,283	2,286[4]	2,180	1,842	1,067
Annualized Capital Cost	$/kW	253	126	199	370	311	311	190
Annual Insurance Cost	$/kW	15	8	13	23	22	18	11
Life Cycle Average Cost								
Capital Cost	Cents/kWh	4.81	2.39	3.78	7.31	6.66	11.68	11.99
O&M Cost	Cents/kWh	1.04	0.66	1.57	0.59	0.68	1.69	1.59
Insurance Cost	Cents/kWh	0.28	0.16	0.24	0.51	0.47	0.69	0.67
Fuel Cost	Cents/kWh	2.12	4.66	6.68	-	-	-	-
Average Cost of Generation	Cents/kWh	8.25	7.88	12.28	8.41	7.80	14.07	14.26[5]

Source: Hagler Bailly Pakistan Estimates

[4] Total investment for a medium scale hydropower project is estimated at $315 million, of which about 70% is for the plant and equipment, corresponding to about $2,200/kW

[5] No project has yet been awarded on this tariff, therefore NEPRA’s previously determined levelized tariff of US Cents 17.00/kWh should be considered.

Exhibit 5.2: Comparison of Cost of Power Generation from the Project Alternatives



5.3 Environmental Flow Assessment

Hagler Bailly Pakistan with the support of Southern Waters conducted an EFlow assessment for the Jhelum River upstream and downstream of the proposed dam. The objectives of the EFlow assessment were to assess the implications of alternative operational and management scenarios for the Project on the ecology of the river over the life of the Project. The Downstream Response to Imposed Flow Transformations (DRIFT) decision support system (DSS) developed by Southern Waters was used for EFlow assessment, with special emphasis on impact of fish species of conservation importance. The specialist report on the basis of which these sections have been prepared is presented as **Environmental Flow Assessment for the Balakot Hydropower Development Project** (see **Volume 2C** of **EIA**) and is referred to as 'EFlow Report' in this section**.**

5.3.1 EFlow Assessment Process

The DRIFT model used adopts a holistic EFlow assessment approach. An overview of the DRIFT methodology is provided in Appendix A of the EFlow Report. The DRIFT model has been widely applied in South Africa and has been used in Pakistan for EFlow assessment of several hydropower projects in the Jhelum Basin. These include the Kishenganga and Neelum-Jhelum HPPs on the Neelum River, the Gulpur HPP on Poonch River, and KAHPP and KOHPP on the Jhelum River.

5.3.2 Scenarios Assessed

The modelled operational EFlow scenarios, include:

- Baseline hydrology without the Project
- Environmental release of 1.5 m^3/s with baseload operation
- Environmental release of 1.5 m^3/s with peaking operation
- Environmental release of 3.5 m^3/s with baseload operation
- Environmental release of 4.5 m^3/s with baseload operation
- Environmental release of 4.5 m^3/s with peaking operation
- Environmental release of 6.1 m^3/s with baseload operation
- Environmental release of 6.1 m^3/s with peaking operation

Four management scenarios, which represent the predicted river condition in 51 years[6] under different levels of protection/management were considered. The protection levels considered were:

- **Business as Usual Protection (BAU):** increase non-flow-related pressures in line with current trends, i.e. 2017 pressures double in intensity over the next 51 years.

[6] This is the length of the 3 historical hydrological record that was used in the assessment.

- **Low Protection (LP):** maintain 2017 levels of non-flow-related pressures on the river; i.e., no increase in human-induced catchment pressures over time.
- **Moderate Protection (MP):** reduce 2017 levels of non-flow-related pressures by 50%, i.e., decline in pressures (relative to 2017) over time.
- **High Protection (HP)**: reduce 2017 levels of non-flow-related pressures by 90%, i.e., decline in pressures (relative to 2017) over time[7].

Impact assessment scenarios considered in this assessment, which are a combination of protection and flow scenarios, are presented in **Exhibit 5.3.**

Exhibit 5.3: Impact Assessment Scenarios and IDs

Dam Operation Type		*Baseline*	*Baseload Operation*				*Peaking Operation*		
Environmental Flow m³/s Release			*1.5)*	*3.5*	*4.5*	*6.1*	*1.5*	*4.5*	*6.1*
Protection Level	Business as Usual (BAU)	BaseBAU	–	B3BAU	–	–	–	–	–
	Low Protection (LP)	BaseLP	–	B3LP	–	–	–	–	–
	Moderate Protection (HP)		–	B3MP	–	–	–	–	–
	High Protection (HP)		B1HP	B3HP	B4HP	B6HP	P1HP	P4HP	P6HP

‘– ‘ scenario was not assessed

5.3.3 Predicted Change in Fish Abundance

Predicted percentage change in abundance or populations of indicator fish species compared to present day populations after construction of the dam are presented in this section. Predictions for the flow dependent indicators change from year to year, depending on variations in flows. The average value over the last 20 years of the 51 year hydrological time series is presented in this report which takes into account natural wet and dry cycles.

5.3.4 Alwan Snow Trout

Predicted change in abundances for the Alwan Snow Trout are presented in **Exhibit 5.4** and illustrated in **Exhibit 5.5**. Key observations are summarized below:

- Upstream of the dam this fish is trapped in the winter season and is unable to migrate down to lower reaches of Kunhar and Jhelum Rivers where the water is slightly warmer. There is a significant loss in population of this fish on account of the stress created by the barrier presented by the dam.
- Downstream of the dam this fish is affected by the low flows. Peaking further downstream has a knock on effect on the population of this fish as it suffers

7 Experience in neighboring rivers has shown that it is easier to impose a complete ban on activities such as illegal fishing and mining than it is to reduce these activities by half.

serious losses on account of variations in flows associated with a peaking operation.

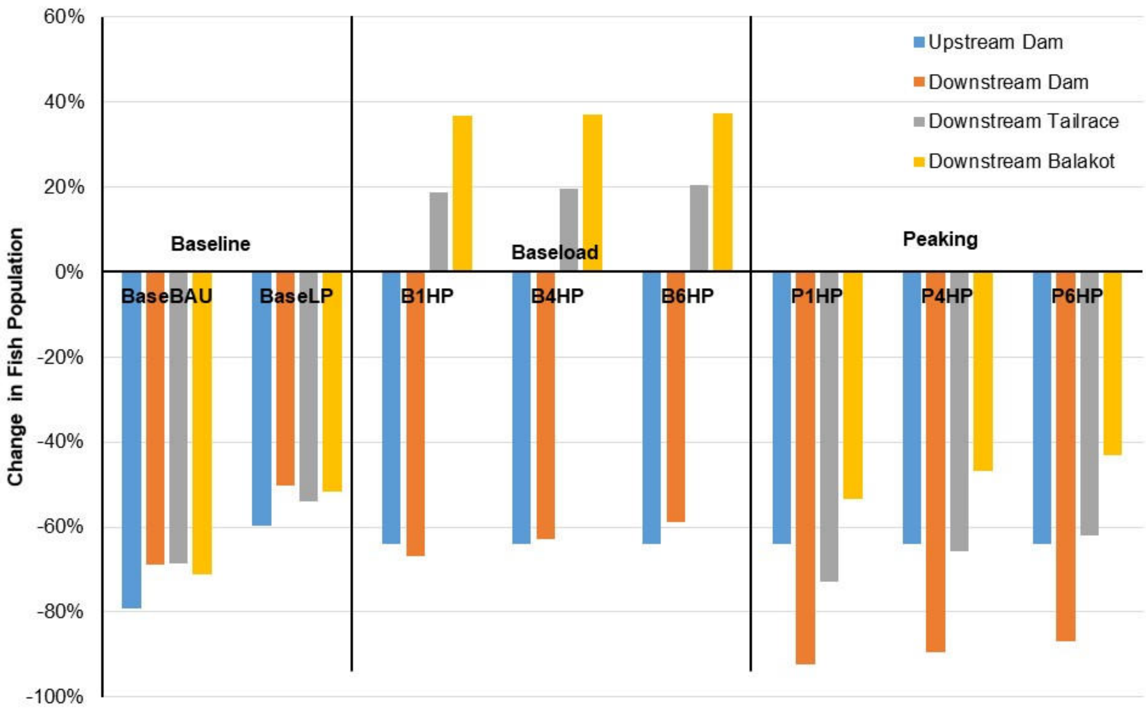
- This fish is able to benefit from a baseload operation and protection, which partially offsets the impact of loss of continuity due to the dam.

Exhibit 5.4: Alwan Snow Trout Predicted Change in Population

All figures are predicted percentage changes in population compared to Present Day over a 51 year period. Red: greater than 70% reduction from Present Day, Orange: 40% to 70% reduction from Present Day, and Green: increase over Present Day

Scenario ID	*Environmental Flow*	*Protection*	*Upstream Dam*	*Downstream Dam*	*Downstream Tailrace*	*Downstream Balakot*
BaseBAU	Baseline hydrology	Business as Usual	-79.2	-68.8	-68.7	-71.2
BaseLP	Baseline hydrology	Low	-59.8	-50.2	-54	-51.6
B3BAU	3.5 m^3/s	Business as Usual	-100	-100	-75.6	-73
B3LP	3.5 m^3/s	Low	-99.7	-100	-64.9	-54.4
B3MP	3.5 m^3/s	Moderate	-75.5	-78	-1.4	17.7
B1HP	1.5 m^3/s	High	-64.1	-66.9	18.6	36.9
B3HP	3.5 m^3/s	High	-64.1	-64.8	19	37
B4HP	4.5 m^3/s	High	-64.1	-62.9	19.5	37.1
B6HP	6.1 m^3/s	High	-64.1	-58.8	20.4	37.3
P1HP	1.5 m^3/s	High	-64.1	-92.2	-73.0	-53.5
P4HP	4.5 m^3/s	High	-64.1	-89.4	-65.8	-46.7
P6HP	6.1 m^3/s	High	-64.1	-86.8	-62.1	-43.2

Exhibit 5.5: Alwan Snow Trout Predicted Change in Population



5.3.5 Nalbant's Loach

Predicted abundances for the Nalbant's Loach are presented in **Exhibit 5.6** and graphed in **Exhibit 5.7**. Key observations are summarized below:

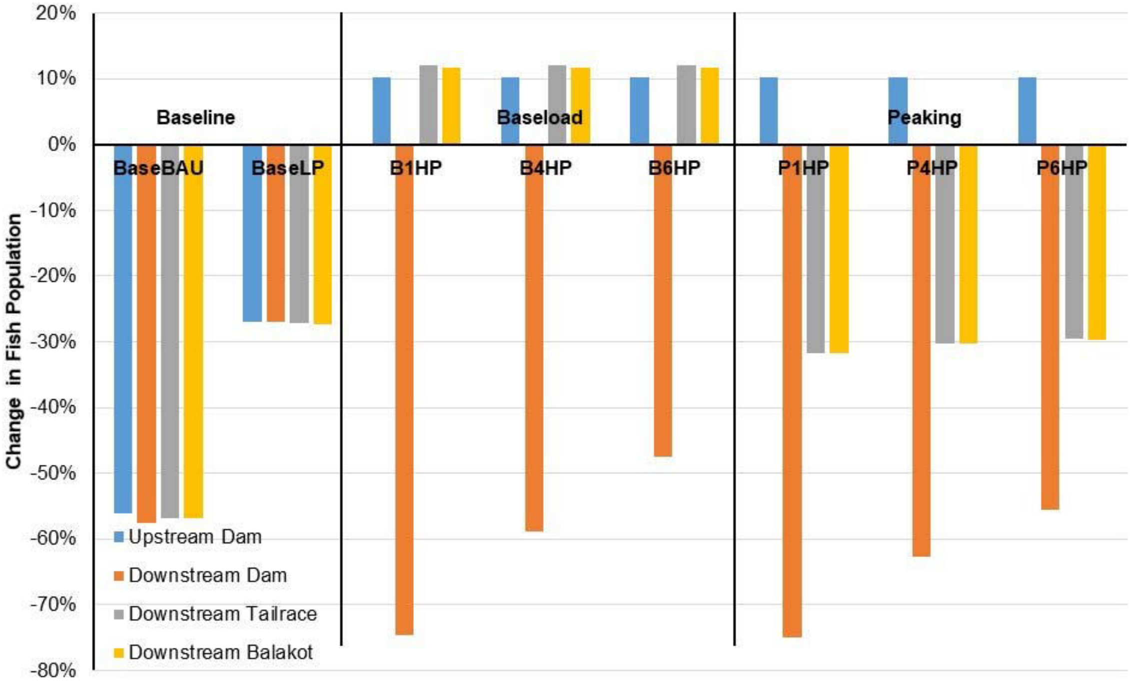
- This is a surface water fish and prefers side channels and tributaries. It is therefore less affected by variations in flow in comparison to the Kashmir Hillstream Loach discussed in the next section.
- This fish is impacted significantly by a peaking operation under which it is subjected to wide variations in habitat availability. The impact, however, much lower in comparison to Alwan Snow Trout which remains in deeper pools in winter and is affected more by changes in velocities generated by peaking, which could dislodge this fish from the pools.

Exhibit 5.6: Nalbant's Loach Predicted Change in Population

All figures are predicted percentage changes in population compared to Present Day over a 51 year period. Red: greater than 70% reduction from Present Day, Orange: 40% to 70% reduction from Present Day, and Green: increase over Present Day

Scenario ID	*Environmental Flow*	*Protection*	*Upstream Dam*	*Downstream Dam*	*Downstream Tailrace*	*Downstream Balakot*
BaseBAU	Baseline hydrology	Business as Usual	-56.2	-57.6	-56.8	-56.9
BaseLP	Baseline hydrology	Low	-26.9	-26.9	-27.1	-27.3
B3BAU	3.5 m^3/s	Business as Usual	-56.8	-100	-55.6	-56.1
B3LP	3.5 m^3/s	Low	-27.5	-94.6	-25.9	-26.3
B3MP	3.5 m^3/s	Moderate	3	-70.4	5.7	5.2
B1HP	1.5 m^3/s	High	10.3	-74.7	12	11.7
B3HP	3.5 m^3/s	High	10.3	-64	12	11.7
B4HP	4.5 m^3/s	High	10.3	-58.8	12	11.7
B6HP	6.1 m^3/s	High	10.3	-47.5	12	11.7
P1HP	1.5 m^3/s	High	10.3	-75.0	-31.7	-31.8
P4HP	4.5 m^3/s	High	10.3	-62.7	-30.3	-30.3
P6HP	6.1 m^3/s	High	10.3	-55.5	-29.6	-29.7

Exhibit 5.7: Nalbant's Loach Predicted Change in Population



5.3.6 Kashmir Hillstream Loach

Predicted abundances for the Kashmir Hillstream Loach are presented in **Exhibit 5.8** and graphed in **Exhibit 5.9**. Key observations are summarized below:

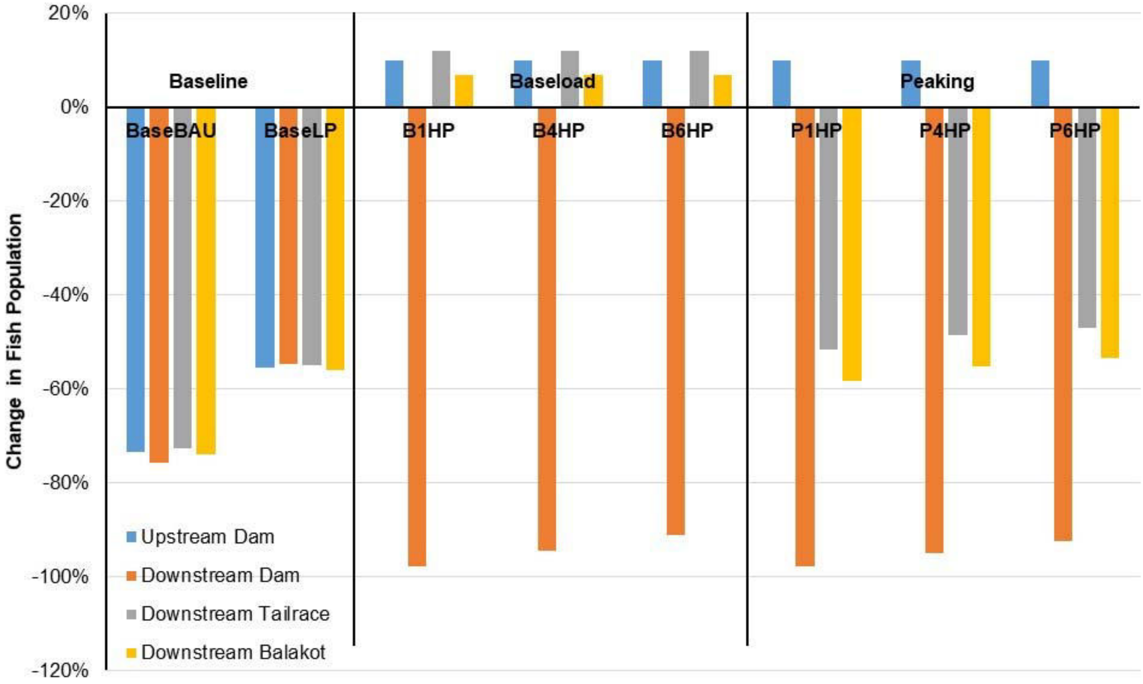
- The fish is sensitive to flow changes and therefore shows a sharp decline in the low flow section downstream of the dam, even with protection in place. Increasing EFlow in the range studied does not significantly increase its population in this segment.
- This fish is non migratory, therefore, under baseload conditions, High Protection improves fish populations downstream of the tailrace.
- Under peaking operation, this fish shows slight gains over the BAU baseline downstream of the tailrace, although these gains are much lower than those under baseload operation.

Exhibit 5.8: Kashmir Hillstream Loach Predicted Change in Population

All figures are predicted percentage changes in population compared to Present Day over a 51 year period. Red: greater than 70% reduction from Present Day, Orange: 40% to 70% reduction from Present Day, and Green: increase over Present Day

Scenario ID	*Environmental Flow*	*Protection*	*Upstream Dam*	*Downstream Dam*	*Downstream Tailrace*	*Downstream Balakot*
BaseBAU	Baseline hydrology	Business as Usual	-73.5	-75.9	-72.8	-73.9
BaseLP	Baseline hydrology	Low	-55.5	-54.8	-55	-56.1
B3BAU	3.5 m^3/s	Business as Usual	-75.9	-100	-72.3	-73.3
B3LP	3.5 m^3/s	Low	-59.2	-100	-54.4	-55.5
B3MP	3.5 m^3/s	Moderate	-2.4	-97.8	2.5	0.8
B1HP	1.5 m^3/s	High	10	-97.9	11.9	6.8
B3HP	3.5 m^3/s	High	10	-96	11.9	6.8
B4HP	4.5 m^3/s	High	10	-94.6	11.9	6.8
B6HP	6.1 m^3/s	High	10	-91.3	11.9	6.8
P1HP	1.5 m^3/s	High	10	-97.8	-51.8	-58.4
P4HP	4.5 m^3/s	High	10	-95	-48.5	-55.2
P6HP	6.1 m^3/s	High	10	-92.4	-47	-53.6

Exhibit 5.9: Kashmir Hillstream Loach Predicted Change in Population



5.3.7 Impact on Fish Abundance under Alternative Management and Operational Options

The impacts on fish species will vary with their habitat requirements, migratory behavior and current pressures on the ecosystem.

5.3.8 Impact of Increasing Protection Levels

Exhibit 5.10 shows the impact of variations in protection levels on fish populations. For illustrative purposes, the impacts are shown for the segment downstream of the tailrace under baseload operation where variations in flow will be minimal, in comparison to the baseline. The barrier effect of the dam on the migratory fish, however, will apply. The following is a summary of observations:

- Under the Business-as-Usual (BAU) Scenario, without the dam in place, the decline in fish populations will average at 66% of present day populations due to pressures related to unregulated fishing and sediment mining whereas the decline is predicted at 45% under the Moderate Protection (MP) baseline.
- After the Project is put in place with Moderate Protection (MP), fish populations will improve by an average of about 70% compared to the BAU baseline and 48% compared to the MP baseline. The increase is expected to be highest for the non-migratory Kashmir Hillstream Loach.

- With High Protection (HP), fish populations are predicted to improve by an average of 80% compared to the BAU Scenario. The increase is expected to be highest for the Alwan Snow Trout at close to an 88% increase over the baseline.
- Increasing protection from Moderate Protection to High Protection results in an increase in population by an average of 12%, irrespective of the baseline scenario chosen for comparison.

Exhibit 5.10: Impact of Variation in Protection on Fish Population, Downstream of Tailrace (Baseload Generation with EFlow of 3.5 m^3/s)

Red: greater than 70% reduction from Present Day, Orange: 40% to 70% reduction from Present Day, and Green: increase over Present Day

	Projected Change in Population (% change from Present Day Populations)					
Fish	*Baseline*		*With Project*			
	BAU	*LP*	*B3BAU*	*B3LP*	*B3MP*	*B3HP*
Biophysical Results						
Alwan Snow Trout	-68.7	-54	-75.6	-64.9	-1.4	19.0
Nalbant's Loach	-56.8	-27.1	-55.6	-25.9	5.7	12.0
Kashmir Hillstream Loach	-72.8	-55	-72.3	-54.4	2.5	11.9
Average	**-66.1**	**-45.4**	**-67.8**	**-48.4**	**2.3**	**14.3**
Incremental Gain compared to Business as Usual Baseline, %						
Alwan Snow Trout			-6.9	3.8	67.3	87.7
Nalbant's Loach			1.2	30.9	62.5	68.8
Kashmir Hillstream Loach			0.5	18.4	75.3	84.7
Average			**-1.7**	**17.7**	**68.4**	**80.4**
Incremental Gain compared to Low Protection Baseline, %						
Alwan Snow Trout			-21.6	-10.9	52.6	73.0
Nalbant's Loach			-28.5	1.2	32.8	39.1
Kashmir Hillstream Loach			-17.3	0.6	57.5	66.9
Average			**-22.5**	**-3.0**	**47.6**	**59.7**

5.3.9 Impact of Increasing EFlow

Exhibit 5.11 shows the impact of increasing EFlow on fish species immediately downstream of the d where the impact of lower releases from the dam will be significant. Given the high anthropogenic pressures on the fish, the benefit of EFlow can be realized only if the river is protected. Under BAU the gains due to increasing EFlow are close to 0%. For example, with EFlow of 3.5 m^3/s under BAU all fish indicators show a 100% decline (not shown below, see previous section for BAU results). Therefore, figures in **Exhibit 5.11** are presented for the High Protection scenario. In other words, EFlow releases can be considered of little consequence in absence of protection of the river. The following is a summary of observations:

- The Kashmir Hillstream Loach is most affected by the lower flows in the reach downstream of the dam, and decline is predicted at over 90% for the range of EFlows considered. Increasing EFlow also benefits this fish the least.
- The Alwan Snow Trout benefits from the increased EFlow, however, impact of increasing EFlow on the population of this fish are limited as they are overshadowed by the impact of the barrier to its migration created by the dam.
- The Nalbant's Loach is least affected by lower flows. However, increasing EFlows benefits this fish the most, with loss in population declining by about 27% as EFlow is increased from 1.5 to 6.1 m^3s/.

Exhibit 5.11: Impact of Variation in Flow on Fish Population, Downstream of Dam with High Protection

Red: greater than 70% reduction from Present Day, Orange: 40% to 70% reduction from Present Day, and Green: increase over Present Day

Fish	*Change in Population, %*				*Incremental gain, % by increasing Environmental Flow*		
Flow Scenario	*B1HP*	*B3HP*	*B4HP*	*B6HP*	*1.5 to 3.5 m^3/s*	*3.5 to 4.5 m^3/s*	*4.5 to 6.1 m^3/s*
EFlow, m^3/s	1.5	3.5	4.5	6.1			
Alwan Snow Trout	-66.9	-64.8	-62.9	-58.8	2.1	1.9	4.1
Nalbant's Loach	-74.7	-64	-58.8	-47.5	10.7	5.2	11.3
Kashmir Hillstream Loach	-97.9	-96	-94.6	-91.3	1.9	1.4	3.3

5.3.10 Impact of Baseload vs Peaking Generation

Shifting from peaking to baseload operation has a large positive effect on fish populations as shown in **Exhibit 5.12**. In case of baseload operation, the hydrology of the river downstream of the tailrace largely remains close to natural. Comparison is provided for an EFlow of 4.5 m^3/s for illustrative purposes. With High Protection, fish populations can be restored to above present day levels.

Exhibit 5.12: Impact of Baseload vs. Peaking Operation on Fish Population, Downstream of Tailrace

Red: greater than 70% reduction from Present Day, Orange: 40% to 70% reduction from Present Day, and Green: increase over Present Day

	Change in Population, %		*Incremental gain, %*
Fish	*P4HP*	*B4HP*	*Peaking to baseload*
Alwan Snow Trout	-46.7	37.1	84
Nalbant Loach	-30.3	11.7	42
Kashmir Hillstream Loach	-55.2	6.8	62

5.3.11 Net Gain Calculations

Net gain was calculated based on the length of the reach represented by the EFlow site multiplied by the predicted changed in abundance at that particular EFlow site. Distribution of fish populations between the main river and the tributaries was also taken into account, as both the main river and tributaries will benefit from protection (see **Exhibit 5.13**).

Exhibit 5.13: Current Distribution of Fish between River and Tributaries

Fish	*Main River*	*Tributary*
Alwan Snow Trout	70%	30%
Nalbant's Loach	30%	70%
Kashmir Hillstream Loach	100%	0%

As the hydrology of the tributaries will be unchanged, the tributaries will gain from protection only. The estimated impact of protection at EF Site 4 under baseload operation where flows remain unaffected was used as a proxy for impact of protection in tributaries.

The segment of the river upstream of the dam will be impacted by peaking releases from the Sukki Kinari HPP prior to construction of the Project, and fish populations will suffer a high losses in this reach of the river. Following the construction of the Project, the fish that are adapted to a flowing river will not be able to adjust to the non-flow reservoir conditions with a greater depth of water, and will practically be eliminated from the reservoir. Net gain was therefore calculated for the reaches downstream of the dam represented by EF Sites 2, 3 and 4.

The predicted abundances were compared against baselines with two different levels of protection (BAU Protection and Low Protection). These dynamic baselines represent the expected fish abundances in the absence of the Project. Lastly, net gain against Present Day (i.e. static baseline) is also presented.

The resultant net gain under each scenario is summarized in **Exhibit 5.14,** and illustrated in **Exhibit 5.15** and **Exhibit 5.16**. Predictions of DRIFT model are subject to an uncertainty of the order of 15% above and below the predicted mean[8], which is indicated as a line in the graphs.

[8] Based on results from Kohala Hydropower Plant Environmental Flow Assessment, Technical Report. Southern Waters in Association with Hagler Bailly Pakistan, November 2016

Exhibit 5.14: Summary of Net Gain Calculations for Selected Scenarios

Operation	Baseload				Peaking		
Environmental Flow (m^3/s)	1.5	3.5	4.5	6.1	1.5	4.5	6.1
Scenario ID	B1HP	B3HP	B4HP	B6HP	P1HP	P4HP	P6HP
Against Business as Usual Baseline							
Alwan Snow Trout	78.3	78.9	79.5	80.7	32.0	35.8	38.0
Nalbant Loach	59.1	60.4	60.9	62.2	51.0	52.6	53.5
Kashmir Hillstream Loach	42.6	43.3	43.8	45.0	2.1	5.2	7.1
Against Low Protection Baseline							
Alwan Snow Trout	59.6	60.2	60.8	62.0	13.3	17.1	19.3
Nalbant Loach	29.1	30.3	30.9	32.2	20.9	22.6	23.5
Kashmir Hillstream Loach	23.5	24.2	24.8	26.0	-17.0	-13.9	-11.9
Against Present Day							
Alwan Snow Trout	8.3	8.9	9.5	10.7	-38.0	-34.2	-32.0
Nalbant Loach	2.0	3.2	3.8	5.0	-6.2	-4.6	-3.6
Kashmir Hillstream Loach	-32.0	-31.2	-30.7	-29.5	-72.5	-69.4	-67.4

Exhibit 5.15: Net Gain Against BAU Baseline for Selected Scenarios

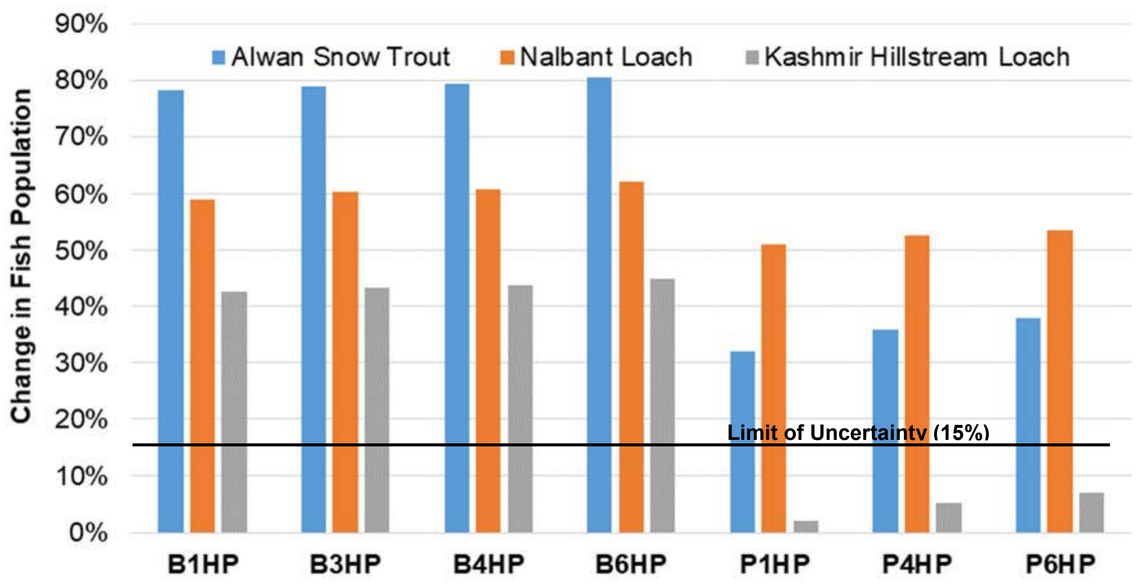
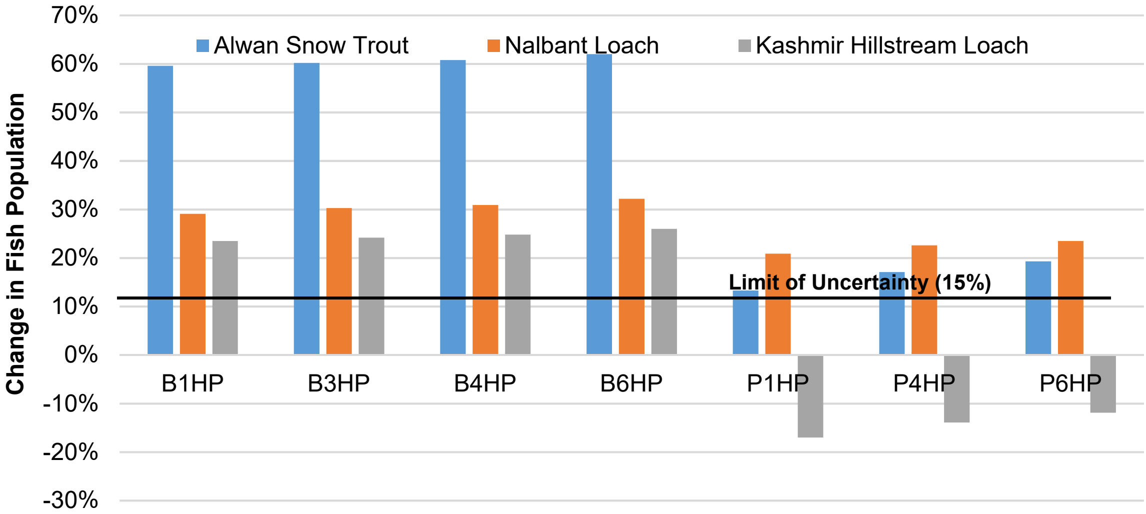


Exhibit 5.16: Net Gain Against Low Protection Baseline for Selected Scenarios



5.3.12 Impact to Power Generation

The following key assumptions are incorporated into the calculation of power loss under the different operational scenarios:

- Impact to power generation was calculated based on the water diverted through the turbines and did not take into account the turbine efficiency at varying flows.
- The operating rules of the Project are detailed in the **Environment Flow Assessment Report for the Balakot Hydropower Development Project** (see **Volume 2C** of the **EIA)**, for which the power generation is calculated.
- Baseline power generation (i.e. 0% power loss) is taken as the peaking scenario with EFlow of 1.5 m^3/s as designed
- The Project is designed to produce 1,187 GWh per year in the baseline scenario (see point above) and the price of power is taken as 0.11 $.kWh. No premium is assigned to peaking power generation.
- Recovery from the EFlow turbine is estimated at 20% of the main power house turbine for the same flow of water through the turbine.

Exhibit 5.17: Power Loss Under EFlow Scenarios

Operation	*EFlow (m^3/s)*	*Scenario ID*	*Power Loss*	*Monetary Loss per year, USD Million*
Peaking	1.5	P1	0.0%	-
	4.5	P4	2.1%	$2.78
	6.1	P6	3.5%	$4.59
Baseload	1.5	B1	0.2%	$0.31
	3.5	B3	2.5%	$3.28
	4.5	B4	3.8%	$4,94
	6.1	B6	5.7%	$7.42

Power loss vs net gain is plotted in **Exhibit 5.18** when calculated against the BAU baseline and in **Exhibit 5.19** when calculated against the Low Protection baseline.

Exhibit 5.18: Power Loss vs Net Gain Against Business as Usual Baseline

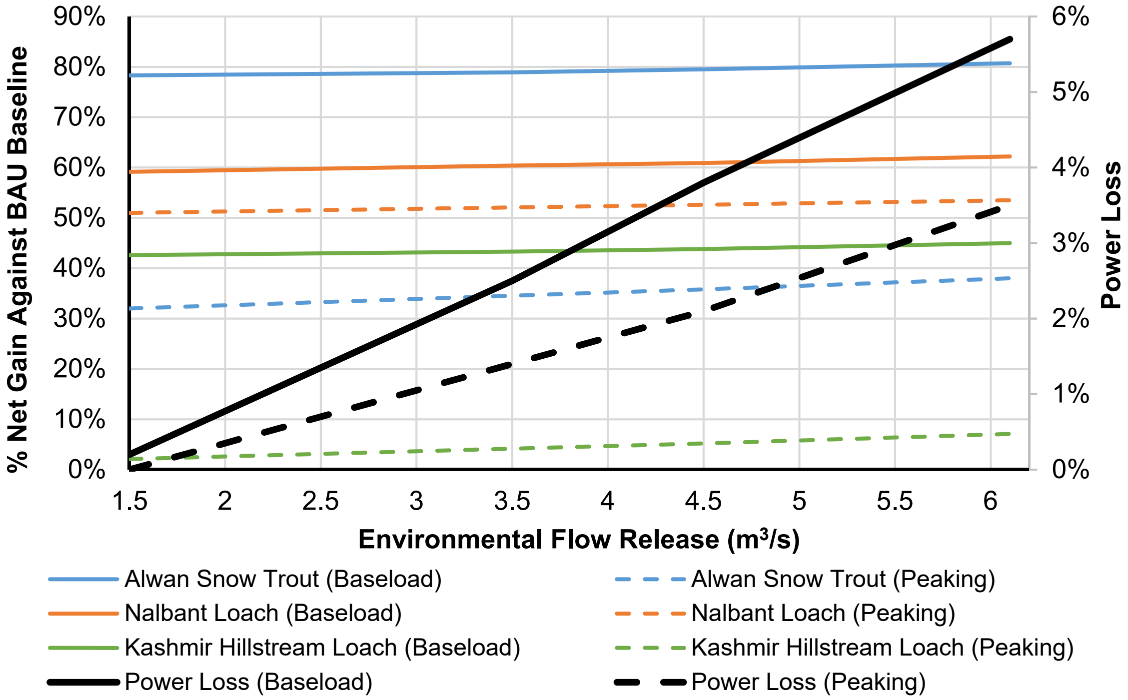
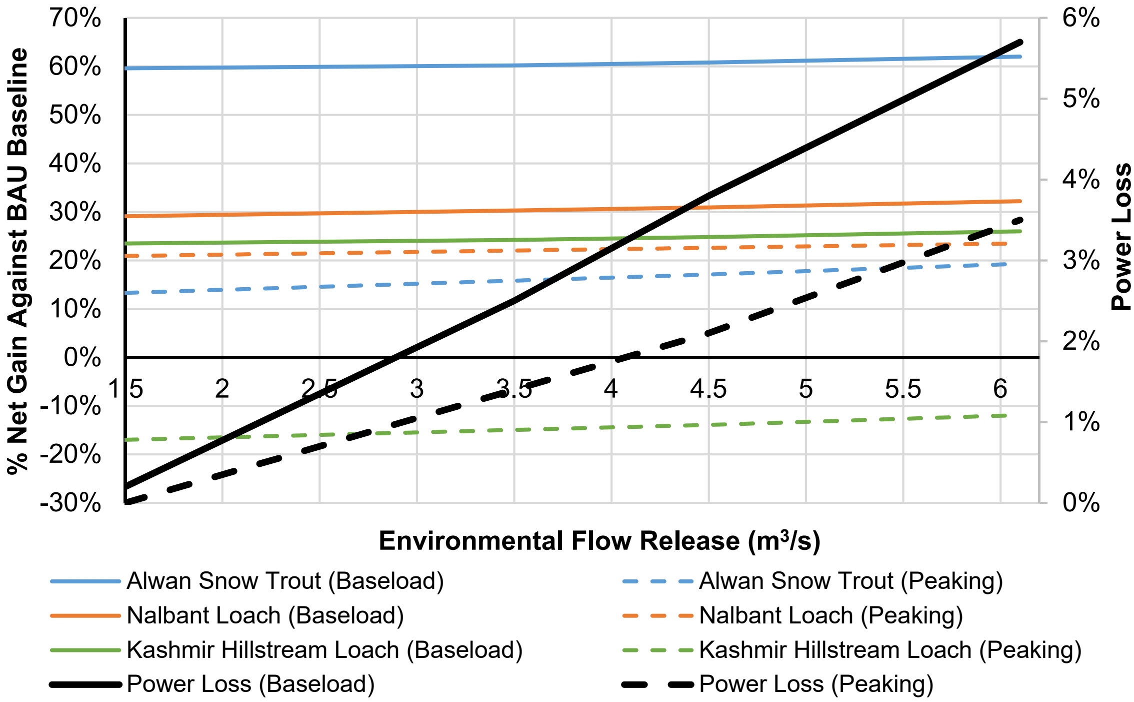


Exhibit 5.19: Power Loss vs Net Gain Against Low Protection Baseline



5.3.13 Conclusions

Two operational scenarios are recommended for consideration of the stakeholders:

- Preferred Case: Baseload operation with an EFlow of 1.5 m^3/s and High Protection (corresponding to scenario B1HP)
- Alternate Case: Peaking operation with an EFlow of 6.1 m^3/s and High Protection (corresponding to scenario P6HP)

With a baseload operation it will be possible to meet the requirement of net gain in population of fish species that trigger Critical Habitat, with a margin for uncertainties in predictions of EFlow modeling of the order of 15% above and below the predicted mean change in populations, and a more conservative baseline of Pro1 level of protection against which net gain is calculated.

With a peaking operation and EFlow release of 6.1 cumec, there will be a loss in power generation of the order of 3.5% compared to the loss under a baseload operation with an EFlow release of 1.5 cumec. While the basic requirement of net gain will be met assuming a BAU Baseline, there will be limited margin for accommodating uncertainties in EFlow modeling predictions. Net gain requirement will not be met assuming a conservative baseline with a Low Protection level of protection.

A peaking operation will produce power to meet the demand on the national power grid during evening peaking hours. Peaking power is presently priced at a premium of about 30% for high end residential and commercial customers with three phase connections. However, power purchase tariff for the generation companies remains at a flat rate, and no premium for peaking power is available to the power producer. This notwithstanding, the power purchaser, Central Power Purchase Agency Guarantee Ltd. (CPPA-G) and system operator, National Power Control Centre (NPCC) of National Transmission and Dispatch Co. Ltd. (NTDCL) under the current framework of Power Purchase Agreement (PPA) retain the right to ask the hydropower producers to operate in peaking mode when technically feasible. Operation on a baseload will therefore require appropriate amendments in the PPA.

Following the approval of EIA and Biodiversity Action Plan by EPA, KP, a baseload operation if opted for will become a legally binding requirement for the Project. Amendments in the PPA will therefore have a policy and legal basis, which will be binding on the power purchaser as well as the electricity regulator, the National Electric Power Regulatory Authority (NEPRA). Further technical studies may be required to design the Project to operate on baseload in view of peaking releases from the Sukki Kinari HPP located upstream of the Project. Obviously, no amendment in standard PPA will be required if a peaking operation is opted for.

The operational configuration selected and agreed upon by the stakeholders, project owner, and the lenders will be presented in the final version of the EIA, along with the justification for the decision.

6. Information Disclosure, Consultation, and Participation

As part of the EIA process, consultations are undertaken with communities and institutions that may have interest in the proposed Project or may be affected by it. This section documents the consultation process for the EIA of the proposed Project and summarizes its results. The consultation process was designed to be consistent with the relevant national legislation and the ADB Guidelines[1] on Information Disclosure, Consultation and Participation.

6.1 Regulatory Requirements

Public consultation is mandated under national environmental law. The Pak-EPA, under Regulation 6 of the IEE-EIA Regulations 2000, has issued a set of guidelines of general applicability and sectoral guidelines indicating specific assessment requirements. These guidelines have been adopted by the EPA KP for use in its jurisdiction. This includes Guidelines for Public Consultation, 1997 (the 'Guidelines'), that are summarized below:

- **Objectives of Public Involvement:** 'To inform stakeholders about the proposed project, to provide an opportunity for those otherwise unrepresented to present their views and values, providing better transparency and accountability in decision making, creating a sense of ownership with the stakeholders'.
- **Stakeholders:** 'People who may be directly or indirectly affected by a proposal will clearly be the focus of public involvement. Those who are directly affected may be project beneficiaries, those likely to be adversely affected, or other stakeholders. The identification of those indirectly affected is more difficult, and to some extent it will be a subjective judgment. For this reason it is good practice to have a very wide definition of who should be involved and to include any person or group who thinks that they have an interest. Sometimes it may be necessary to consult with a representative from a particular interest group. In such cases the choice of representative should be left to the group itself. Consultation should include not only those likely to be affected, positively or negatively, by the outcome of a proposal, but should also include those who can affect the outcome of a proposal'.
- **Mechanism:** 'Provides sufficient relevant information in a form that is easily understood by non-experts (without being simplistic or insulting), allow sufficient time for stakeholders to read, discuss, consider the information and its implications and to present their views, responses should be provided to issues and problems raised or comments made by stakeholders, selection of venues and timings of events should encourage maximum attendance'.

1 Asian Development Bank (ADB), Environmental Safeguards: A Good Practice Sourcebook Draft Working Document, December 2012.

- **Timing and Frequency:** Planning for the public consultation program needs to begin at a very early stage; ideally it should commence at the screening stage of the proposal and continue throughout the EIA process.
- **Consultation Tools:** Some specific consultation tools that can be used for conducting consultations include; focus group meetings, needs assessment, semi-structured interviews; village meetings and workshops.
- **Important Considerations:** 'The development of a public involvement program would typically involve consideration of the following issues; objectives of the proposal and the study; identification of stakeholders; identification of appropriate techniques to consult with the stakeholders; identification of approaches to ensure feedback to involved stakeholders; and mechanisms to ensure stakeholders' considerations are taken into account'.

6.2 Lender's Requirements

Information disclosure, consultation and participation are key elements of stakeholder engagement and essential for the successful management of a project's environmental and social impacts. ADB's requirements for community engagement are focused on the engagement of affected people.[2]

Disclosure of relevant information about the proposed project and its potential impacts will help stakeholders to understand the impacts, risks and opportunities of the Project. Relevant information, including that documented in environmental assessment reports, should be provided in a place, language and form that is accessible and understandable to affected people and other stakeholders. This process commences early in the project cycle and continues throughout the life of the project.[3]

6.3 Consultation Methodology

Consultations with the Project stakeholders were undertaken in April, May and June 2017. The main document for distribution to stakeholders during the consultations was the Background Information Document (BID) that informed them about the EIA process and provided a background about the Project. The BID was made available in English (**Appendix M**) and Urdu (**Appendix N**) to suit the language preferences of different stakeholders. Meetings with institutional stakeholders were arranged in Mansehra, Peshawar and Islamabad.

6.3.1 Stakeholders Consulted

Community Stakeholders

Stakeholders are groups or individuals that can affect or take affect from a project's outcome. Affected Communities include population that is likely to be affected by the Project activities. Potential impacts of the Project on the local environment include disturbances and changes to the physical and biological environment, such as, land

2 Asian Development Bank (ADB), Environmental Safeguards: A Good Practice Sourcebook Draft Working Document, December 2012.

3 Ibid

transformation, noise disturbances, and air and water quality issues. These disturbances can result in indirect socioeconomic impacts, such as, physical or economic displacement. These impacts are expected to reduce with the increased distance from the Project facilities. A basin wide study approach was used for the EIA of the Project; therefore 35 rural communities were consulted along the Kunhar River. In addition to the Potentially Affected Communities, nomad communities frequenting the area, local government and local Non-Government Organization (NGO) officials were also consulted.

Exhibit 6.1 lists the community stakeholders consulted. Consultation were conducted in representative number of communities while ensuring that people from various segments of the society participate in the consultation, to ensure proper coverage of possible stakeholder concerns. **Exhibit 6.2** shows location of stakeholders consulted near Project site.

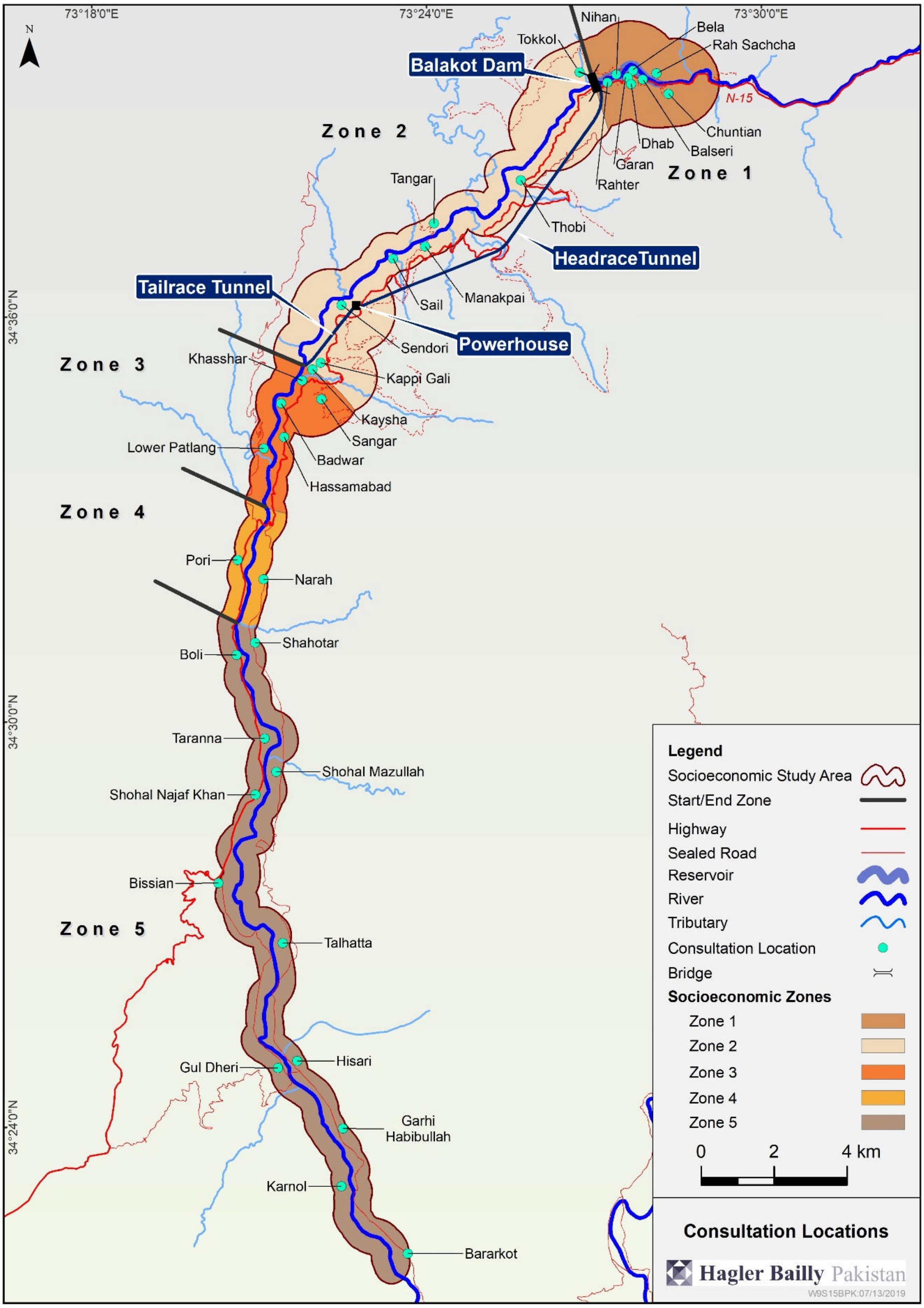
Exhibit 6.1: List of Community Stakeholders Consulted

Zones	*Stakeholders*	*Consultation Group*	*Date Consulted*
1	Balseri	M, F	3-May-17
	Bela	M, F	2-May-17
	Chuntian	M, F	4-May-17
	Dhab	M, F	4-May-17
	Garan	M, F	4-May-17
	Nihan	M, F	2-May-17
	Rah Sachcha	M, F	5-May-17
	Rahter	M, F	3-May-17
2	Kappi Gali	F	6-May-17
	Tokkol	M, F	6-May-17
	Kaysha	M	5-May-17
	Manakpai	M, F	7-May-17
	Sail	M	7-May-17
	Sendori	M, F	8-May-17
	Tangar	F	7-May-17
	Thobi	M, F	5-May-17
3	Badwar	M, F	10-May-17
	Hassamabad	M	9-May-17
	Khasshar	M	9-May-17
	Lower Patlang	M, F	9-May-17
	Sangar	M	9-May-17

Zones	Stakeholders	Consultation Group	Date Consulted
4	Poli	M	19-May-17
	Narah	M	19-May-17
5	Bararkot	F	17-May-17
	Bissian	M	10-May-17
	Boli	M, F	10-May-17
	Garhi Habibullah	M, F	11-May-17
	Gul Dheri	M, F	14-May-17
	Hisari	M, F	10-May-17
	Karnol	M, F	15-May-17
	Shahotar	M, F	10-May-17
	Shohal Mazullah	M, F	18-May-17
	Shohal Najaf Khan	M, F	11-May-17
	Talhatta	M, F	16-May-17

Note: M = Male and F = Female

Exhibit 6.2: Consultation Locations



Institutional Stakeholders

The institutional stakeholders consulted for the Project include relevant government agencies, NGOs and private sector organizations. The list of stakeholders consulted is shown in **Exhibit 6.3**.

Exhibit 6.3: List of Institutional Stakeholders

Stakeholders	*Date Consulted*
Government and Related	
Environmental Protection Agency, Khyber Pakhtunkhwa	April 10, 2017
Forest Department, Khyber Pakhtunkhwa	April 27, 2017
Wildlife Department, Khyber Pakhtunkhwa	April 27, 2017
Fisheries Department, Khyber Pakhtunkhwa	April 27, 2017
Social Welfare Department, Khyber Pakhtunkhwa	May 19, 2017
Kaghan Development Authority	May 22, 2017
Tourism Corporation, Khyber Pakhtunkhwa	June 12, 2017
Revenue Department, Khyber Pakhtunkhwa	July 4, 2017
Deputy Commissioner, Mansehra, Khyber Pakhtunkhwa	July 4, 2017
NGOs	
World Wildlife Fund – Pakistan	April 12, 2017
Himalayan Wildlife Foundation	April 19, 2017
Adventure Time Pakistan	May 2, 2017
Private Sector	
Star Hydropower (Pvt.) Ltd	April 12, 2017
International Finance Corporation (IFC)	May 26, 2017
Educational Institutions	
Archaeology Department, Hazara University	April 27, 2017
Archaeology Department, University of Peshawar	May 30, 2017

6.3.2 Consultations Mechanism

The consultation mechanism for institutional stakeholder is provided below.

Community Consultation

The Potentially Affected Communities (PAC) were visited and consultations were conducted with the community members within their settlements to encourage and facilitate their participation. Representatives, notables and other interested groups from the Potentially Affected Communities were invited. In most of the consultation, women also participated, however, where required, separate consultations were conducted with community women.

Institutional Stakeholder Consultation

Letters to inform experts/institutional stakeholders about the objective of the consultation process and to arrange meetings with the stakeholders were dispatched in advance. A Background Information Document (BID) was enclosed with the letters for the information of the stakeholders.

For institutional consultation, HBP organized meetings in Islamabad, Peshawar, and Mansehra for government departments and agencies, academics and NGOs, and private sector companies. Invitations for the meetings were sent two weeks before the meetings and these were followed up with phone call to ensure maximum participation.

The stakeholders were asked to share their concerns about the Project and Project-related activities along with any recommendations about management and mitigation measures.

6.4 Summary of Consultations

6.4.1 Community Consultation

Exhibit 6.4 summarizes the key concerns emerging from community consultations and explains how each concern is addressed in the EIA. The detailed log of consultations is provided in **Appendix P.** Photographs of the consultation are shown **Exhibit 6.5**.

6.4.2 Institutional Consultation

The key concerns emerging from institutional stakeholder consultations are summarized in **Exhibit 6.6.** The detailed log of consultations is provided in **Appendix P.**

Exhibit 6.4: Summary of Concerns Expressed in Community Consultations

Concerns Expressed by Stakeholders	*How they are Addressed*
Use of natural resources by locals	
Sand mining and fishing sites will be submerged affecting community wellbeing.	A biodiversity Action Plan (BAP) for the Project has been developed to regulate sediment mining and fishing. The Eflow recommended for the Project will increase fish populations downstream of the Project, thereby, increasing fish catch (see **Volume 2C** of the **EIA**).
The locals in the village collect both sand and wood debris from the river. Dam construction would block the downstream flow of the river and limit wood and sand supply.	A biodiversity Action Plan (BAP) for the Project has been developed to regulate sediment mining and fishing. The Eflow recommended for the Project will increase fish populations downstream of the Project, thereby, increasing fish catch (see **Volume 2C** of the **EIA**).
Women said they use the river for a variety of purposes including catching fish, washing clothes, and gathering wood. After construction of the dam, they may not be able to do this.	A biodiversity Action Plan (BAP) for the Project has been developed to regulate sediment mining and fishing. The Eflow recommended for the Project will increase fish populations downstream of the Project, thereby, increasing fish catch (see **Volume 2C** of the **EIA**). There is almost no river water use in the low flow area. There is a chance that springs above the tunnel will dry up during or after the tunneling. A hydrocensus was carried out as part of the EIA above the tunnel alignment. Restoration of water supply is proposed for the settlements where there will be impacts on springs and a budget has been included for this in the EMP.

Concerns Expressed by Stakeholders	*How they are Addressed*
Dam construction would increase water levels and block the river's downstream flow of driftwood that is primarily used as fuel wood by locals. Locals will then cut forest trees, resulting in deforestation.	Based on surveys, a very small number of people in the Study Area use driftwood, therefore, this is not a major impact.
Disturbances due to construction activities	
Land sliding will increase due to tunnels boring and walls of houses will be damaged due vibrations from tunnel boring	Addressed in the mitigation measures in **Section 7**
Environmental issues will increase due to excavation, vehicles, and operation of other heavy machinery	Addressed in the mitigation measures in **Section 7**
The dust from the tunnel boring activity would cause diseases and environmental problems.	Addressed in the mitigation measures in **Section 7**
Traffic increase due to project activity would result in congested roads.	Addressed in the mitigation measures in **Section 7**
Machinery and vehicles used in project activities would cause environmental problems.	Addressed in the mitigation measures in **Section 7**
The dam will lead to increased river temperatures and will disrupt the sewage dilution process of the river.	No change in water flow rate is anticipated in Balakot, the main town downstream of the dam, therefore this impact is not likely to be significant.
Due to catastrophic flood, or breakage of dam, we might suffer, what is the backup plan for our village?	A contingency plan is being developed for such situation.
Water supply from the springs and streams may dry out as result of project construction.	There is almost no river water use in the low flow area. There is a chance that springs above the tunnel will dry up during or after the tunneling. A hydrocensus was carried out as part of the EIA above the tunnel alignment. Restoration of water supply is proposed for the settlements where there will be impacts on springs and a budget has been included for this in the EMP. Addressed in the mitigation measures in **Section 7**
This village has no relevance to the river but is fully dependent on stream water for drinking purpose. Both human and animals are fed through this natural resource, after tunnel formation water table will reduce that affect our drinking water from streams.	Addressed in the mitigation measures in **Section 7**

Concerns Expressed by Stakeholders	*How they are Addressed*
The vibrations created by blasting for tunnels will damage house walls and make land unstable.	Addressed in the mitigation measures in **Section 7**
Project construction activities would deteriorate the natural beauty of the village.	Addressed in the mitigation measures in **Section 7**
Women expressed their fear about the effects of tunnel boring. Their houses can be affected, landslides will increase and there may be more earthquake in their area.	If the houses are affected they will be compensated by the Project.
The link between right and left bank of the river will be broken due to the submergence of the suspension bridges.	Access will be provided wherever it is disturbed.
Loss of agricultural land	
Agricultural land will be affected due to an increase in the water level in reservoir which will affect incomes.	Affected Households will be compensated properly.
Compensation for locals	
We need high priority in employment opportunities in the project activities and no outsider is to be allowed to work in the project unless local human resource is accommodated to the level of local satisfaction.	Priority in jobs and labor will be given to the locals.
Government should provide free electricity to local communities in exchange for their support and cooperation.	There is no such policy in the country.
Appropriate negotiation is required between affected people and government to resettle the affectees of the project.	The resettlement process will be undertaken with full participation of the affected community.
Villagers will not be happy with resettlement. However, if resettlement is necessary then alternative village or houses should be built for them.	Noted.
All the decisions which are related to community land ownership should be displayed in DC office accordingly.	Agreed.
We are requesting for free Chinese and English Language courses for our children so that they may get new opportunities of job according to market demand	The proponents will consider supporting any such effort.
Women quoted the example of payment problems with the developers of Sukki Kinari HPP and that people are not satisfied with the payments that government offered as resettlement cost.	Market prices of affected assets will be provided for this Project.

Concerns Expressed by Stakeholders	*How they are Addressed*
There was a major fear amongst the community that the government will not fulfil their promises in land acquisition case keeping in mind the situation with the Sukki Kinari HPP.	Point noted
Social issues due to movement of labor	
Non–village residents with different cultures will come to the area because of the project and damage the community's culture.	A clause will be added in the contractor's contract documents that they will be confined to their camps and will not breach privacy of local communities.
As we came to know that labor camp is proposed to construct nearby Dhab Village, we don't allow to construct labor camp because it will creates social issues due to increase of in–migration of labor for project construction. Labor camp should be outside from community settlement.	Design of the project is also being reviewed and if it is found possible design will be changed to avoid resettlement.
Our communal forest and other social fabric get destroyed.	A full compensationpackage is beign developed under the Land Acquisition and Resettlment Plan
Social security risk will increase due to increase of in–migration of labor for project construction.	Addressed in the mitigation measures in **Section 7**
Women suggested that the government construct the dam elsewhere and their plans should not affect residential settlements.	Design of the Project is being reviewed and if possible the design will be changed to avoid resettlement. If not, then people will be compensated for resettlement.
Women opposed the construction of the Project because they are concerned about its adverse consequences especially since the negative effects of the earthquake 2005 and floods 2010. They are unhappy about relocation and loss of land, and fruit orchards. They insisted that if they are to be relocated, they want to be provided not only with property but also similar environmental conditions.	A comprehensive resettlement plan has been prepared to relocate and rehabilitate affectees.

Exhibit 6.5: Photographs of Community Consultations

At Balseri

At Bela

At Dhab

At Garan

At Nihan

At Rah Sachcha


At Garan

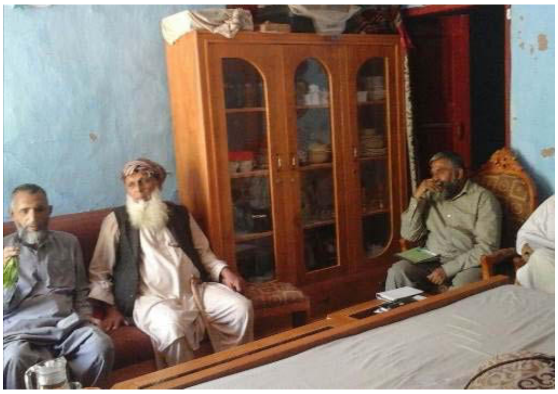

At Nihan


At Rah Sachcha


At Rahter


At Manakpai


At Sail


At Sendori


At Tangar


At Thobi


At Badwar


At Hassamabad


At Garhi Habibullah

At Bissian

At Boli

At Shohal Mazullah

At Gul Dheri

At Talhatta

At Hisari


At Shahotar


At Karnol


At Bararkot (JK)


At Manakpai


At Gul Dheri

Exhibit 6.6: Summary of Concerns Expressed and Management Measures Recommended

Concerns Expressed by Stakeholders	*How they are Addressed*
Disturbance to the aquatic ecosystem	
The Project will result in disturbance to the existing ecosystem.	Noted. This is the reason for the preparation of a Biodiversity Action Plan (BAP) (see **Volume 2C** of the **EIA**) which addresses these changes and provides measures for mitigating them and restoring or improving the ecosystem.
Removal of trees and deforestation of thick forests	
The presence of thick forests, including Reserve Forests, was highlighted. A key concern is the disturbance to these areas and clearance of forests for the Project.	Mitigation measures during the construction phase will include minimization of disturbance to forest areas and emphasis on finding alternatives to clearing forested areas where possible. Along with this, re-planation of and support to native species as well as prevention of the spread of alien invasive species will be included. During the operational phase mitigation measures will include avoidance of disturbance to forest areas by workers.
The Forest Department, KP is of the opinion that the Project footprint does not include large forested areas, therefore, it is not expected to degrade significant forest habitat. In particular, there is no concern with respect to Reserved Forests as the nearest ones are not located within or adjacent to the Project infrastructure. The habitat is already fragmented due to human activity. The locals have modified the habitat.	Noted. The information regarding Reserved Forests is especially useful for the EIA. The fragmented habitat was observed by the field team carrying out terrestrial ecology surveys. The terrestrial habitat has, therefore, been designated as Modified Habitat under IFC PS6.
The Forest Department is in favor of the Project as it will generate much needed electricity with limited damage to forested areas. Compensatory replantation is recommended for loss of any trees due to Project-related activities. The Forest Department has not decided on the ratio of replantation yet.	Noted. Compensatory re-plantation has been included as a requirement in the EMP in a ratio of 1:10.

Concerns Expressed by Stakeholders	*How they are Addressed*
Downstream impacts and modification of environmental flows	
Operational impacts are a concern for multiple stakeholders including the EPA KP and the other developer in the basin. It is important to know the modification to environmental flows (EFlows) as a result of Project operations. It is also important to know the plans for peaking and flushing including their timing and quantities of water and sediment which will be released. Recommendations included the following: ▶ Communication between developers was emphasized as important by the representative of Star Hydropower (Pvt.) Ltd. ▶ The representative from EPA KP expressed the need to plan for use of fish ladders. This opinion was shared by the representatives of the Fisheries Department. It was noted as important not only use a fish ladder but also to look into ways to improve the efficiency of fish ladders beyond 25-30%.	The environmental flow due to the Project will be determined using holistic environmental flow assessment. The methodology has been explained to the stakeholders and their concerns and opinions about it have been documented. The EFlow assessment is completed and the results have been shared and discussed with the stakeholders. Based on the assessment, an EFlow of 1.5 m^3/s at baseload operation is recommended with High Protection (see **Environmental Flow Assessment Report** in **Volume 2C** of the **EIA**)
The environmental flow agreed upon needs to be maintained.	The EFlow will be maintained as agreed. Monitoring of the environmental flow is part of the monitoring plan in the EMP.
Changes downstream of the dam can result in sites of archaeological importance being affected, especially if there is flooding.	Under the Antiquities Act, 2016 in KP, PEDO needs to be obtain clearance from the Director of Directorate of Archaeology and Museum, KP in accordance with the requirement under the Act to obtain clearance for any major project including hydropower.
A robust impact assessment is required to not only assess the impacts on the Kunhar River but also downstream in the Jhelum River. In particular, the impacts of peaking flows and sediment discharges need to be addressed.	Impacts downstream of Patrind HPP are not within the scope of the EIA of the Project. The major impacts on that part of the Kunhar River and downstream of the confluence, into Jhelum River are due to the Patrind HPP. The impacts downstream of Patrind HPP have been discussed qualitatively, as part of the CIA of the Project, using information from the ESIA of Patrind HPP.

Concerns Expressed by Stakeholders	*How they are Addressed*
The EIA should review the impacts on downstream projects for multiple scenarios, relating to construction activities, failure of cofferdam, accidental release of excavated materials and muck.	These impacts are considered in various sections.
The cumulative impact assessment is required which takes into consideration impacts in the basin on endemic and endangered aquatic species. This includes impacts in the lower Jhelum River as well.	In the case of the CIA, for impacts downstream of the confluence, qualitative assessment using information from the EIA of Patrind HPP has been carried out. The Patrind HPP will have major impacts at and downstream of the confluence, therefore, assessment of these impacts is part of the environmental assessment for Patrind HPP.
The cumulative impact assessment should also review the (provincial/state) transboundary issues relating to ecological, social, legal, and jurisdictional aspects of the project.	The Patrind HPP creates a barrier at the downstream end of the Kunhar River, close to the confluence with Jhelum River. Therefore, downstream of the confluence, the impacts of Patrind HPP are of concern.
The ESIA should take advantage of previous data collection and analyses that may be found in ESIAs and river basin planning documents for other hydropower developments.	Noted. Data from previous work done in the basin has been used, for example, in the ecology baseline.
The overall ESIA process should essentially be impact and risk based assessment.	Noted. The EIA process is an impact and risk based assessment.
Climate Change	
The ESIA analysis may also review the project for impacts and risks on and from climate change.	A climate change risk assessment is included in the EIA.
Spawning grounds	
The spawning grounds for fish fauna will be affected due to changes in flows. As a result native species will be impacted. Most importantly the Alwan Snow Trout, a migratory species and the two endemic species, Nalbant’s Loach and Kashmir Hillstream Loach will be affected.	Noted. The presence of these species has been confirmed as part of sampling carried out for the Ecological Baseline of the EIA. A Critical Habitat Assessment, under IFC PS6, in line with that recommended in ADB SPS 2009, was carried out and is presented in the Ecological Baseline. The three fish

Concerns Expressed by Stakeholders	*How they are Addressed*
	species mentioned were taken into consideration. Based on the criteria provided in the Critical Habitat Assessment guidelines, the biodiversity values for which Critical Habitat is determined include the two endemic species, Nalbant's Loach and Kashmir Hillstream Loach. The Project is required to show Net Gain for both species and a BAP (see **Volume 2C** of the **EIA**) has been developed that recommends measures to achieve this.
The use of hatcheries is recommended by the Fisheries Department.	Experimental breeding the Kashmir Hillstream Loach is recommended in the BAP (see **Volume 2C** of the **EIA**).
The ESIA may also develop framework on integrated fish monitoring plan, biodiversity management, sand and gravel mining management.	A monitoring and evaluation framework is included in the BAP developed for this Project. It monitors fish fauna as well as other aspects of the aquatic ecology and environment. Measures to manage biodiversity are a part of the EMP and the BAP. Management of sand and gravel mining is included in the BAP.
Fishing licenses	
Fishing licenses are provided for fishing in the area being occupied by the Project. The development will affect fishing in the area.	Offsets for loss in fish populations are proposed as part of the BAP. Implementation of measures proposed in the BAP will result in increased fish populations elsewhere in Kunhar River.
Submergence of certain areas is a concern	
The submergence of areas due to water level rise and creation of the reservoir is a concern because it will affect both biodiversity (in particular vegetation) and the locals.	Re-plantation of trees is recommended to compensate for the loss of vegetation.

Concerns Expressed by Stakeholders	*How they are Addressed*
The loss of habitat due to submergence is a concern for the Wildlife Department, KP. This will affect the flora and fauna of the riparian zone as well as causing modification of the habitat due to creation of a wetland.	As noted above, re-plantation is recommended as part of the EMP. This will restore habitat lost as a result of submergence by the reservoir.
The Wildlife Department recommends that the reservoir be declared a Protected Area. The Fisheries Department recommends using the reservoir for stocking of fish. However, it is important to prevent the spread of invasive fish fauna. A safe areas for fish within the reservoir is recommended and if access to the reservoir is restricted to the public, the option of pond sharing with the Fisheries Department, KP should be considered.	No native fish species will be able to live in the reservoir as the water temperature will be too low. The stocking of introduced species is not recommended as they adversely affect the populations of native fish species.
Adverse impacts on the local community	
The presence of a colony and camps for workers and laborers will present challenges. These include the regulation of activities to prevent pollution of the environment, proper waste disposal, restrictions on workers partaking in illegal activities especially those damaging to the environment such as exploitation of wildlife and introduction of invasive species.	Strict regulations and the training of workers will be recommended as part of the Environmental Management Plan (EMP) to limit potentially damaging activities including poaching, introduction of alien invasive species and exploitation of wildlife.
The representative from HWF stated that a commitment should be made to provide locals with as many jobs related to the Project as possible. These include technical jobs for which training should be started as soon as possible.	Priority will be given to the affected households/locals in project jobs and labor.
Sediment should be sourced locally and contracts for sediment extraction and provision should be with the locals, not outsiders.	To the extent possible, contracts will be given locally.
There should be an agreement with the government to provide 24 hour electricity daily to the community being affected by the Project.	Noted. However, it is not in the jurisdiction of PEDO.
The maximum benefit of the Project should be to the locals. The resettled people, in particular, should be wealthier with an improved quality of life.	LARP will be planned on the principle that living standards of affected households will remain same after the project implementation.
Under social assessments, the EIA should include analysis on human rights, community benefit sharing, conflicts and security, etc.	These have been convered under the Social and Poverty Analysis Report

Concerns Expressed by Stakeholders	*How they are Addressed*
The ESIA may also develop framework on conflicts & security management plan, livelihood restoration, etc. that would require joint implementation by key stakeholders.	Grievance redressal mechanism and livelihood restoration plan will be included in the EIA
Resettlement is a concern especially as there is commercial infrastructure in the Project area	
All displaced households should be rehabilitated.	All the displaced households will be rehabilitated according to the Land Acquisition and Resettlement Plan (LARP).
Public infrastructure such as Basic Health Units (BHU) should be relocated.	Public infrastructure will be relocated by the project, it is planned in the LARP.
Graves should be managed with the consent of the communities.	Graves management is addressed in the LARP. Either the graves will be shifted or they will be made permanent at their current locations.
The Project should provide special assistance to vulnerable households.	Vulnerable households will receive special assistance and it is included in the entitlement plan of the LARP
Households whose livelihood is affected should be provided with vocational trainings to get benefits from the project.	Vocational trainings is included in the Livelihood Restoration Plan, which is a part of the LARP.
The representative from SHCL highlighted that a market will have to be re-located as a result of the Project, therefore, resettlement is a major and sensitive issue which will need to be addressed carefully.	A land acquisition and resettlement action plan is being developed to address the related impacts.
People who are relocated are likely to move downward based on the trend in this area. This is a positive move from the forest conservation perspective, as it leaves areas higher up free from disturbance.	Noted.
The NGO, HWF, wants to see the quality of life improve for those resettled. Value should be added to their lives. The HWF representative recommended that the new housing provided should be based on comprehensive planning. A sectoral approach should be taken such as that adopted for Islamabad. The infrastructure should be a model for other villages in the Kaghan Valley.	Relocation of houses will be based on the consent of the local communities. Most of the households consulted have opted for cash compensation and self-relocation however, project managed relocation will also be considered in the planning. As part of project managed relocation, all the basic facilities will be provided to the affected peoples. As a policy

Concerns Expressed by Stakeholders	*How they are Addressed*
A town planner should be hired for the work and there should be residential, commercial and amenities plots.	principle, at least pre-project living standards of the affected households will be maintained.
Impacts on terrestrial ecology and species of conservation importance	
Construction phase disturbances area concern for terrestrial wildlife more so than operational phase disturbances. Air and noise pollution, in particular are important to address. The Project is located in areas that have Reserve Forests. Disturbance of these forests will affect the wildlife associated with these forests as well as the activities and resources of the locals that depend on them. The area was highlighted as being 'critical' for wildlife by the representative of the WWF. Species of conservation importance include Taxus spp., Himalayan Grey Langur, Black Bear, Western Tragopan, the Long tailed Tip, Khalij Pheasant, Kokhlas Pheasant. Vulture spp., Common Leopard and ungulates spp. including Ibex, Muntjak Deer, and Grey Goral. The risk of local extinctions was highlighted. Seasonal risks to wildlife are also present because of the presence of altitudinal migrants which descend into areas in and around the Project infrastructure during the winter. The representative from the WWF emphasized that Himalayan biodiversity has a slow growth rate and does not recover rapidly. Recommended mitigation measures for the wildlife included the following: ▶ Timing construction activities to minimize disturbance to wildlife. Preference should be given to constructing during winter when animals are less active. ▶ Strict controls on exploitation of wildlife by Project staff. ▶ Protection of forests upstream of the dam. ▶ Forest targeted restoration and conservation. ▶ Avoiding removal of Taxus spp. ▶ Investments in watershed management programs. ▶ Regular checks on water quality. ▶ Focused studies on Taxus spp., Western Tragopan and Musk Deer.	A Biodiversity Action Plan (BAP) (see **Volume 2C** of the **EIA**) has been prepared to address the challenges associated with the impacts on biodiversity due to the Project. The measures are aimed at achieving net gain depending on the biodiversity, in particular, the species of conservation identified as being impacted by the Project.

Concerns Expressed by Stakeholders	*How they are Addressed*
The Wildlife Department, KP also noted some of the species mentioned above along with the Chakhor. They are especially concerned about the Khalij Pheasant as this is an important area for it. The HWF is interested in contributing towards protection of biodiversity.	
Flushing and Sediment Management	
Flushing will be carried out which will impact the fish fauna of the reservoir. However, it is noted that flushing will be done in the flooding seasons, when flushing is necessary anyways. The schedule for flushing should be shared with the public so that people know about water level changes.	*To be responded following finalization of Feasibility Study*
The analysis of alternatives should cover different approaches to sediment management. This could range from different designs (e.g., dedicated sluicing gates low in the dam vs spillway releases) to different release regimes (e.g., multiple releases in the high-water season vs one or two release periods) to different levels of cooperation and coordination among cascade hydropower operators (e.g., synchronization of releases by upstream and downstream projects to unilateral scheduling of sediment releases).	*To be responded following finalization of Feasibility Study*
Peaking	
The analysis of alternatives should cover different approaches to peaking flows, from run-of-river to two- to four- hour daily peaking discharges.	The analysis of alternatives has covered both baseload and peaking scenarios. The daily discharges covered include five- hours daily peaking discharges
Seasonal limitations on peaking should be considered as well.	This has been taken into consideration. Peaking will only be done from September to April, i.e. the dry season.
Developers are encouraged to consult with relevant authority to discuss the possibility that the Project be operated as a run-of-river project without peaking discharges during the entire year or during key biodiversity periods of the year.	*Responded to be reviewed following finalization of Feasibility Study* An EFlow Assessment (see **Environmental Flow Assessment Report** in **Volume 2C** of the **EIA**) has been carried out for the Project. It has recommended two EFlows including:

Concerns Expressed by Stakeholders	How they are Addressed
	▶ An EFlow of 1.5m^3/s with the Project operating at baseload or ▶ An EFlow of 6m^3/s with peaking operations with an associated loss of 3.5% power generation compared to 1.5m^3/s at baseload Both options achieve net gain in biodiversity values for which Critical Habitat is designated provided High Protection is implemented as a non-flow related measure. These options have been presented to the developer, PEDO. The first option of an EFlow of 1.5m^3/s with operation at baseload is recommended.
Water level	
The NGO Adventure Time Pakistan are concerned about changes to the water level due to the Project. The activity of White Water Rafting is carried out only on the Kunhar River in Pakistan, in two areas, one of which is the stretch between Balakot Town and Garhi Habibullah. From the point of view of the sport, a higher water level in this stretch is preferable.	The fluctuation in water levels as a result of peaking will be attenuated due to inflows from the tributaries, therefore, in this stretch the water level is not expected to be significantly impacted.
Impact on tourism	
The impacts on tourism are expected to be positive because of the development of a reservoir. In the Khanpur Dam, for example, activities for children are organized.	The reservoir is likely to be off-limits to the public, however, a section of it may be open for tourism.
The Tourism Corporation, KP (TCKP) stated that there is a lack of data on tourism with the Corporation and only recently their capacity for data collection and other activities has been increased. Therefore, they are in the process of data collection.	Noted.
The TCKP has plans on developing the area for tourism and will propose to donors like the World Bank. If the Project can provide any assistance, that would be welcome.	Noted.

Concerns Expressed by Stakeholders	*How they are Addressed*
Historical value	
The District of Mansehra is rich in history. More than 1,000 sites have been identified in it. This area has been important as a historic trade route and Bhuddist archaeology is important here. The Archaeology Department of Hazara University recommends conducting surveys to determine the archaeological value in the area. If any artifacts of importance are found, excavations can be done. Assessing the area, keeping in view the dam, is important. Any information gained should be shared with the public. The Provincial Antiquities Act has been revised in 2016 and should be taken into consideration.	Under the Antiquities Act, 2016 in KP, PEDO needs to be obtain clearance from the Director of Directorate of Archaeology and Museum, KP in accordance with the requirement under the Act to obtain clearance for any major project including hydropower.
The Archaeology Department, University of Peshawar has no primary or secondary data on the Project area and can, therefore, not comment on the archaeological value of the site.	Noted.
Waste disposal	
Waste generated as a result of the Project should be quantified. This includes the excavated soil and rock material which requires off-site disposal.	This is outside the scope of the EIA. It is being done as part of the feasibility study.
Potential sites for safe disposal of muck should be reviewed for risks of washout, land sliding etc. Consideration of a detailed Muck Disposal Plan during the construction phase is also recommended.	This can only be done when information on the location of these sites is available which is being done as part of the feasibility study.
Jurisdiction of the Kaghan Development Authority (KDA)	*These responses requires review following discussion with PEDO, once the Feasibility Study is finalized*
The Project falls in an area that is entirely within the jurisdiction of the KDA. The KDA supports this move by the Provincial Government of KP to increase energy generation in the province but insists that this should be done in coordination with the KDA.	As part of PEDO's responsibilities outlined in the EMP (**Section 9**, *Environmental Management Plan*), it will, ▶ Support local government in the implementation of infrastructure project and ▶ Support NGOs specializing in development of infrastructure to assist local government.
The KDA has a number of development plans in the area which can be affected by the Project and Project-related impacts. These plans include facilities for sanitation, drainage, waste disposal, garbage collection, firefighting, park development for families and children etc. Project-related	As part of PEDO's responsibilities outlined in the EMP (**Section 9**, *Environmental Management Plan*), it will,

Concerns Expressed by Stakeholders	*How they are Addressed*
impacts can increase commercial activity in the area, thereby, putting pressure on these services. For example, increased activity will result in increased pollution and waste generation. Keeping in view these plans and functions of the KDA, it is important to coordinate with the KDA. The KDA functions as a service provider, building control agency and executing agency for any scheme in the area.	▶ Support local government in the implementation of infrastructure project and ▶ Support NGOs specializing in development of infrastructure to assist local government.
The natural beauty of the area, with all of its flora and fauna are important for the KDA, which is aiming at preserving these as a priority. Therefore, conservation of natural resources is important.	Biodiversity management has been considered as part of the EMP (see **Section 9**, *Environmental Management Plan*) and a BAP (see **Volume 2C** of the **EIA**) has been developed to address impacts on biodiversity.
By legislation, the KDA is the owner of the area and coordination with the KDA is required for public as well as private sector Projects.	As part of PEDO's responsibilities outlined in the EMP (**Section 9**, *Environmental Management Plan*), it will, ▶ Support local government in the implementation of infrastructure project and ▶ Support NGOs specializing in development of infrastructure to assist local government.
It is very important that the KDA be kept up-to-date on all developments and information be shared with the KDA in a timely manner.	As above.
Building the capacity of the KDA is recommended. Specifically the KDA wants to build financial capacity so that it can function more effectively as a service provider.	As above.
Management in Coordination with the Hydropower Industry	
The developers are encouraged to participate in the Hydropower Developers' Working Group, and participate in supporting future activities of the Working Group. This could take the form of participating in Group meetings, direct contributions to various initiatives, as well as participating or even leading certain activities. To that end, the IFC would very much appreciate it if you would provide to us contact information for the Project management.	Noted. Participation of PEDO in the Hydropower Developers' Working Group is recommended in the Biodiversity Action Plan (BAP) (see **Volume 2C** of the **EIA**) for the Project.

Concerns Expressed by Stakeholders	*How they are Addressed*
Non Project-related pressures	
There are numerous non Project-related pressures on wildlife including the following: Habitat loss and fragmentation due to expansion of human settlements Human-wildlife conflict especially with predators like the Common Leopard and Black Bear. After the major earthquake in the area, people have moved to lower elevations resulting in increased habitat for these species. As a result their populations have expanded and they have expanded their range. On the aquatic ecosystem, these pressures include human population growth causing an increase in pollution and effluent discharge into the river. This has resulted in an increase in pH in some areas, making them unsuitable for fish fauna. There is also increased noise pollution from road construction. Abrupt changes in the ecosystem are a concern which can result from climate change, for example.	The BAP will address issues associated with biodiversity management and protection. An increase in the capacity for watch and ward is part of the BAP which will contribute to both aquatic and terrestrial biodiversity protection. A part of the BAP is an M&E plan which will monitor water quality, therefore, pollution levels in the river. A climate change assessment is part of the EIA.
The violations of wildlife laws, including those against aquatic biodiversity, are being enforced by the Wildlife Department.	Noted. Any additional watch and ward system established as part of this Project, under the BAP, will be implemented in coordination with the Wildlife Department, KP
The Fisheries Department, KP has divided the Kunhar River into six zones. Of these, one zone is a sanctuary where no disturbance is allowed and where there are a greater number of fish watchers than in other zones. However, the zonation has changed due to increased pollution as fish are not travelling into areas they previously were. In addition to this, implementation of watch and ward is difficult because more people are visiting these areas as compared to the past.	An M&E plan, which includes data collection on water quality, is part of the BAP developed for this Project. It will collect data to determine if levels of pollution are above acceptable thresholds. Adaptive management is recommended as part of the BAP to address issues associated with unacceptably high levels of pollution.
Release of sewage into river is an existing issue	
The existing issue of sewage being dumped into the river, both from residential discharge and commercial discharge, was highlighted as a key concern. It was emphasized that the Project should not contribute further to this and if possible contribute to its mitigation.	Proper waste disposal procedures will be part of the requirements of the Project both during the construction and operation phases. At this stage options for sewage treatment and reduction of the effluent discharged into the river will be assessed.

Concerns Expressed by Stakeholders	*How they are Addressed*
Lack of data on wildlife	
There is a lack of data on wildlife especially on key species like the Common Leopard and the Indian Palm Civet. The Wildlife Department, KP only has data on game animals and lacks the capacity for data collection. This was also the view of the Fisheries Department concerning fish fauna. In particular, the impacts of pollution on fish fauna are a concern. It was noted by the fisheries Department that the growth of fish has not altered over the past few years and no abnormal growth has been observed. However, this is only based on observation, not based on data collection and research.	Data on wildlife has been collected and reported in the Ecological Baseline for the EIA. This included data collection on vegetation, mammals, birds, herpetofauna, fish fauna, macro-invertebrates. A BAP (see **Volume 2C** of the **EIA**) has been prepared which includes a monitoring and evaluation (M&E) plan to collect data on wildlife that will be impacted by the Project, with a focus on aquatic ecology, mainly fish fauna. The M&E plan also includes data collection water quality and other physical environmental aspects.
The Wildlife Department recommended data collection in extensive detail including on entomology in the area.	Data is being collected for the baseline of the EIA of the Project. Data collection is focused on biodiversity likely to be affected by the Project, not for all biodiversity present in the area. Aquatic insects are being surveyed because they will be impacted. Terrestrial are not being impacted, therefore, they will not be surveyed.
The Fisheries Department recommends weekly monitoring of pH. At the moment the Department only collects data on temperature.	An M&E plan, which includes data collection on water quality, is part of the BAP (see **Volume 2C** of the **EIA**) developed for this Project.
Lack of staff	
The Wildlife Department lacks the staff to effectively implement watch and ward. There is a need to build departmental capacity.	An increase in the number of watchers is recommended under the BAP along with financing for the increased capacity.
Lack of awareness amongst the locals	
There is a lack of awareness amongst the locals about the importance of wildlife and a lack of understanding about the sustainable use and economic benefits of wildlife.	The BAP includes measures to increase awareness amongst the locals regarding the importance of protecting biodiversity and engaging them in conservation activities.

Consultations on Environmental Flow Assessment

Stakeholder consultations were held to discuss the Environmental Flow Assessment carried out for the Project (see **Environmental Flow Assessment Report** in **Volume 2C** of the **EIA**). Two consultations were held. The first one was held before the EFlow Assessment to explain the process to stakeholders and document their views before starting the assessment. The second one was held after the EFlow Assessment to explain discuss the results of the DRIFT DSS. The following stakeholders were invited and attended the consultations:

- Pakhtunkhwa Energy Development Organization (PEDO)
- Asian Development Bank (ADB)
- Khyber Pakhtunkhwa (KP) Environmental Protection Agency
- World Wide Fund for Nature-Pakistan
- KP Wildlife Department
- KP Forest Department
- KP Department of Fisheries
- Department of Environmental Sciences, University of Peshawar
- Directorate General (Extension), Livestock and Dairy Development

The process of EFlow assessment was described, and the results of the EFlow assessment were shared with the participants. The behaviors of different fish species and how they are likely to be impacted by the Project was described. Recommendations for alternatives available for management of the Project operations to minimize the impact on aquatic fauna were presented. Pressures on the river system including fishing and sediment mining, and disposal of urban effluents and solid waste into the river were described. The strategy for management of biodiversity developed for Biodiversity Action Plan (BAP) of the Gulpur HPP and subsequently adopted in the BAP/Management Plan of Karot and Kohala HPPs was described, and it was suggested that the approach that has been tested in implementation of BAP of Gulpur HPP should be adopted. This includes a watch and ward protection of the river, sustainable management of sand and gravel mining, a watershed management program, and research on aquatic biodiversity.

The main concerns expressed by stakeholders and responses to them are provided in **Exhibit 6.7.** Photographs of the consultations are provided in **Exhibit 6.8.** The logs for the consultations are provided in **Appendix Q**. The presentations given are provided in **Appendix R**.

Exhibit 6.7: Summary of Main Concerns Expressed by Stakeholders and Responses

Concerns Expressed by Stakeholders	*How they are Addressed*
What is the ratio of environment to economic weightage in the calculations in DRIFT? How does it work?	DRIFT does not provide a single number for required environmental flow but rather allows stakeholders to make that decision by providing results for each scenario. DRIFT is used as an optimization tool.
What about the 2010 flood? The graphs do not show high flood values.	The 2010 flood did not significantly impact Kunhar River.
Climate Change, new seasons and fluctuations will be considered in DRIFT? In the last 5 years the hydrology of the river seems to have changed.	The climate change models are not reliable. 51 years flow data is used to design dams and climate change models are incorporated in risk assessment to see the effect. Using only last 7 years data for dam design data is not sufficient.
Cumulative impacts of HPPs are a serious concern, how will these be addressed	A cumulative impact assessment is part of the EIA. The approach suggested in the CIA of Kohala HPP is suggested to be followed. The basin wide impacts have been studied at a high level in the IFC sponsored Hydropower Strategy for the Jhelum-Poonch Basin, the second phase of which is to start soon. The stakeholders in KP will be kept informed and will be contacted for participation by IFC in the course of implementation of the second phase of the basin-wide initiative.
Will it be possible to construct a fish ladder?	Given the dam height of the order of over 60 meters, it will not be technically feasible to construct a fish ladder. Genetic studies and physical transport of fish from downstream to upstream of the dam will be recommended of genetic studies show impacts of isolation.

Exhibit 6.8: EFlow Consultations at the PEDO Office, Peshawar

The key conclusions from the consolations were as follows:

- The approach to mitigation and management of cumulative impacts at the basin level was endorsed.
- The institutional and financial model where the government departments supervise and provide legal cover, and independent non-government or private sector qualified organizations are contracted by PEDO to implement the BAP was endorsed.
- Inclusion of environmental costs as Project costs for inclusion in power tariff was accepted.

6.5 Future Consultations

Further consultations to be undertaken as part of the Project EIA process have been outlined in the **Stakeholder Engagement Plan** in **Appendix O**.

The Project management will continue community engagement activities throughout the life of the plant. Visits will be undertaken in all the communities twice or more times in a year, depending on the number of concerns raised under each consultation. Ongoing community engagement activities relevant to the EIA include:

- Ongoing reporting on progress on the implementation of environmental and social management measures identified during the EIA process and recording of comments on the effectiveness of these measures;
- Updating communities about new Project developments and recording comments on these; and,
- Ongoing operation of the grievance redress mechanism (**Stakeholder Engagement Plan** in **Appendix O**).

An overview of Stakeholder Engagement Plan is provided in **Exhibit 6.9.**

Exhibit 6.9: List of Stakeholders and their Relevance for the EIA and the Project

Stakeholder Group	*Stakeholders*	*Engagement Method*	*Frequency*
Regulatory Institutions	Khyber Pakhtunkhwa Environmental Protection Agency (KP EPA)	▶ Face-to-face meetings. ▶ Periodic reports	▶ Annually or earlier, if required
Government Institutions	Fisheries Department, KP Wildlife Department, KP Forest Department, KP Revenue Department, KP Agriculture Department, KP Social Welfare Department, KP	▶ Face-to-face meetings. ▶ Periodic reports	▶ Annually or earlier, if required
Non-Governmental Organizations and Civil Society Organizations	There are a number of NGOs operating in KP. Some of these include: ▶ Sarhad Rural Support Program ▶ Aga Khan Rural Development Program The NGOs working on protection and management of wildlife and natural resources: ▶ World Wide Fund for Nature (WWF) ▶ Himalayan Wildlife Foundation (HWF)	▶ Notification of availability of information on website ▶ Invitation to public events	▶ As and when the information is available or the meeting is held
Communities being relocated	Communities with river-dependent livelihoods and being relocated/resettled	▶ Meetings with the communities ▶ Visit to homes ▶ Group meetings ▶ Sharing of documents in Urdu	On an ongoing basis during resettlement process
Communities within a 500 m buffer of the river	Communities with river-dependent livelihoods	▶ Meetings with the communities ▶ Group meetings	At least once every year
Communities within 1 km of the Project infrastructure	Communities that may be directly impacted by the Project	▶ Meetings with the communities ▶ Group meetings ▶ Sharing of documents in Urdu	At least once every six months

7. Project Impacts and Mitigation Measures

During the scoping stage of the EIA process, several potential environmental and social impacts of the Project were identified. The baseline surveys were conducted keeping in consideration the potential impacts. In this section, the potential environmental and social impacts are evaluated. The impacts have been identified based on consideration of the information presented in previous chapters. To avoid unnecessary repetition of supporting information, cross referencing to previous sections is given where necessary. Following the impact assessment, the mitigation measures related to each impact category is presented.

7.1 Introduction

The general methodology used for impact assessment is described in this section. It describes the process of impact identification and definition, significance rating, mitigation, management and good practice measures.

7.1.1 Impact Identification and Definition

There are several guidelines and textbooks on identification and description of environmental and social impacts. These documents use various tools in an attempt to define a comprehensive and consistent method to capture the potential impacts of a proposed Project. However, it is now widely recognized by EIA practitioners that impact evaluation is not a purely objective and quantitative exercise. It has a subjective element; often based on judgment and values as much as scientific criteria. Recognizing this, a uniform system of impact description is used to enable the reviewers to understand how impacts have been interpreted. The description of each impact will have the following features:

- a definition of the impact using an **impact statement** identifying the Project activity or activities that causes the impact, the pathway or the environmental parameter that is changed by the activity, and the potential receptors of the impact (aspect-pathway-receptor)
- **description of the sensitivity and importance value** of the receiving environment or receptors (based on the stakeholder consultations undertaken)
- **extent of change** associated with the impact
- **rating of the significance** of the impact
- description of appropriate mitigation and management measures and potential effectiveness of the proposed measures
- characterization of the level of uncertainty in the impact assessment

The significance of an impact is determined based on the product of the consequence of the impact and the probability of its occurrence. The consequence of an impact, in turn, is a function primarily of three impact characteristics:

- magnitude
- spatial scale
- timeframe

Magnitude is determined from quantitative or qualitative evaluation of a number of criteria including:

- sensitivity of existing or reasonably foreseeable future receptors
- importance value of existing or reasonably foreseeable future receptors, described using the following:
  - inclusion in government policy
  - level of public concern
  - number of receptors affected
  - intrinsic or perceived value placed on the receiving environment by stakeholders
  - economic value to stakeholders
- severity or degree of change to the receptor due to impact, measured qualitatively or quantitatively, and through comparison with relevant thresholds:
  - legal thresholds—established by law or regulation
  - functional thresholds—if exceeded, the impacts will disrupt the functioning of an ecosystem sufficiently to destroy resources important to the nation or biosphere irreversibly and/or irretrievably
  - normative thresholds—established by social norms, usually at the local or regional level and often tied to social or economic concerns
  - preference thresholds—preferences for individuals, groups or organizations only, as distinct from society at large
  - reputational thresholds—the level of risk a company is willing to take when approaching or exceeding the above thresholds

Spatial scale is another impact characteristic affecting impact consequence. The spatial scale of impacts can range from localized (confined to the proposed Project site) to extensive (national or international extent). They also may vary depending on the component being considered.

The impact **timeframe** is the third principal impact characteristic defining impact consequence and relates to either its duration or its frequency (when the impact is intermittent). Impact duration can range from relatively short (less than four years) to long (beyond the life of the Project). Frequency ranges from high (more than 10 times a year) to low (less than once a year). These timeframes will need to be established for each Project based on its specific characteristics and those of the surrounding environment.

Once the impact consequence is described on the basis of the above impact characteristics, the **probability of impact** occurrence is factored in to derive the overall impact significance. The probability relates to the likelihood of the impact occurring, not the probability that the source of the impact occurs. For example, a continuous Project activity may have an unlikely probability of impact if there are no receptors within the area influenced by that activity.

The **reversibility of each impact** at the end of construction and operation are important, as these impacts may need on-going management after operation. The reversibility of each impact at the end of construction and operation will be noted and described alongside the three primary characteristics of magnitude, spatial scale and duration.

The characteristics are outlined in **Exhibit 7.1.**

Exhibit 7.1: Characteristics Used to Describe Impact

Characteristics	*Sub-components*	*Terms used to describe the impact*
Type		Positive (a benefit), negative (a cost) or neutral
Nature		Biophysical, social, cultural, health or economic Direct, indirect or cumulative
Phase of Project		Construction, operation, decommissioning or post closure
Magnitude	Sensitivity of receptor	High, medium or low capacity to accommodate change High, medium or low conservation importance Vulnerable or threatened Rare, common, unique, endemic
	Importance or value of receptor	High, medium or low concern to some or all stakeholders High, medium or low value to some or all stakeholders (for example, for cultural beliefs) Locally, nationally or internationally important Protected by legislation or policy
	Severity or degree of change to the receptor	Gravity or seriousness of the change to the environment Intensity, influence, power or strength of the change Never, occasionally or always exceeds relevant thresholds
Spatial scale	Area affected by impact - boundaries at local and regional	Area or Volume covered Distribution

Characteristics	Sub-components	Terms used to describe the impact
	extents will be different for biophysical and social impacts.	Local, regional, transboundary or global
Timeframe	Length of time over which an environmental impact occurs or frequency of impact when intermittent	Short term or long term Intermittent (what frequency) or continuous Temporary or permanent Immediate effect (impact experienced immediately after causative project aspect) or delayed effect (effect of the impact is delayed for a period following the causative project aspect)
Probability - likelihood or chance an impact will occur		Definite (impact will occur with high likelihood of probability) Possible (impact may occur but could be influenced by either natural or project related factors) Unlikely (impact unlikely unless specific natural or Project related circumstances occur)
Reversibility/Sustainability		Potential for recovery of the endpoint from a negative impact Reversible or irreversible Sustainability for positive impacts
Effectiveness of management measures (will management measures reduce impact to an acceptable level)		Indication of what could occur in the absence of management measures Effectiveness of proposed measures
Confidence in impact evaluation (degree of certainty in the significance ascribed to the impact)		Scientific uncertainty – limited understanding of ecosystem (or community) and processes governing change Data uncertainty – restrictions introduced by incomplete or incomparable information, or by insufficient measurement techniques Policy uncertainty – unclear or disputed objectives, standards or guidelines

7.1.2 Impact Significance Rating

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the approval process; secondly, it serves to show the primary impact characteristics, as defined above, used to evaluate impact significance. The impact significance rating system is presented in **Exhibit 7.2** and described as follows:

- **Part A**: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale and duration.
- **Part B**: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A; and

- **Part C**: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from Part B) and the probability of occurrence.

Using the matrix, the significance of each described impact is rated.

Exhibit 7.2: Method for Rating the Significance of Impacts

PART A: DEFINING CONSEQUENCE IN TERMS OF MAGNITUDE, DURATION AND SPATIAL SCALE *Use these definitions to define the consequence in Part B*			
Definition		Criteria	
MAGNITUDE		Negative	Positive
	Major	Large number of receptors affected Receptors highly sensitive and/or are of conservation importance Substantial deterioration, nuisance or harm to receptors expected Relevant thresholds often exceeded Significant public concern expressed during stakeholder consultation Receiving environment has an inherent value to stakeholders	Large number of receptors affected Receptors highly amenable to positive change Receptors likely to experience a big improvement in their situation Relevant positive thresholds often exceeded
	Moderate	Some receptors affected Receptors slightly sensitive and/or of moderate conservation importance Measurable deterioration, nuisance or harm to receptors Relevant thresholds occasionally exceeded Limited public concern expressed during stakeholder consultation Limited value attached to the environment	Some receptors affected Receptors likely to experience some improvement in their situation Relevant positive thresholds occasionally exceeded
	Minor	No or limited receptors within the zone of impact Receptors not sensitive to change Minor deterioration, nuisance or harm to receptors Change not measurable or relevant thresholds never exceeded Stakeholders have not expressed concerns regarding the receiving environment	No or limited receptors affected Receptors not sensitive to change Minor or no improvement in current situation Change not measurable Relevant positive thresholds never exceeded No stakeholder comment expected
TIMEFRAME (determine specific to each Project)		Duration of continuous aspects	Frequency of intermittent aspects
	Short term/ low frequency	Less than 4 years from onset of impact	Occurs less than once a year
	Medium term/ frequency	More than 4 years from onset of impact up to end of life of project (approximately 30 years)	Occurs less than 10 times a year but more than once a year
	Long term/ high frequency	Impact is experienced during and beyond the life of the project (greater than 30 years)	Occurs more than 10 times a year

SPATIAL SCALE (determine specific to each project)		Biophysical	Socio-economic		
	Small	Within the project fence line or within 200 m of unfenced facilities	Within the municipality in which the activity occurs		
	Intermediate	Within the district in which is the facilities are located	Within the province in which the activity occurs		
	Extensive	Beyond the district in which the facilities are located	Beyond the province in which the activity occurs		
PART B: DETERMINING CONSEQUENCE RATING *Rate consequence based on definition of magnitude, spatial extent and duration*					
MAGNITUDE		TIMEFRAME	SPATIAL SCALE		
			Small	Inter-mediate	Extensive
Minor		Short term / low frequency	Low	Low	Medium
		Medium term / frequency	Low	Low	Medium
		Long term / high frequency	Medium	Medium	Medium
Moderate		Short term / low frequency	Low	Medium	Medium
		Medium term / frequency	Medium	Medium	High
		Long term / high frequency	Medium	High	High
Major		Short term / low frequency	Medium	Medium	High
		Medium term / frequency	Medium	Medium	High
		Long term / high frequency	High	High	High
PART C: DETERMINING SIGNIFICANCE RATING *Rate significance based on consequence and probability*					
			CONSEQUENCE		
			Low	Medium	High
PROBABILITY (of exposure to impacts)		Definite	Low	Medium	High
		Possible	Low	Medium	High
		Unlikely	Low	Low	Medium

7.1.3 Mitigation, Management and Good Practice Measures

Using the matrix, the significance of each described impact is initially rated. This initial rating assumes the management measures inherent in the Project design and described in the Project description (**Section 3**) are in place. For example, if a fuel store has secondary containment, the initial impact rating takes this into account.

Wherever the Project is likely to result in unacceptable impact on the environment, additional mitigation measures are proposed (over and above the inherent design measures included in the Project description). In addition, good practice measures may be proposed however these are unlikely to change the impact significance. In the case of positive impacts, management measures are suggested to optimize the benefits to be gained. Where mitigation measures are required the impact will be rated again to show the residual impact after implementation of management controls.

The following mitigation hierarchy will be utilized in selecting practical mitigation measures for unacceptable impacts as follows (in order of preference):

- avoid the impact wherever possible by removing the cause(s)
- reduce the impact as far as possible by limiting the cause(s)
- ameliorate the impact by protecting the receptor from the cause(s) of the impact
- providing compensatory measures to offset the impact, particularly where an impact is of high significance and none of the above are appropriate.

A rating of impact considering mitigations will be carried out to highlight the effectiveness of proposed management measures designed to mitigate or enhance the impact, and by characterizing the level of confidence or uncertainty in the assessment.

For each of the impacts identified, a table will be filled in **Exhibit 7.3.**

Exhibit 7.3: Impact Assessment Template

Impact 01: Loss of riverine ecosystem due to inundation by Project reservoir								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Long Term	Extensive	High	Definite	High	-	High
Mitigation Measures:								
Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Major	Long Term	Extensive	High	Definite	High	+	High

7.1.4 Impact Grouping

The impacts in this chapter are grouped as follows:

- **Ecology**
  - 7.2 Aquatic Ecology
  - 7.3 Terrestrial Ecology
- **Physical Environment**
  - 7.4 Ambient Air Quality
  - 7.5 Blasting and Vibration
  - 7. 6 Hydrology and Water Quality
  - 7. 7 Construction Noise
  - 7.8 Soil, Topography, Land Stability
  - 7.9 Aesthetics
  - 7.10 Traffic and Roads
- **Socioeconomic Environment**
  - 7.11 Livelihood and well-being
  - 7.12 Socio-cultural impacts
- **Cross-thematic Aspects**
  - 7.13 Cumulative impact assessment
  - 7.14 Climate change

7.2 Aquatic Ecology

The potential impacts on the ecology and biodiversity of Kunhar River, under the selected environmental flow release and management configuration, are presented below. The methodology for selecting the configuration is presented in **Section 5.3**, *Environmental Flow Assessment*.

An EFlow scenario of 1.5 m^3/s with baseload operation is recommended as the preferred option in the EFlow Assessment Report (see **Volume 2C** of the **EIA**). Under this option there is highest net gain in populations of key fish species with implementation of High Protection. An alternative scenario with an EFlow of 6.1 m^3/s and peaking operation was also considered. However, this is not recommended as it results in loss of power generation as well as a lower net gain, even with High Protection.

Consistent with ADB and IFC Guidelines, the Project was designed to achieve a net gain in biodiversity in view of the location of the Project in a Critical Habitat (**Section 4.2.8,** *Habitat Assessment*). The EFlow with baseload operation is preferable because the impacts on the ecological resources are lower. Given the high anthropogenic pressures on the fish, the benefit of EFlow can be realized only if the river is protected. In other words, EFlow releases can be considered of little consequence in absence of protection of the river. In case of baseload operation the river downstream of the tailrace is not significantly changed and therefore with protection fish populations can be restored to above present day numbers.

The aquatic ecological resources of the Study Area are described in **Section 4.2.6,** *Ecology Baseline: Aquatic Ecology.* The impacts are summarized below:

- Impact 01: Change in ecological integrity of the Kunhar River in the Area of Management following implementation of the Biodiversity Action Plan (BAP) (see **Volume 2C** of the **EIA**).
- Impact 02: Loss of riverine ecosystem due to inundation by Project reservoir.
- Impact 03: Degradation of the river ecosystem in the low flow segment downstream of the Project dam.
- Impact 04: Alteration of the River Ecosystem Downstream of the Tailrace

7.2.1 Change in the Ecological Integrity of Kunhar River through Implementation of the Biodiversity Action Plan

Impact 01: Change in the Ecological Integrity through implementation of the BAP (see **Volume 2C** of the **EIA**)								
Applicable Project Phase			*Construction and Operation*					
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Major	Long Term	Extensive	High	Definite	High	+	High

Project construction and operation are likely to have a significant negative impact on the ecological integrity in the 40.3 km segment of the river downstream of the Project tailrace to the upstream end of the reservoir of Patrind HPP under Business-as-Usual protection scenario.

According to the EFlow Assessment carried out as part of the Project EIA, (see **Section 5.2** of t**he EFlow Assessment Report** in **Volume 2C** of the **EIA**), Project operation with an EFlow of 3.5 m^3/s (which is higher than the recommend EFlow of 1.5 m^3/s) and Business-as-Usual protection, the populations of all three fish species of conservation importance - Nalbant's Loach, Kashmir Hillstream Loach and Alwan Snow Trout – show a decline of more than 70%. However, with the implementation of a Biodiversity Action Plan (BAP) (see **Volume 2C** of the **EIA**), the overall ecological integrity of the Kunhar River within the Area of Management of the BAP is predicted to improve compared to the projected baseline conditions despite Project construction and operation. **Exhibit 7.4** presents the gain/loss in population of key fish species due to the implementation of the BAP with High Protection. Habitat distribution between tributaries and the main river was taken into account in calculating the weighted gain. The assessment consists of operation of Project with an EFlow of 1.5 m^3/s as compared to the Pre-Project Baseline with Business-as-Usual Protection. The key findings are as follows:

- Gains in fish populations are the highest downstream of Balakot where river flow is less affected by the Project, closely followed by gains downstream of the tailrace.

- Native fish populations are adapted to flowing rivers and will not survive in the reservoir created by the dam. The reported decrease is over and above the decrease due to the decline in fish populations under the Business-as-Usual baseline.

Exhibit 7.4: Summary of Net Gain in Abundance of Key Fish Species with Implementation of the BAP, Compared to Pre-Project Baseline with Business-as-Usual Protection

Green = Net Gain, Red= Net Loss

EFlow	*Downstream of Dam*	*Downstream of Tailrace*	*Downstream of Balakot*	*Tributaries*	*Weighted Average Net Gain*
Length (km)	*4.5*	*15.4*	*24.9*	*-*	*Weighted Sum*
Alwan Snow Trout	1.9	87.3	108.1	107.3	78.3
Nalbant's Loach	-17.1	68.8	68.6	68.9	59.1
Kashmir Hillstream Loach	-22	84.7	80.7	-	42.6

Following construction of the Project and implementation of High Protection, there is a weighted average net gain of 78.3%, 59.1% and 42.6% for the Alwan Snow Trout, Nalbant's Loach, and Kashmir Hillstream Loach respectively compared to that under the Business-as-Usual protection. The BAP includes the recommendation for experimental captive breeding of the Kashmir Hillstream Loach. This is the species that shows the lowest weighted average net gain.

In addition to setting the EFlow at 1.5 m^3/s and High Protection, basin-wide measures, mainly establishment and operation of an Institute for Research in River Ecology (IRRE) and a Watershed Management Program (WMP) have also been included, triggered by the Cumulative Impact Assessment (see **Section 7.13**, *Cumulative Impact Assessment*) and the BAP. The establishment of the IRRE and WMP is subject to approval of associated costs in the tariff by NEPRA.

7.2.2 Loss of Riverine Ecosystem due to Inundation by Project reservoir

<table>
<tr><td colspan="10">Impact 02: Loss of riverine ecosystem due to inundation by Project reservoir</td></tr>
<tr><td colspan="3">Applicable Project Phase</td><td colspan="7">Construction and Operation</td></tr>
<tr><td rowspan="2">Initial Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Major</td><td>Long Term</td><td>Intermediate</td><td>High</td><td>Definite</td><td>High</td><td>-</td><td>High</td></tr>
<tr><td colspan="10">Mitigation measures:
1. Implementation of the BAP (see Volume 2C of the EIA) which includes the following:
a. Subsistence fishing using rods and cast nets with limited weights will be allowed through a permitting system.
b. Illegal fishing activities will be banned using a watch and ward system. In particular, destructive fishing practices will be prevented to minimize damage to sensitive habitats.
c. Sediment mining will be regulated to prevent destruction of fish habitat.
d. Physical transportation of migratory and non-migratory fish from downstream to upstream of the dam if needed to prevent genetic isolation in the long term.
e. Experimental captive breeding of fish species of conservation importance on which the impacts of the Project are significant, and stocking in river reaches where populations need to be restored.</td></tr>
<tr><td rowspan="2">Residual Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Major</td><td>Long Term</td><td>Intermediate</td><td>High</td><td>Definite</td><td>High</td><td>-</td><td>High</td></tr>
</table>

A segment of the river of length 4.5 km upstream of the Project dam will be inundated by the Project reservoir, where the river will cease to exist. The fish that require riffle habitat such as the Nalbant's Loach and Kashmir Hillstream Loach will not survive in the reservoir. Net gain for these fish species will be achieved by offsetting the loss in its population in the reservoir with the increase in population achieved in other segments of the river through implementation of the BAP. The segment of the river upstream of the reservoir will be impacted by peaking releases from Sukki Kinari HPP. The results of the EFlow Assessment for this segment have not been used to calculate net gain given in **Exhibit 7.4** because of the impact of peaking releases from the Sukki Kinari HPP.

While the ecosystem will change from riverine to lake, a new ecosystem will be created which will support life forms that are adapted to it. Wetland conditions created in the reservoir may also support some resident and migratory birds as has happened in case of Mangla Reservoir.

7.2.3 Degradation of the river ecosystem in the low flow segment downstream of the Project dam

Impact 03: Degradation of the river ecosystem in the low flow segment downstream of the Project dam								
Applicable Project Phase				*Construction and Operation*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Major	Long Term	Intermediate	High	Definite	High	-	High
Mitigation measures: 1. Implementation of the BAP. (However, even with an EFlow of 1.5 m^3/s and High Protection, the losses in fish populations cannot be mitigated in this river segment. These losses will be offset by gains in other segments of the river).								
Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Major	Long Term	Intermediate	High	Definite	High	-	High

The dam will create a barrier resulting in fragmentation of habitat. The habitat downstream of the dam will be exposed to lower flows due to diversion of the river flow into the power generation tunnels. With an EFlow of 3.5 m^3/s and Business-as-Usual scenario, all species show a decline in population of 100%. With an EFlow of 1.5 m^3/s and High Protection, there will still be a decline in fish populations from the baseline for the three species present in this stretch, however less than 100%. The species that shows gain against the baseline Business-as-Usual scenario in this segment is the Alwan Snow Trout (1.9%). The other two species show a loss. However, the Alwan Snow Trout is also affected by the blockage of connectivity upstream and conditions downstream due to its migratory behavior.

It should be noted that downstream of the dam major impacts include reduction of sediment and water abstraction through diversion which are not relieved due to EFlows.

7.2.4 Alteration of the River Ecosystem Downstream of the Tailrace

<table>
<tr><td colspan="10">Impact 04: Degradation of the River Ecosystem Downstream of the Tailrace</td></tr>
<tr><td colspan="3">Applicable Project Phase</td><td colspan="7">Construction and Operation</td></tr>
<tr><td rowspan="2">Initial Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Major</td><td>Long Term</td><td>Intermediate</td><td>High</td><td>Definite</td><td>High</td><td>-</td><td>High</td></tr>
<tr><td colspan="10">Mitigation measures:
1. Implementation of the BAP (see Volume 2C of the EIA) which includes the following:
a. Subsistence fishing using rods and cast nets with limited weights will be allowed through a permitting system.
b. Illegal fishing activities will be banned using a watch and ward system. In particular, destructive fishing practices will be prevented to minimize damage to sensitive habitats.
c. Sand and gravel mining will be regulated to prevent destruction of fish habitat.
d. Physical transportation of migratory and non-migratory fish from downstream to upstream of the dam if needed to prevent genetic isolation in the long term.
e. Experimental captive breeding of fish species of conservation importance on which the impacts of the Project are significant, and stocking in river reaches where populations need to be restored.</td></tr>
<tr><td rowspan="2">Residual Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Moderate</td><td>Long Term</td><td>Intermediate</td><td>High</td><td>Definite</td><td>High</td><td>+</td><td>High</td></tr>
</table>

The EFlow Assessment carried out as part of the EIA of the Project concluded that the river habitat downstream of the tailrace tunnel will be affected due to the changes in flow as a result of release of water from the tailrace tunnel (see **Section 5.2** of t**he EFlow Assessment Report** in **Volume 2C** of the **EIA**). Under baseload operation with an EFlow of 3.5 m^3/s and Business-as-Usual, the populations of the Alwan Snow Trout, Nalbant's Loach and Kashmir Hillstream Loach show declines in excess of 50%. With peaking operation with an EFlow of 6.1 m^3/s the declines will be similar.

Under baseload operations, the river downstream of the tailrace is not significantly changed and with High Protection (through the implementation of the BAP) fish populations can be restored to above present day numbers. The gain over the baseline Business-as-Usual scenario with an EFlow of 1.5 m^3/s and High Protection is positive for all three species. For the Alwan Snow Trout it is 87.3%, for the Nalbant's Loach it is 68.8% and for the Kashmir Hillstream Loach it is 84.7%.

The baseload scenario downstream of the tailrace and downstream of Balakot Town closely approximates the baseline hydrology. Therefore, increase in protection increases fish abundance in these sections. Downstream of Balakot Town, gain over the baseline Business-as-Usual scenario is 108.1% for the Alwan Snow Trout is, 68.6% for the Nalbant's Loach is and 80.7% for the Kashmir Hillstream Loach.

7.3 Terrestrial Ecology

The Project is a run-of-river hydropower project and will require construction of a dam on the Kunhar River. The Project, with design capacity of 310 MW, will use the water resources of the Kunhar River for power generation.

A map showing the location of the proposed Project facilities is provided in **Section 1** (*Introduction*). The major structures associated with the Project include the dam, powerhouse, the headrace tunnel, tailrace tunnel, surge tank, switch yard, storage yards, labour camps, staff colony, and access roads. A detailed description of the Project is provided in **Section 3** (*Project Description*). A low flow section of a length of about 13.4 km will be created downstream of the dam, between the dam and the tailrace tunnel. The permanent footprint of the proposed Project includes the area that will be acquired for the dam, reservoir, powerhouse, roads and some other facilities. A temporary footprint includes the land that will be required or disturbed due to the facilities that will be developed during the construction phase in the dam, powerhouse and the parts of the stretch of land between Sangar and Paras Village.

The Area of Habitat Loss is defined as the areas that will be occupied due to construction and operation of Project infrastructure.[1] It has been demarcated taking into consideration the footprint of each Project facility and a 50 m zone around each facility, as well as the area that will be submerged under water due to formation of reservoir (**Exhibit 7.5**). The Area of Habitat Loss is estimated at 2.1 km^2.

The Zone of Impact for Terrestrial Ecological Resources (referred to in this section as the Zone of Impact) consists of the Project facilities and a 1 km potential impact zone around these facilities to account for an area in which the ecological resources may be impacted by Project-related disturbances such as sound, light and vibrations during construction and operations (**Exhibit 7.5**).

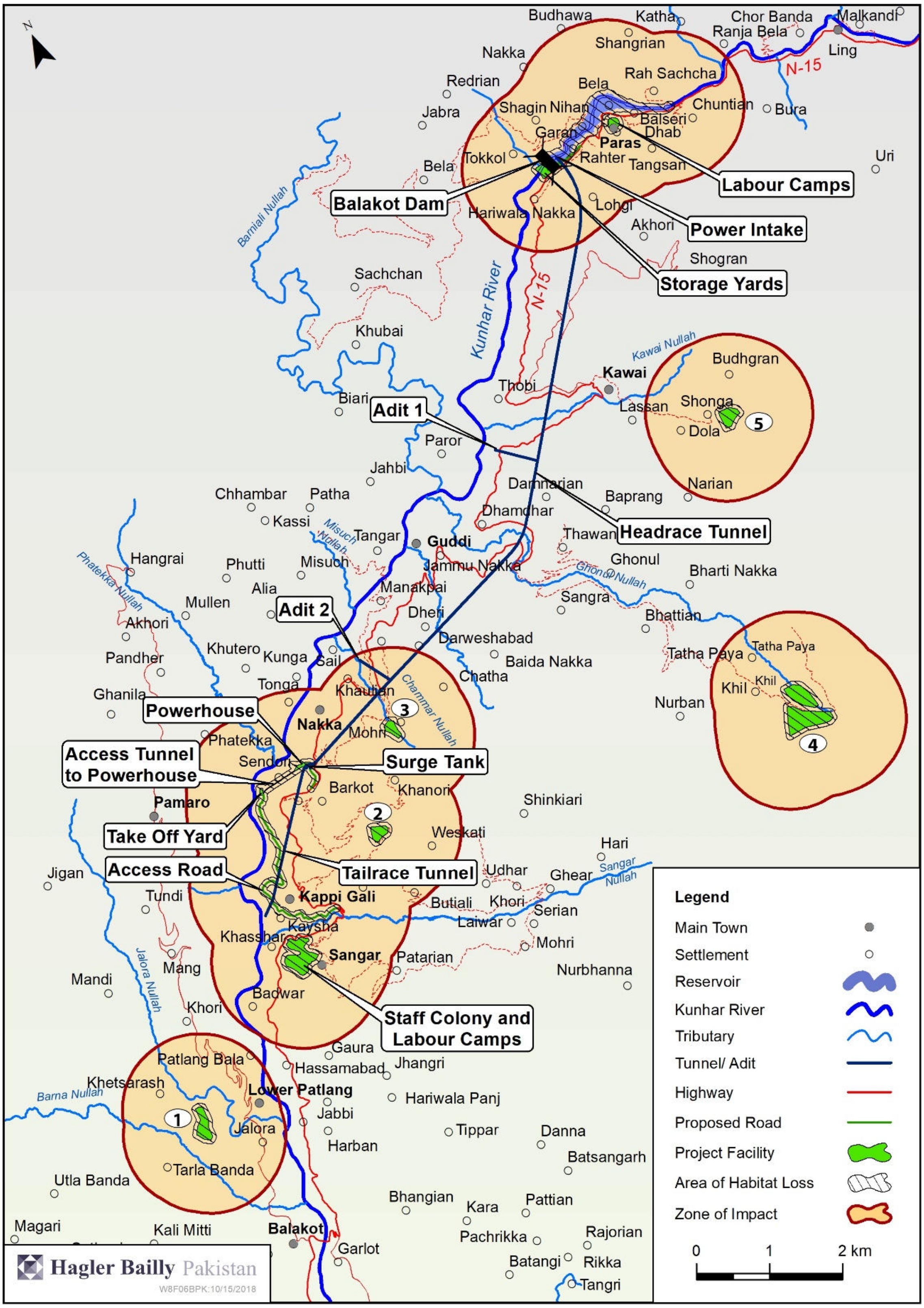
The Zone of Impact and Area of Habitat Loss include the spoil disposal zones marked 1 to 5 (**Exhibit 7.5**). These are potential spoil disposal zone and are indicative only (see **Section 3.5**). Finalization of which zones will be used and their areas will be done at a later stage. However, as information on the likely ones and the actual areas to be used within each zone is currently unnot available all have been considered as part of the Zone of Impact and Area of Habitat Loss.

The terrestrial ecological resources of the Study Area are described in **Section 4.2.7** (*Ecology Baseline*: *Terrestrial Ecology*). The aspects affecting ecology and biodiversity in the Terrestrial Study Area are discussed below:

- Impact 05: Terrestrial habitat loss caused by construction related activities.
- Impact 06: Decline in abundance and diversity of terrestrial flora and fauna caused by construction related activities.
- Impact 07: Project operation leading to animal disturbance, displacement and decline.

[1] This includes temporary facilities

Exhibit 7.5: Zone of Impact and Area of Habitat Loss



7.3.1 Terrestrial Habitat Loss

<table>
<tr><td colspan="9">Impact 05: Terrestrial habitat loss caused by construction related activities</td></tr>
<tr><td colspan="5">Applicable Project Phase</td><td colspan="4">Construction</td></tr>
<tr><td rowspan="2">Initial Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Minor</td><td>Short Term</td><td>Small</td><td>Low</td><td>Possible</td><td>Low</td><td>-</td><td>High</td></tr>
<tr><td colspan="9">Mitigation measures:
1. Provide awareness training to staff and contractors on: prevention of injury of animals; identification of likely species found on site; identifications of animal hazards (such as venomous snakes); and what to do if dangerous animals are encountered.
2. Encourage personnel to report sightings of wildlife of conservation importance or incidents of poaching to PEDO.
3. Minimize disturbance to, or movement of, soil and vegetation.
4. Prevent soil damage and erosion.
5. Prevent Alien Invasive Species (AIS) establishment on exposed stored soil (do not store bare soil near known sources of AIS). Invasive species management is recommended based on the risk assessment presented in Section 4.2.7, Description of the Environment, where the invasive species identified in the Project area have been ranked based on the risk they pose. The habitat most at risk is the Riparian Habitat. The species that are highest risk include Parthenium Weed, Common Weed and Castor Oil Plant (see Section 4.2.7, Description of the Environment).
6. Train and raise awareness regarding AIS among Project staff and contractors.
7. Retain as much natural vegetation as possible.
8. Solid waste should only be disposed of at designated sites and a Waste Management Plan developed and implemented.
9. Minimize the Project footprint, clearly delineate and restrict access beyond work sites and other areas to be disturbed.
10. Within the quarry and borrow areas, activities will be restricted to areas at a distance from perennial water channels so as to avoid disturbances to them including the risk of siltation.</td></tr>
<tr><td rowspan="2">Residual Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Minor</td><td>Short Term</td><td>Small</td><td>Low</td><td>Possible</td><td>Low</td><td>-</td><td>High</td></tr>
</table>

Site clearance and construction of Project infrastructure such as the powerhouse, dam, and the inlets and outlets of the tunnels will result in immediate and direct modification of land and loss of approximately 1.15 km^2 (75 hectares) of terrestrial habitat leading to loss of plants and displacement of animals in this area. There will be a permanent modification of land within the footprint of specific Project facilities and its ancillaries but the loss will be less severe in the areas that lie adjacent to and immediately outside the Project facilities. In addition, once the Project begins operations, an area of approximately 0.256 km^2 (25.6 hectares) will become submerged due to formation of a reservoir upstream of the dam (**Section 3,** *Project Description*). The submerged terrestrial habitat will be converted into aquatic habitat. The habitat loss and fragmentation resulting from Project infrastructure will lead to displacement of terrestrial species.

Land disturbance due to construction-related activities will lead to a localized reduction in food, shelter and range for mammals, birds and herpetofauna (reptiles and amphibians). Surface stripping will result in the removal of vegetation cover and may cause accidental death of small mammals and reptiles. The more mobile species will be able to move away from the area prior to preliminary earthworks. However, the less mobile species, especially herpetofauna species, will not be able to relocate. Food supplies in the form of seeds, vegetation and prey species will be negatively affected on a localized basis (only within the Project infrastructure facilities and its ancillaries).

The Area of Habitat Loss (total of 2.1 km^2) consists largely of mixed pine and scrub forest and riparian habitat. The dominant plant species in the Forest habitat type (74% by area) include *Pinus wallichiana*, *Cedrus deodara*, *Rumex dissectus*, *Ficus carica* and *Cannabis sativa*. The dominant plant species in the Agricultural Areas habitat type (20% by area) include *Juglans regia*, *Berberis sp.*, and *Fragaria vesca*. Within the Area of Habitat Loss there is also riparian habitat in which the dominant plant species include *Parthenium hysterophorus*. *Conyza canadensis* and *Rumex dissectus*. *Parthenium hysterophorus* is an invasive species and the others are common and widespread plant species in the wider area. The May 2017 Survey identified seven invasive species in both Terrestrial and Riparian Habitat including Cannabis *Cannabis sativa*, Tree-of-heaven *Ailanthus altissima*, Black Locust *Robinia pseudoacacia*, Pink Cheeseweed *Malva parviflora*, Parthenium Weed *Parthenium hysterophorus*, Common Weed *Phragmites karka* and Castor Oil Plant *Ricinus communis*. Some of the plant species found in the Area of Habitat Loss have a socio-economic value for the local communities. Species found in the Agricultural Area habitat type have food value while some of the wild plant species (in the Scrub Forest, Pine Forest habitat types and Riparian habitat type) have a variety of uses including use for their medicinal properties, firewood and grazing of livestock. For example, the species *Cedrus deodara* and *Urtica dioica*, are used for therapeutic application. Plants also have value as firewood and for grazing of livestock. However, all these species are common and abundant in the wider area. Habitat loss caused by construction of Project infrastructure will not have any significant impact on the overall population of these vegetation species though individual plants are likely to suffer harm.

Mammal species observed in this Area of Habitat Loss include the Asiatic Jackal *Canis aureus*, the Red Fox *Vulpes vulpes*, the Indian Crested Porcupine *Hystrix indica*, and the Small Asian Mongoose *Herpestes javanicus*. Abundant bird species observed included the Common Raven *Corvus corax*, the Bank Myna *Acridotheres ginginianus*, the White-cheeked Bulbul *Pycnonotus leucotis*, Black Drongo *Dicrurus macrocercus*, and Great Tit *Parus major*. No vulture species were observed during the May 2017 Survey. The habitats being disturbed are also not considered critical to the breeding, nesting or feeding of vulture species. Abundant herpetofauna included the Agrore Valley Rock Agama *Laudakia agrorensis* and the Asian Garden Lizard *Calotes versicolor*. No flora or fauna species of conservation importance were found or reported from this Area of Habitat Loss. No critical habitat, threatened or unique ecosystem was identified in this area. The habitats found in the Area of Habitat Loss are homogenous and widespread. They hold no significance for the survival of endemic or restricted range species.

Even though there will be irreversible short term harm to some ecological receptors (individuals), the species will not suffer as the area of habitat occupied by the Project infrastructure will be is small. Therefore, the magnitude of impact is considered minor.

7.3.2 Impacts on Biodiversity due to Construction Activities

Impact 06: Decline in abundance and diversity of terrestrial flora and fauna caused by construction related activities.

Applicable Project Phase				*Construction*				
Initial Impact	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

Mitigation measures:

1. Large flood lights should not be installed outside 50 m of the Project fence.
2. Lights should be directed towards Project facilities and not towards the natural habitats.
3. Regulations for Project staff and contractors to avoid illegal poaching to be incorporated in contract documents.
4. Provide awareness training to staff and contractors on: prevention of injury of animals; identification of likely species found on site; identifications of animal hazards (such as venomous snakes); and what to do if dangerous animals are encountered.
5. Provide adequate knowledge to the workers on relevant government regulations and punishments for illegal poaching and trade in animals and plants.
6. Encourage personnel to report sightings of wildlife of conservation importance or incidents of poaching to PEDO.
7. Enforce speed limits in ecologically sensitive areas if identified.
8. Project staff and contractors to report kills of large mammals particularly designated species of conservation concern.
9. Train and raise awareness regarding AIS among Project staff and contractors.
10. The Contractor shall prepare an Environmental Training Plan for all construction workers: the Plan shall address the following items:

- All Contractor’s employees shall be required to comply with environmental protection procedures and they shall be able to provide evidence that they attended the training sessions detailed in the Plan;
- The Plan shall educate all construction workers on the following issues but not limited to them: fire arm possession, traffic regulations, illegal logging and collection of non-timber forestry products, non-disturbance of resettlement communities, hunting and fishing restrictions, waste management, erosion control, health and safety issues, all prohibited activities, the Code of Conduct requirements and disciplinary procedures, and general information on the environment in which they will be working and living;
- Establishment of penalties for those who violate the rules;
- Proposed methods for conducting the training program, which shall include formal training sessions, posters, data in newsletters, signs in construction and camp areas and ‘tool box’ meetings.

11. Equipment emitting excessive noise in comparison with other similar equipment will not be allowed to operate.
12. Equipment under use will be regularly maintained, tuned, and provided with mufflers to minimize noise levels.
13. Equipment in poor state of maintenance, particularly without effective noise control will be checked to determine if it can be improved, and replaced with less noisy equipment as soon as practicable.
14. Blowing of horn will be prohibited on all sensitive areas except under emergency conditions.
15. Project staff and contractors to report kills of large mammals particularly designated species of conservation concern.
16. Source goods/materials locally where possible.
17. Minimize disturbance to, or movement of, soil and vegetation.

18. Compensatory trees will be planted. The EPC Contractor will plant a minimum of ten trees for each tree removed in acquired land. 19. PEDO will monitor and maintain the vegetation until it is established. 20. Prevent soil damage and erosion. 21. Prevent AIS establishment on exposed stored soil (do not store bare soil near known sources of AIS). 22. Train and raise awareness regarding AIS among Project staff and contractors. See **Section 4.2.7** of the Ecology Baseline. 23. Solid waste should only be disposed of at designated sites. 24. Implementation of Biodiversity Action Plan.								
Residual Impact	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

Construction of Project infrastructure such as the powerhouse, dam and tunnels will result in disturbance to the floral and faunal species in the Zone of Impact around the Project facilities (**Exhibit 7.5**) due to blasting, noise, vibrations, illumination, and introduction of alien species. Pollution may increase due to vehicles and machinery, spillage of fuels or chemicals, emissions and noise. Increased movement of vehicles will increase the risk of incidences of vehicle collisions with wildlife.

Habitat loss, habitat fragmentation and sensory disturbances may result in a decrease in species abundance and possibly change species diversity within the Zone of Impact. In addition, the spatial and temporal distribution of species will also be affected as a result of loss of habitat integrity due to habitat fragmentation and degradation. Habitat alteration and disturbance may increase the likelihood of spread of alien invasive species such as Parthenium Weed, Castor Oil Plant and Cannabis. The three habitat types (**Section 4.2,** *Ecology Baseline*) found in this Zone of Impact will be affected. The Agricultural Area habitat type was observed to contain the highest diversity of plant species per sampling location while Scrub Forest habitat type had the highest overall species diversity. No terrestrial critical habitat was identified in the Zone of Impact and it does not contain any threatened or unique ecosystem. Moreover, the habitats found in this Area of Habitat Loss are homogenous and widespread. They hold no significance for the survival of endemic or restricted range species.

In addition to direct land disturbance, the site fencing may present a barrier to movement, resulting in habitat fragmentation for small and medium sized mammals as well as the herpetofauna found in the Terrestrial Study Area.

Seed sources for re-establishing plants will remain available from adjacent lands (driven by wind). The areas around the Zone of Impact provide similar habitat to the habitat already existing at the site. Therefore, repopulation by flora and fauna is likely to occur in the areas not occupied by the Project infrastructure, once disturbance associated with construction is stopped.

Rules to regulate hunting exist. However, they are seldom enforced. Improved access to the site as a result of the Project may indirectly increase the incidence of poaching. To prevent further exacerbation of existing impacts and prevent poaching by Project staff and contractors, awareness training will be provided along with information on the penalties for poaching (in terms of the Project's policies and KP wildlife protection laws). Long term impacts are therefore unlikely. By working with local government agencies particularly the KP Fisheries and Wildlife Departments, PEDO can implement measures to enhance conservation in the area. Increase in Project-related traffic may increase the incidence of road animal kills.

Inadequate management and disposal of waste from the construction site and camping locations can lead to deterioration of soil and habitat quality with consequent negative impacts on the flora and fauna.

In addition, the biodiversity may be disturbed due to loss of soil productivity caused by contamination from oil spills and leakages from Project vehicles and machinery, uncontrolled discharge of wastewater, and storm water runoff from the Project site. Soils disturbed due to vegetation stripping and exposure as a result of Project-related construction activities will be more easily eroded by the forces of wind and water. This eroded soil will have lower productivity due to loss of top soil. In addition, the eroded soil may damage the aquatic ecological resources by siltation of the river.

At a local scale, a decrease in biodiversity and ecological function caused by construction-related disturbances is of minor magnitude near the Project facilities. Moreover, because of the homogenous and widespread distribution of species, the area wide impact on biodiversity is also minor.

7.3.3 Impacts on Terrestrial Biodiversity due to Project Operation

Impact 07: Project operation leading to animal disturbance, displacement and decline.								
Applicable Project Phase				*Operations*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Long Term	Small	Medium	Possible	Medium	-	High

Mitigation measures:

1. Large flood lights should not be installed outside 50 m of the Project fence.
2. Lights should be directed towards Project facilities and not towards the natural habitats.
3. Provide awareness training to staff and contractors on: prevention of injury of animals; identification of likely species found on site; identifications of animal hazards (such as venomous snakes); and what to do if dangerous animals are encountered.
4. Incorporate regulations for Project staff and contractors to avoid illegal poaching in contract documents.
5. Provide adequate knowledge to the workers on relevant government regulations and punishments for illegal poaching.
6. Encourage personnel to report sightings of wildlife of conservation importance or incidents of poaching to PEDO.
7. Project staff and contractors to report kills of large mammals particularly designated species of conservation concern.
8. Train and raise awareness regarding AIS among Project staff and contractors. See **Section 4.2.7** of the Ecology Baseline.
9. The Contractor shall prepare an Environmental Training Plan for all construction workers. Solid waste should only be disposed of at designated sites.
10. Implementation of Biodiversity Action Plan.

Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Medium	Small	Low	Possible	Low	-	High

The operation of the hydropower plant and associated activities will result in some potential disturbances to species, which may exacerbate the effects of habitat loss and decreased species abundance. In addition, the spatial and temporal distribution of species will also be affected as a result of loss of habitat integrity due to habitat fragmentation and degradation. These disturbances include noise and light. As plant operation will be continuous, the disturbances will also be continuous and affect both diurnal and nocturnal wildlife. The lighting required for operation and safety at the Project site can influence nocturnal foraging behaviors as well as disrupt sleep patterns of crepuscular and nocturnal species. However, considering the fact that no threatened ecosystem or species of conservation importance is reported from the Zone of Impact, the magnitude of this impact is considered minor.

7.4 Ambient Air Quality

The ambient air quality will be affected by the Project activities primarily during the construction phase. In this section, the impacts of construction activities on ambient air quality and the associated air emissions are identified, high risk areas including, nearby receptors and tourist spots are located and suggested mitigation measures are presented.

The baseline air quality is described in **Section 4.1.8** (*Ambient Air Quality*). It shows that, compared to NEQS and IFC-EHS limits, the concentrations of NO_X, NO, NO_2 and SO_2 are low, whereas dust concentrations (PM_{10} and $PM_{2.5}$) are high. Furthermore, emission of particulate matter is a greater concern from construction activities than gaseous pollutants. Therefore, the focus of the impact assessment is on the quantification and mitigation of dust emissions. The main impact is identified below.

Impact 08: Increase in ambient and ground level concentration of air pollutants from construction activities and vehicular movement may cause health impacts to the community.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Medium Term	Small	Medium	Possible	Medium	-	High

Mitigation measures:

1. Develop and implement an Air Pollution Control Plan.
2. Prepare a Site Specific Environmental Management Plan (SSEMP) (see **Section 9,** *Environmental Management Plan*) for each construction site that must outline areas to be cleared, vegetated areas to be protected or fenced, solid waste disposal locations, and sprinkling locations. All appropriate measures indicated in Generic Construction Site Environmental Management Plan (CSEMP) in **Section 9** (*Environmental Management Plan*) should be incorporated in the SSEMP.

Fugitive and exhaust emissions from transport vehicles

3. Cover all trucks hauling soil, sand, and other loose materials or require all trucks to maintain at least two feet of freeboard (i.e., the minimum required space between the top of the load and the top of the trailer).
4. Install and maintain all vehicles and machinery with appropriate emission control equipment.
5. Regularly maintain vehicles and equipment to keep emissions in check.
6. Smoke from internal combustion engines should not be visible for more than ten seconds.
7. To the extent possible, use new and low emission equipment and vehicles.
8. Purchase best quality fuel and lubes and where possible use lead free oil and lubes.
9. Sprinkle water on all unsealed roads used by Project vehicles that are within 200 m of any settlement.
10. Cover loads and long-term piles of friable material to reduce fugitive dust emission.
11. Reduce traffic speeds on all unpaved surfaces to 15 miles per hour or less.
12. Paved roads shall be swept frequently if soil material has been carried onto adjacent paved, public thoroughfares from the Project site.
13. Install wheel washers where vehicle exit onto paved road from unpaved.

14. Wheel washing of vehicles leaving the site.
15. Wash vehicles/equipment prior to each trip.
16. Use catalytic converters on vehicles, an emission control device, used to convert harmful pollutants to less harmful pollutants e.g. it converts the nitrogen oxides back into nitrogen and oxygen.
17. Appropriate maintenance of vehicles and machinery.

Fugitive dust emissions from blasting

18. Indicate the limits of a clearing land with highly visible markers.
19. Leave a layer of about 5 m of undisturbed softs above the top of the overburden blasts. This will act as a blanket to contain air blast, dust and fly rock.
20. Sprinkle water on the area where blasting is done to settle down the particulate matter emissions.

Fugitive dust emissions from quarry areas

21. Indicate the limits of a clearing land with highly visible markers.
22. Avoid earth stripping or moving in periods of dry and windy weather.
23. Carry out dust generating activities where maximum protection can be obtained through topography or in areas where prevailing winds will blow dust away from sensitive areas/uses.
24. Water spraying of conveyors/conveyor transfer points, stockpiles and roads.
25. Covering of fine dry loads or spraying of loads prior to exiting the site, and if necessary regular cleaning of public roads in the vicinity of the entrance.

Fugitive dust emissions from concrete batching plants

26. Suspend earthwork operation when wind speed exceeds 20 km/hr. in areas within 500 m of any settlement.
27. The whole process of weighing and mixing would be performed in a fully enclosed environment.
28. The mixers should be equipped with dust collectors.
29. Site the concrete batching plant out of prevailing high winds to minimize dust emissions.
30. The prevailing wind direction should be considered to ensure that bunkers and conveyors are sited in the leeward direction to minimize the effects of the wind.
31. The provision of natural or artificial wind barriers – such as trees, fences and landforms – to help control the emission of dust from the plant should be considered.
32. Batching plants should be sited on land that is not flood prone.
33. Batching plants should be kept as near to natural sinks to minimize emissions to ambient environment.
34. All stacks to be vertical and at least 3 m above ground.

Fugitive dust emissions from aggregate production and handling system

35. Suspend operation when wind speed exceeds 20 km/hr. in areas within 500 m of any settlement.
36. The prevailing wind direction should be considered to ensure that aggregate handling systems located in the leeward direction to minimize the effects of the wind.
37. Sprinkle water on all exposed surfaces, particularly those close and up-wind of settlements.

Wind-blown dust from exposed surfaces such as bare land and waste dumping sites

38. Cover all exposed surfaces, particularly those close and up-wind of settlements.
39. All grading operations on a project should be suspended when winds exceed 20 miles per hour.
40. Minimize disturbance to, or movement of, soil and vegetation.
41. Sprinkle water on all exposed surfaces, particularly those close and up-wind of settlements.
42. Retain as much natural vegetation as possible.

Wind-blown dust from stockpiles of dusty materials such as sand and other minerals

43. On-site dirt piles or other stockpiled PM should be covered, wind breaks installed and water and/or soil stabilizers employed to reduce wind-blown dust emissions.
44. Adequately wet, cover with plastic, or provide with wind shield all stockpiles to reduce dust emission.
45. Sprinkle water on all exposed surfaces, particularly those close and up-wind of settlements.
46. Minimize disturbance to, or movement of, soil and vegetation.
47. Prevent soil damage and erosion.
48. Retain as much natural vegetation as possible.

Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

7.4.1 Emission Sources

Exhibit 7.6 shows the list of all possible emission sources along with their description.

Exhibit 7.6: Inventory of Emission Sources

Source/Activity	*Zone of Impact*	*Mitigation/Monitoring Measures*
Fugitive and exhaust emissions from transport vehicles Transport emissions include emissions from vehicles moving on roads and from their exhausts. As vehicle moves on the road, due to friction between vehicle's tire and road, the dust particles come in suspension which causes dust (PM_{10} and $PM_{2.5}$) emissions. Exhaust emissions include emissions attributable to engine related processes such as fuel combustion and particles that exit the tailpipe.	**General Guidelines:** ▶ A buffer of 50 meters (m) along the route(s) used by construction vehicles as given in Guidance on the Assessment of Dust from Demolition and Construction document by Institute of Air Quality Management, 2014.[2] **Project Specific Zone:** ▶ Total quarried material to be transported to the required destinations is 250,000 cubic meters (m^3). ▶ Total spoil quantity to be transported to the spoil dumping sites is 1.1 million m^3. ▶ The material will come to the Project site from different areas of Pakistan through N-15. From N-15 the material will go to the construction sites through access roads. ▶ The material generated on-site both as raw material and as waste material will go to their final destination points through site access roads to dam and powerhouse sites, quarry areas and waste dumping sites. ▶ The buffer zone around the transport corridor that includes the N-15 and access roads is provided below. **Additional Assessment Required:** ▶ If additional access roads are required for transport from quarries or to waste disposal sites then receptors within 50 m of the road should be assessed for sensitivity.	▶ Cover all trucks hauling soil, sand, and other loose materials or require all trucks to maintain at least two feet of freeboard (i.e., the minimum required space between the top of the load and the top of the trailer). ▶ Install and maintain all vehicles and machinery with appropriate emission control equipment. ▶ Regularly maintain vehicles and equipment to keep emissions in check. ▶ Smoke from internal combustion engines should not be visible for more than ten seconds. ▶ To the extent possible, use new and low emission equipment and vehicles. ▶ Purchase best quality fuel and lubes and where possible use lead free oil and lubes. ▶ Sprinkle water on all unsealed roads used by Project vehicles that are within 200 m of any settlement. ▶ Cover loads and long-term piles of friable material to reduce fugitive dust emission. ▶ Reduce traffic speeds on all unpaved surfaces to 15 miles per hour or less.

[2] Guidance on the Assessment of Dust from Demolition and Construction document by Institute of Air Quality Management, 2014. http://www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf

Source/Activity	*Zone of Impact*	*Mitigation/Monitoring Measures*
		▶ Paved roads shall be swept frequently if soil material has been carried onto adjacent paved, public thoroughfares from the Project site. ▶ Install wheel washers where vehicle exit onto paved road from unpaved. ▶ Wheel washing of vehicles leaving the site. ▶ Wash vehicles/equipment prior to each trip. ▶ Use catalytic converters on vehicles, an emission control device, used to convert harmful pollutants to less harmful pollutants e.g. it converts the nitrogen oxides back into nitrogen and oxygen. ▶ Appropriate maintenance of vehicles and machinery.
Fugitive dust emissions from blasting Tunnels, adits and underground powerhouse will be excavated through drilling and blasting. Air quality due to blasting will be degraded near the mouth of these sites where the blasting will be near the surface. Along the length of the tunnel and the underground powerhouse etc. air	**General Guidelines:** A buffer of 200 m from the point of blasting where there is high risk of dust emissions according to the Impact Evaluation of Blasting, 2009.[3] **Project Specific Zone:** This zone for the tunnel and adit mouths are shown below**.**	▶ Indicate the limits of a clearing land with highly visible markers. ▶ Leave a layer of about 5 m of undisturbed softs above the top of the overburden blasts. This will act as a blanket to contain air blast, dust and fly rock. ▶ Sprinkle water on the area where blasting is done to settle down the particulate matter emissions.

[3] Impact Evaluation of Blasting, Vlakfontein Opencast Project, 2009 http://www.srk.co.za/files/File/South-Africa/publicDocuments1/Vlakfontien/Appendix%27s/Appendix%20V%20Vibrations%20and%20Blast%20Impact%202010/EIA_Blasting_Vlak_09%20Rev%203.pdf

Source/Activity	Zone of Impact	Mitigation/Monitoring Measures
quality will not be effected as this is far underground. Blasting may also take place to extract materials at the quarry sites.		
Fugitive dust emissions from quarry areas Quarry areas are used to excavate stones, rocks, sand, gravel and aggregate from ground. This includes stripping of topsoil, blasting of area, crushing and screening of aggregates and loading of excavated material from quarries to stockpiles. Wind erosion from exposed surfaces also leads to dust emissions.	**General Guidelines:** ▶ A buffer of 500 m from the quarry areas where there is high risk of dust emissions as discussed in the Guidelines for Planning Authorities for Quarries and Ancillary Activities, 2004.[4] **Project Specific Zone:** ▶ According to the Feasibility Study, marble and limestone outcrops are exposed along the road while travelling from the proposed dam site to Naran. These exposures can be considered for the development of rock quarry for obtaining coarse aggregates. Samples were collected from marble deposits at Mahandri and limestone deposits at Paras. ▶ In this area, either small existing quarries can be expanded or new rock quarries can be developed for production of coarse aggregates. ▶ The following factors should be considered for selection of the rock quarries: a) It should be located in the close proximity to the power complex; b) Availability of open areas near the quarries to set-up crushing plants and stockpiles for aggregates; c) Good quality and sufficient quantities of rock should be available to meet the Project requirements; d) Favourable topographic conditions for safe quarrying and other operations; and	▶ Indicate the limits of a clearing land with highly visible markers. ▶ Avoid earth stripping or moving in periods of dry and windy weather. ▶ Carry out dust generating activities where maximum protection can be obtained through topography or in areas where prevailing winds will blow dust away from sensitive areas/uses. ▶ Water spraying of conveyors/conveyor transfer points, stockpiles and roads. ▶ Covering of fine dry loads or spraying of loads prior to exiting the site, and if necessary regular cleaning of public roads in the vicinity of the entrance.

[4] Guidelines for Planning Authorities for Quarries and Ancillary Activities, Department of the Environment, Heritage and Local Government, 2004. http://www.housing.gov.ie/sites/default/files/migrated-files/en/Publications/DevelopmentandHousing/Planning/FileDownLoad%2C1606%2Cen.pdf

Source/Activity	Zone of Impact	Mitigation/Monitoring Measures
	e) Quarrying operations should not interfere with the construction activities. Total quarried material to be transported to the requried destinations is 250,000 cubic meters (m^3). ▶ Quarries should be located further than 500 m of sensitive receptors such as homes, schools, mosques etc.	
Fugitive dust emissions from concrete batching plants Concrete batching plants are where ingredients such as sand, cement, water and aggregate are mixed to form concrete. This consists of various activities such as storage of raw materials in bunkers and stockpiles, transfer of raw materials by front end loaders, conveyors, hoppers and loading of materials to the trucks.	**General Guidelines:** ▶ A buffer of 100 m between batching plants and sensitive land uses as included in the Recommended Buffer Distances for Industrial Residual Air Emissions, 1990.[5] **Project Specific Zone:** ▶ Location of concrete batching plants are not available in the Feasibility Study. ▶ Batching plants should be located further than 100 m of sensitive receptors such as homes, schools, mosques etc.	▶ Suspend earthwork operation when wind speed exceeds 20 km/hr. in areas within 500 m of any settlement. ▶ The whole process of weighing and mixing would be performed in a fully enclosed environment. ▶ The mixers would all equipped with dust collectors, no dust emission would be expected. ▶ Siting the concrete batching plant out of prevailing high winds minimizing dust emissions. ▶ The prevailing wind direction should be considered to ensure that bunkers and conveyors are sited in the leeward direction to minimize the effects of the wind. ▶ The provision of natural or artificial wind barriers – such as trees, fences and landforms – to help control the emission of dust from the plant should be considered.

5 Environmental Guidelines for the Concrete Batching Industry, http://www.epa.vic.gov.au/~/media/Publications/628.pdf

Source/Activity	*Zone of Impact*	*Mitigation/Monitoring Measures*
		▶ Batching plants should be sited on land that is not flood prone.
Fugitive dust emissions from aggregate production and handling system Sand and gravel are typically mined in a moist or wet condition by open pit excavation or dredging. After mining, the materials are transported to the processing plant where the material is dried, screened and crushed which is a source of particulate matter emissions. Typically, the dust associated with aggregate operations consists of particles from exposed soil and rock.	**General Guidelines:** ▶ A buffer of 1000 m between the point of operations and sensitive land uses.[6] **Project Specific Zone:** ▶ Location of quarries are not available in the Feasibility Study. ▶ Fine aggregate production should be minimized and directly extracted where possible. ▶ Final aggregate handling and production systems should be located further than 1000 m of sensitive receptors such as homes, schools, mosques etc. ▶ In case the above is not possible, then homes within this zone should either be temporarily relocated or mitigation measures strictly implemented in this zone.	▶ Suspend operation when wind speed exceeds 20 km/hr. in areas within 500 m of any settlement. ▶ The prevailing wind direction should be considered to ensure that aggregate handling systems located in the leeward direction to minimize the effects of the wind. ▶ Sprinkle water on all exposed surfaces, particularly those close and up-wind of settlements.
Wind-blown dust from exposed surfaces such as bare land and waste dumping sites Waste dumping sites are not themselves an emission source but unloading the waste (dumping) onto dump sites results in dust emissions.	**General Guidelines:** ▶ A buffer of 250 m between waste dumping sites (after completion this site will turn into a landfill site) and residential development as given in IFC-EHS Guidelines Waste Management Facilities, 2007.[7] **Project Specific Zone:** ▶ Final waste dumping sites should be located further than 250 m of sensitive receptors such as homes, schools, mosques etc.	▶ Cover all exposed surfaces, particularly those close and up-wind of settlements. ▶ All grading operations on a project should be suspended when winds exceed 20 miles per hour. ▶ Minimize disturbance to, or movement of, soil and vegetation. ▶ Sprinkle water on all exposed surfaces, particularly those close and up-wind of settlements.

6 http://environment.govmu.org/English/Documents/env%20guidelines/29/30Stone.pdf

7 IFC-EHS Guidelines Waste Management Facilities, 2007, http://www.ifc.org/wps/wcm/connect/1cd72a00488557cfbdf4ff6a6515bb18/Final+-+Waste+Management+Facilities.pdf?MOD=AJPERES

Source/Activity	*Zone of Impact*	*Mitigation/Monitoring Measures*
		▶ Retain as much natural vegetation as possible.
Wind-blown dust from stockpiles of dusty materials such as sand and other minerals Wind erosion erodes the exposed surfaces of stockpiles resulting in dust emissions.	**Project Specific Zone:** Location of stockpile areas are not available in the Feasibility Study.	▶ On-site dirt piles or other stockpiled PM should be covered, wind breaks installed and water and/or soil stabilizers employed to reduce wind-blown dust emissions. ▶ Adequately wet, cover with plastic, or provide with wind shield all stockpiles to reduce dust emission. ▶ Sprinkle water on all exposed surfaces, particularly those close and up-wind of settlements. ▶ Minimize disturbance to, or movement of, soil and vegetation. ▶ Prevent soil damage and erosion. ▶ Retain as much natural vegetation as possible. Additional mitigation measures for stockpiles are discussed in **Section 7.8** *(Soil, Topography and Land Stability)***.**

7.4.2 Identification of High Risk Areas

A buffer is provided around each source (called as '*Zone of Impact*') and identified receptors that are within the Zone of Impact and are prone to be affected by the possible increase in pollutant levels due to the construction activities. Identified receptors along with associated risk and proposed air quality sampling locations are presented in **Exhibit 7.7**.The zones are shown in **Exhibit 7.8** to **Exhibit 7.10**.

Exhibit 7.7: Receptors in Risk Areas

Zone of Impact	*Nearby Villages and Affected Receptors*	*Risk*	*Exhibit Reference*
Dam site	None	**Low:** Due to the absence of any sensitive receptor.	**Exhibit 7.8**
Adits mouth	▶ Few houses ▶ One graveyard in Khaulian ▶ One mosque in Khaulian	**High:** Due to the presence of many sensitive receptors and also as the $PM_{2.5}$ levels exceed the NEQS and the PM_{10} levels are very close to the NEQS and leaving very narrow room for construction activities to add up over the baseline levels.	**Exhibit 7.9**
Powerhouse site	▶ Few houses in Dabrian and Sendori villages ▶ Picnic spot near Dabrian		**Exhibit 7.10**
Waste dumping sites	▶ Few houses at waste dumping sites 1 and 3 ▶ None in case of waste dumping sites 2,4 and 5	**High—**at waste dumping sites 1 and 3: Due to the presence of many sensitive receptors and also as the $PM_{2.5}$ levels exceed the NEQS and the PM_{10} levels are very close to the NEQS and leaving very narrow room for construction activities to add up over the baseline levels. **Low**— at waste dumping sites 2,4 and 5: Due to the absence of any sensitive receptor.	**Exhibit 7.11**

Exhibit 7.8: Zone of Impact—Dam Site

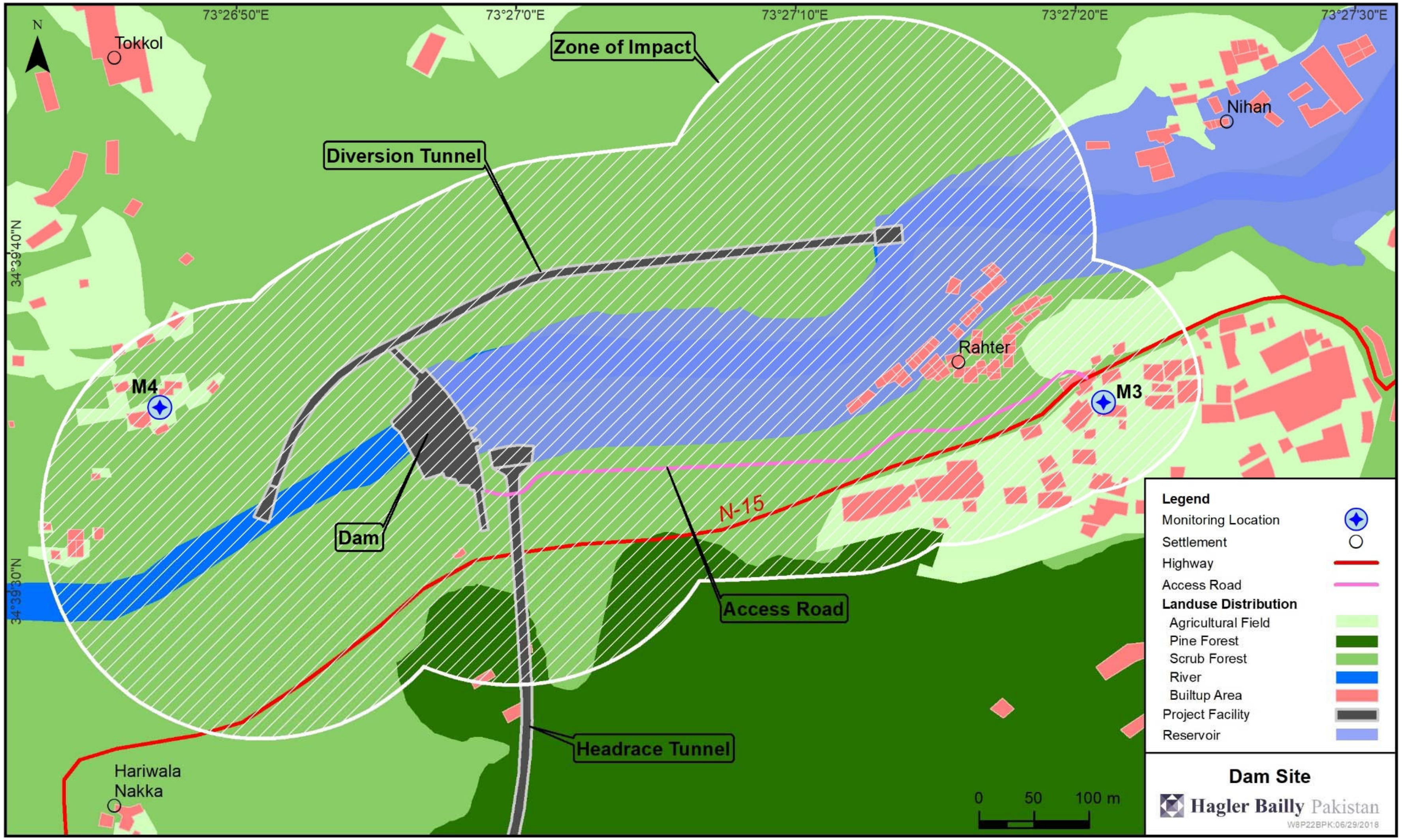


Exhibit 7.9: Zone of Impact—Adits

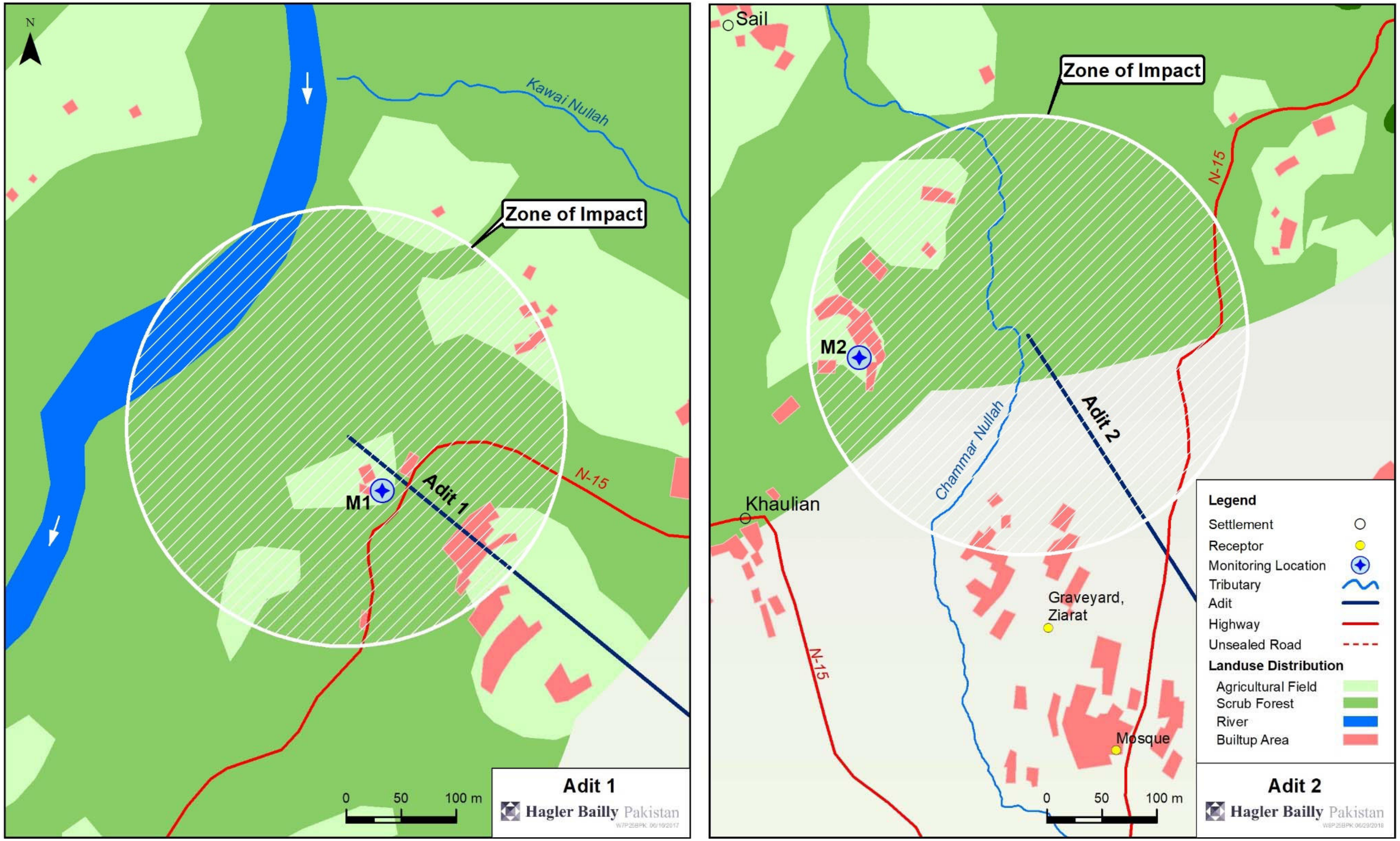


Exhibit 7.10: Zone of Impact—Powerhouse Site

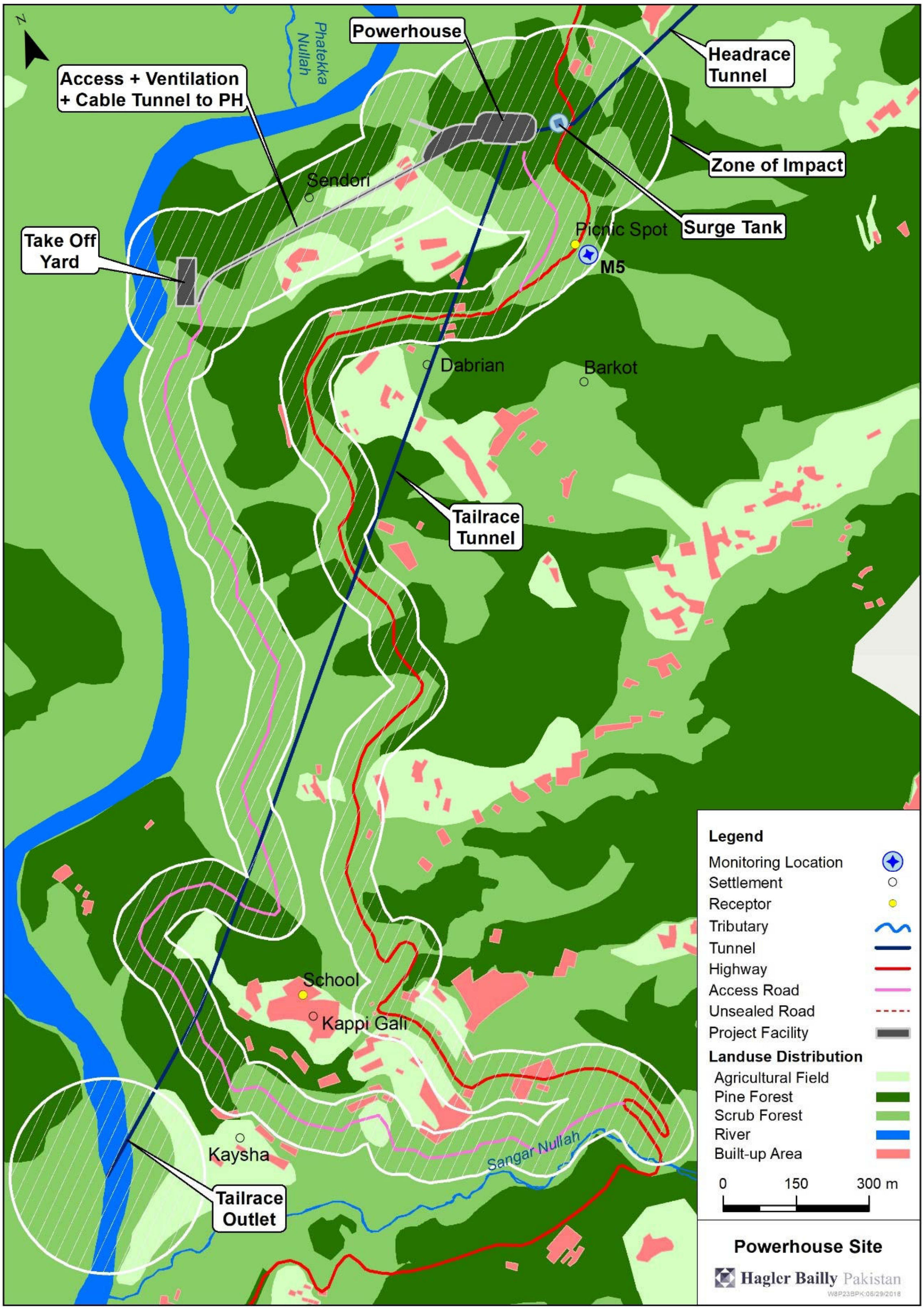
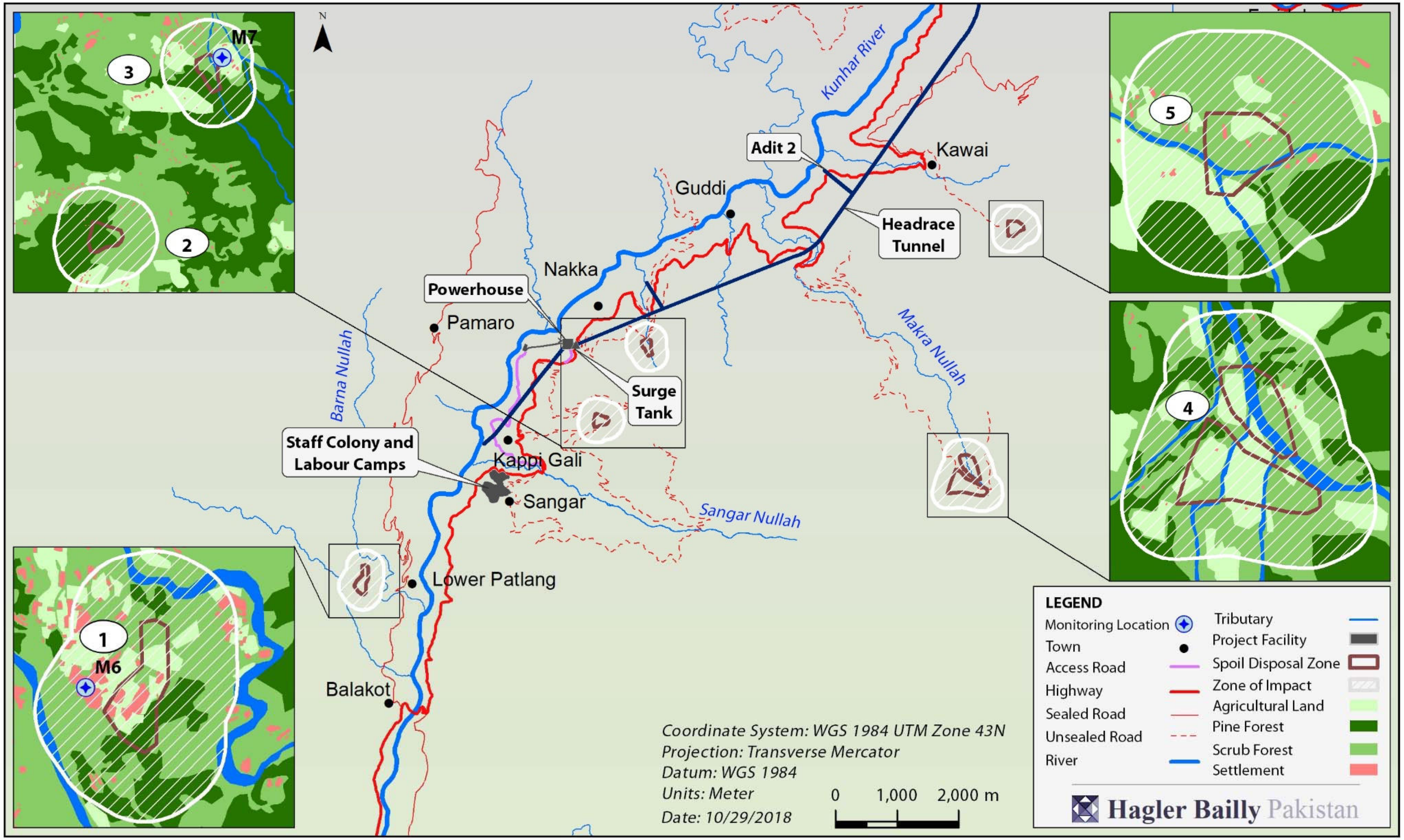


Exhibit 7.11: Zone of Impact—Waste Dumping Sites



7.5 Blasting and Vibration

The major risks of blasting and vibration due to the Project are:

- ▶ Impact 09: Vibration from construction activities including blasting may disturb (including annoyance, sleep disturbance, and potential damage to structures) local communities.
- ▶ Impact 10: Blasting may pose a health hazard due to flying debris.

Damage to springs from blasting is discussed in the next section.

7.5.1 Vibration from Construction Activities

Impact 09: Vibration from blasting during the construction phase may disturb local communities.								
Applicable Phase	**Project**			*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Medium Term	Intermediate	Medium	Possible	Medium	-	High

Mitigation measures:

1. Develop a Blasting and Explosives Management Plan and Vibration Monitoring Plan.
2. Conduct a pre-construction survey of structures at risk of vibration impacts households.

- ▶ In the initial stages, the blasting induced vibration shall be measured as a function of maximum instantaneous charge and distance from the blasting site. This data shall be then used to refine the Blasting Induced Vibration Risk Zones on the basis of the adopted criteria.
- ▶ Using, the refined Blasting Induced Vibration Risk Zones maps and the tunnel boring schedule, the Supervision Consultant in consultation with the PEDO and the Construction Contractor, shall identify the houses that will be affected and the impact duration and schedule.
- ▶ For the houses that will fall in the Structural Damage Risk Zone, a temporary relocation plan will be developed. An amendment to the Land Acquisition and Resettlement Plan (LARP) (see **Volume 8**) will be commissioned for this purpose. Before start of blasting, all residents of houses in the Structural Damage Risk Zone will be relocated as per the LARP (see **Volume 8**).
- ▶ A survey will be undertaken in both zones, to determine the pre-blasting conditions of the buildings. The survey will be commissioned by the Supervision Consultant and will identify and record any existing damage to the structures. The survey will cover the following aspects:
  - ▷ Overall condition of the structures, both exterior and interior.
  - ▷ Documentation of defects observed in the structure using digital imagery along with notes, measurements and sketches.
  - ▷ Documentation of pre-existing cracks using digital imagery along with notes, measurements and sketches.

3. Following completion of the blasting, the survey will be repeated in the Structural Damage Risk Zone to determine the condition of the buildings and verify that they are safe for re-occupation. If the buildings are safe, the residents will be allowed to return to their houses following any necessary damage repairs. If the buildings are damaged beyond repair, compensation will be paid to the owners as per the LARP. If there are any claims or reports of damage in the Cosmetic Damage Risk Zone, the affected house will be surveyed against the pre-Project survey and repairs will be undertaken as appropriate.

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<tr><td colspan="10">
4. Following are key mitigation measures for the management of blasting:
▶ Blasting will be scheduled during the day only.
▶ Local communities will be informed of blasting timetable in advance and will be provided adequate notice of when blasts are required outside of the planned schedule.
▶ A Blasting Management Plan will be developed by the Construction Contractor. The Plan will be reviewed and approved by the Supervision Contractor before the initiation of the blasting work.
▶ Throughout the blasting activity, vibration sensors will be installed at strategic location to monitor the impact of blasting and to ensure that the vibration levels are within the adopted criteria. The monitoring plan will be part of the Blasting Management Plan.
▶ Unscheduled blasting will be strictly prohibited in any case.
5. Meaningful contact with the community shall be maintained and their grievance shall be attended to in a timely manner. In this regard:
▶ A meaningful community engagement plan will be developed. The plan will cover identify the affected community; the key contact persons; frequency of engagement; the information to be shared; the responsibilities to manage the plan; and the notice period to be giving to the community for various blasting related generating activities.
▶ The Grievance Redress Mechanism will be used to record, investigate, and respond to any complaints. Investigation of the complaints will be undertaken by the Supervision Consultant.
6. Develop a Vibration Monitoring Plan that will include monitoring of vibration levels and frequency around the blasting sites. The objectives of the monitoring will be to:
▶ Ensure that vibration levels in the communities are within the adopted criteria levels;
▶ Maintain record of vibration to settle any potential conflicts; and
▶ Monitor changes in the vibration levels due to possible changes in the rock formation and take appropriate corrective actions.
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<tr><td rowspan="2">Residual Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Minor</td><td>Short Term</td><td>Small</td><td>Low</td><td>Possible</td><td>Low</td><td>-</td><td>High</td></tr>
</table>

Sources of vibration includes construction equipment movement, pile driving, compaction, hammering (hydraulic or pneumatic), operation of batching plant and generators. Another source of vibration will be the blasting to be undertaken for tunneling. The propagation of vibration from construction activities are different in nature from the vibration from blasting. The construction activities are undertaken essentially on ground surface and spreads basically as two-dimensional waves. In contrast, the tunneling is undertaken below the surface and spreads in three-dimension. For this reason, the impact of the two is assessed separately.

In the case of ground vibrations, the level of vibration is measured by the Peak Particle Velocity (PPV) with units of millimeters of movement per second. The proposed criteria for damage to buildings are shown in **Exhibit 7.12**. These are derived from British Standard BS 6472 and are German Standards DIN 4150-3:1999.

Exhibit 7.12: Criteria for Structural Damage Due to Vibration

Risk Zone	*PPV Range*
No Damage Likely	PPV < 5 mm/s
Cosmetic damage risk zone	PPV 5 to 15 mm/s
Structural damage risk zone	PPV > 15 mm/s

Vibration Impact of Construction Activities on the Surface

Exhibit 7.13 provides an indication of the approximate vibration levels that may be expected for various vibration sources.

These levels are well below the threshold of any possibility of damage to structures due to vibrations from typical construction activities related to roller, compactors, and movement of construction equipment.

Exhibit 7.13: Approximate Vibration Levels for Various Sources

Activity	*Typical levels of ground vibration*
Vibratory rollers	Up to 1.5 mm/s at distances of 25 m Higher levels could occur at closer distances; however, no damage would be expected for any building at distances greater than approximately 12 m (for a medium to heavy roller)
Hydraulic rock breakers (levels typical of a large rock breaker operating in hard sandstone)	4.50 mm/s at 5 m 1.30 mm/s at 10 m 0.4 mm/s at 20 m 0.10 mm/s at 50 m
Compactor	20 mm/s at distances of approximately 5 m, 2 mm/s at distances of 15 m. at distances greater than 30 m, vibration is usually below 0.3 mm/s
Bulldozers	1 to 2 mm/s at distances of approximately 5 m. at distances greater than 20 m. vibration is usually below 0.32 mm/s
Air track drill	4 to 5 mm/s at a distance of approximately 5 m, and 1.5 mm/s at 10 m. at distances greater than 25 m, vibration is usually below 0.6 mm/s and at 50 m or more, vibration is usually below 0.1 mms
Truck traffic (over normal (smooth) road surfaces)	0.01 to 0.2 mm/s at the footing of buildings located 10 to 20 m from a roadway
Truck traffic (over irregular surfaces)	0.1 to 2.0 mm/s at the footings of buildings located 10 m to 20 m from a roadway

Source: Northern Expressway Environmental Report: Noise and Vibration technical Paper. 2007. http://www.southroad.sa.gov.au/__data/assets/file/0019/13780/Noise_and_Vibration_Technical_Paper.pdf

Vibration Impact of Tunnel Construction

Blasting for construction results in noise as well as ground vibrations that cannot be confined to the site. As blasting is an occasional activity it does not affect the ambient noise limits evaluated, but can be disturbing to local communities with short-term noise exceeding 10 dBA. Single noisy events such as blasting can be audible over a large area.

Although each incident is short term in nature, the repetitiveness of the noise may give rise to complaints if not managed sensitively. The subjective reaction to a single disturbing noise event will depend on the activities being undertaken by the receptor and the manner in which the program for noisy events is communicated to identified receptors. For example, a large noise event at nighttime may give rise to complaints, where at any other time it would be accepted.

The Project will conduct construction blasting consistent with Pakistan and international safety standards. Open pit blasting will be conducted using standard mining industry practices and procedures for securing personnel and equipment. This includes evacuating the blast area to a distance of at least 500 m to avoid any damage from fly rock.

The PPV is directly related to the size of the blast and the distance from the blast—the closer to the blast the greater the vibration. PPV is calculated as follows:

$$PPV = K\,(R/Q^{0.5})^{B},$$

where:

PPV = peak particle velocity (mm/s);

K = site constant (1140)

R = distance to point of concern (m);

Q = maximum instantaneous charge weight (40 kg, see **Exhibit 7.14**);

B = rock properties constant (-1.6).

Exhibit 7.14: Instantaneous Charge Weight Calculation

Parameter	Value	Explanation
Tunnel cross-section (m^2)	65	From design drawings. Headrace tunnel is 8 m by 8.80 m horseshoe shape.
Borehole depth (m)	5	Assumed, based on personal communication with road construction engineer
Rock removed in one blast cycle (m^3)	325	
Rock type	Hard	
Powder factor (kg/m^3)	0.8	For hard rock[8]
Total charge weight (kg)	260	Powder factor x rock removed in one blast
Maximum instantaneous charge weight (kg)	40	Estimated from typical borehole pattern and personal communication with road construction engineer

8 Dyno Nobel. Blasting and Explosives Quick Reference Guide. 2010.

A PPV of 15 mm/s is calculated to occur about 95 m from the edge of the blasting source (in all directions) and a PPV of 5 mm/s is calculated to occur about 190 m from the edge of the blasting as shown in **Exhibit 7.15**.

Exhibit 7.15: Calculated PPV as Function of Distance from Blast Site

PPV (mm)	*R (m)*
547.7	10
180.7	20
94.4	30
59.6	40
41.7	50
31.2	60
24.3	70
19.7	80
16.3	90
14.9	95
13.8	100
11.8	110
10.3	120
9.0	130
8.0	140
7.2	150
6.5	160
5.9	170
5.4	180
4.9	190
4.5	200

Extensive blasting will be undertaken during the construction of the headrace tunnels. In **Exhibit 7.16** it can be seen that the headrace tunnel is at a depth of less than these critical distances in certain areas along its length. The depth profile for the construction adits are provided in **Exhibit 7.17** and **Exhibit 7.18**. It can be seen that it is close to the ground level in several locations.

Exhibit 7.16: Depth Profile of the Headrace Tunnel

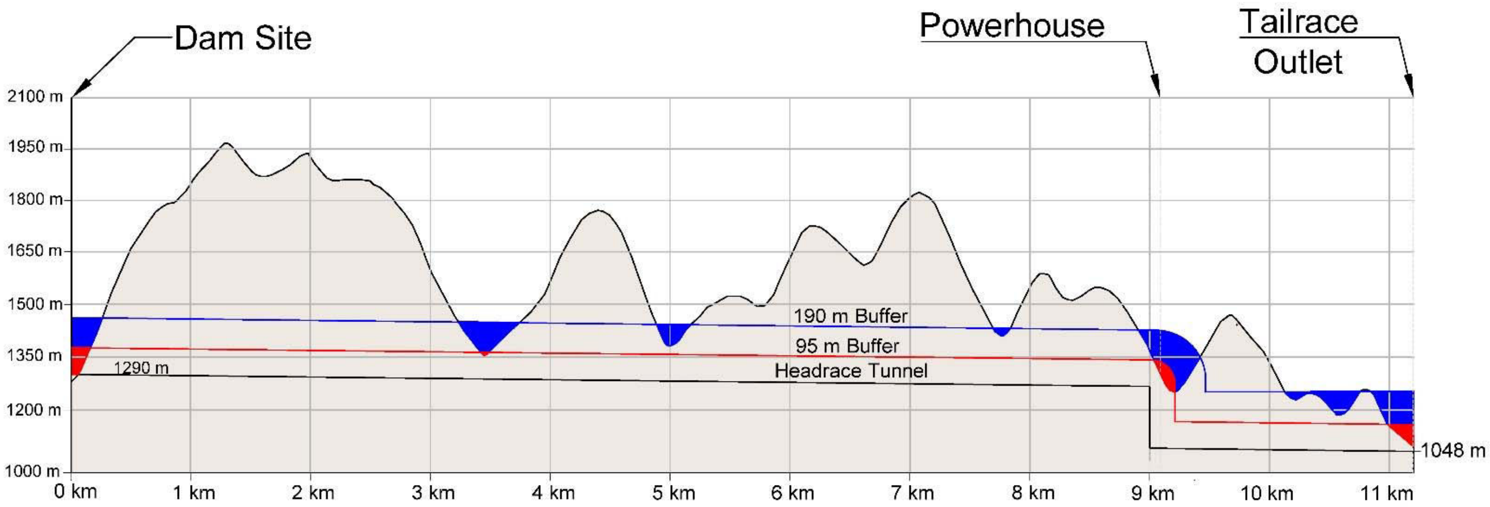


Exhibit 7.17: Depth Profile of Construction Adit 1

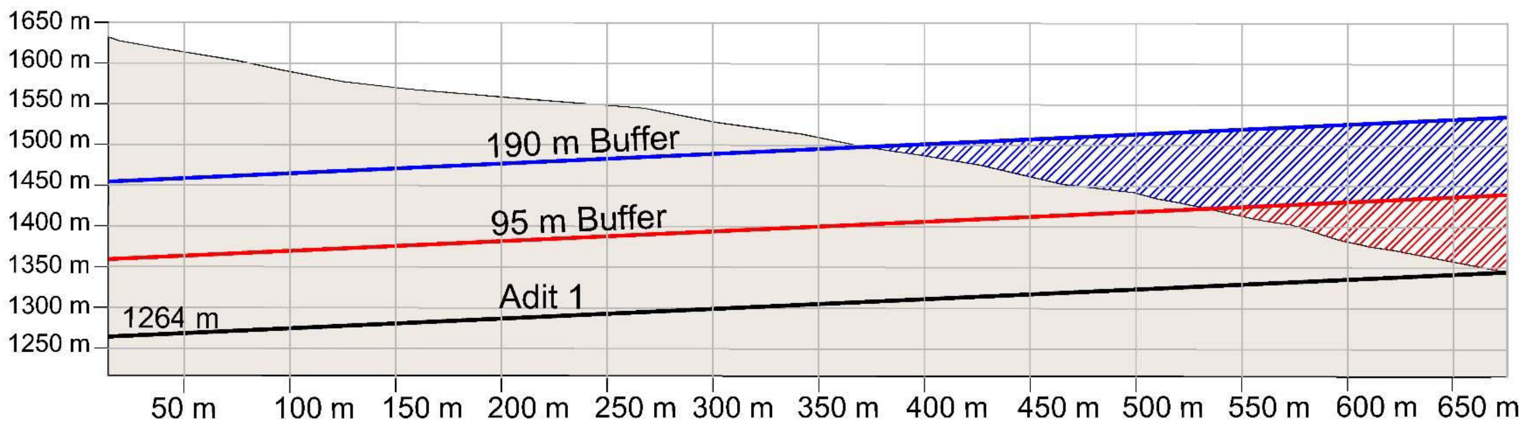
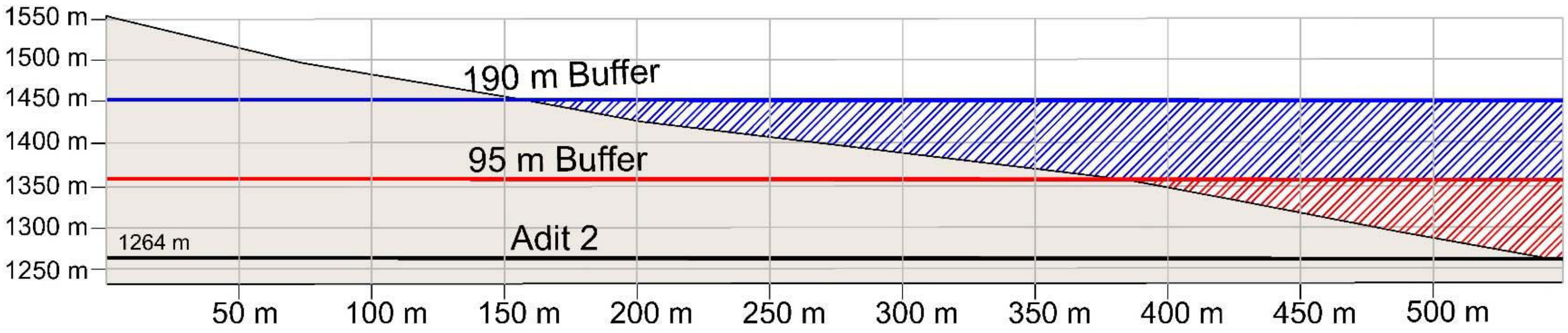


Exhibit 7.18: Depth Profile of Construction Adit 2



The following procedure is proposed for addressing the vibration concerns:

- ► Identify potential problem areas surrounding the Project sites.
  - ▷ The boundaries of risk zones are drawn without taking into consideration the variation in elevation of the terrain. The actual boundaries are likely to be closer to the tunnels.
  - ▷ The risk zone boundaries take into considerations, the location of the construction adits and their elevation profiles.
  - ▷ The complete lengths of the access tunnels for the powerhouse are included in the Structural Risk Zone.
- ► Based on the above criteria the total houses identified for preconstruction surveys include:
  - ▷ 120 structures of which 13 are within 95 m (structural damage risk zone).
  - ▷ The locations of these structures are illustrated in **Exhibit 7.19** and **Exhibit 7.20.**
  - ▷ **Appendix S** presents an index of structures within the risk zones, including detailed maps, and coordinates for each structure.

Mitigations Measures

Overall Approach

The PPV is predicted using a semi-empirical model which is the best alternate in the absence of measured field data. Although, there is reasonable confidence in the predicted value, the norm is to measure field data to assess vibration levels. In the initial stages, the blasting induced vibration shall be measured as a function of maximum instantaneous charge and distance from the blasting site. This data shall be then used to refine the Blasting Induced Vibration Risk Zones on the basis of the adopted criteria.

Early during the construction phase, the construction contractor shall develop a detailed tunnel blasting plan as part of the overall construction schedule. The plan shall specify, to a reasonable level of accuracy, the schedule for boring.

Using, the refined Blasting Induced Vibration Risk Zones maps and the tunnel boring schedule, the Supervision Consultant in consultation with the Roads Department and the Construction Contractor, shall identify the houses that will be affected and the impact duration and schedule.

For the houses that will fall in the Structural Damage Risk Zone, a temporary relocation plan will be developed. An amendment to the Land Acquisition and Resettlement Plan (LARP) will be commissioned for this purpose. Before start of blasting, all residents of houses in the Structural Damage Risk Zone will be relocated as per the LARP (see **Volume 8**).

Exhibit 7.19: Vibration Risk Area 1

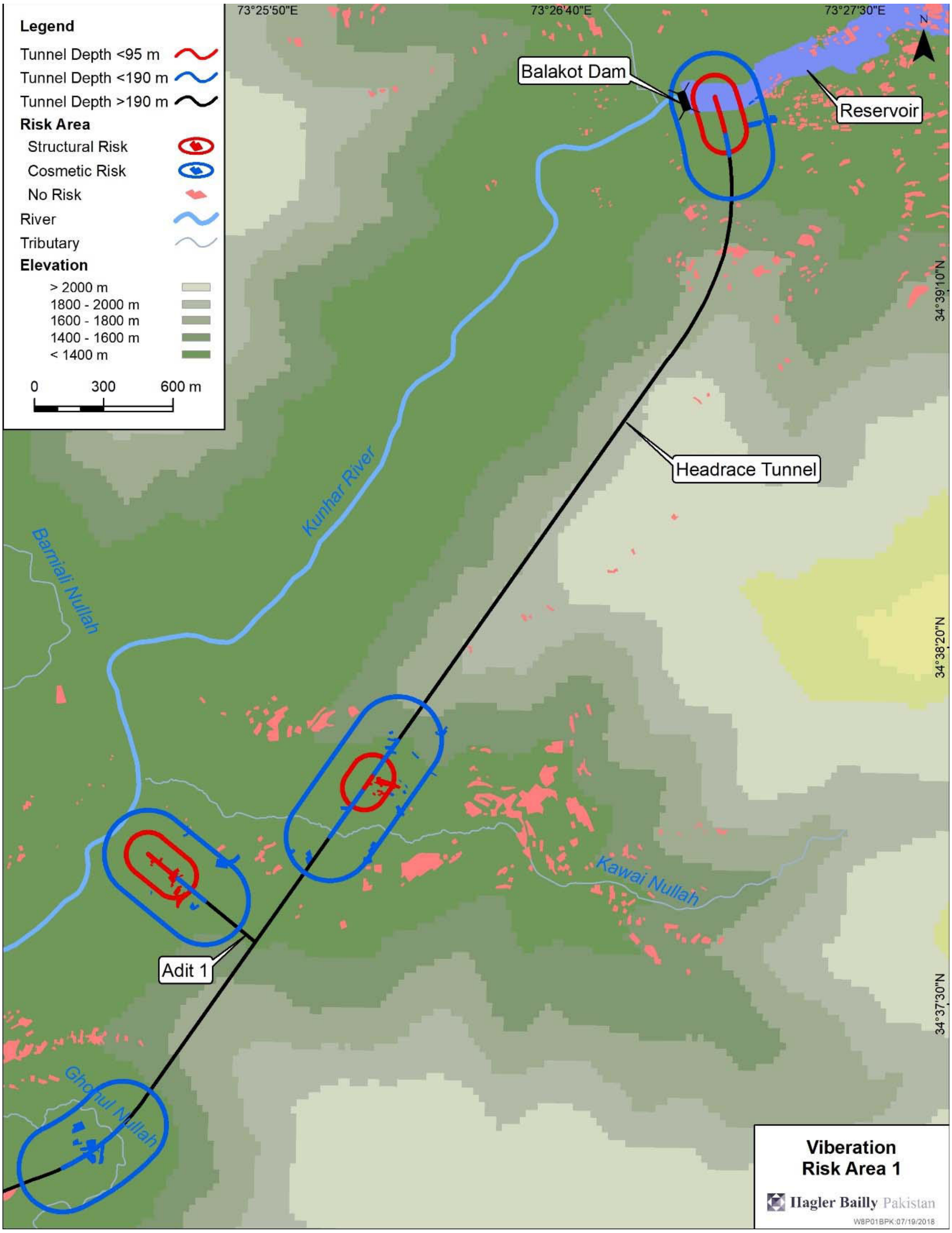
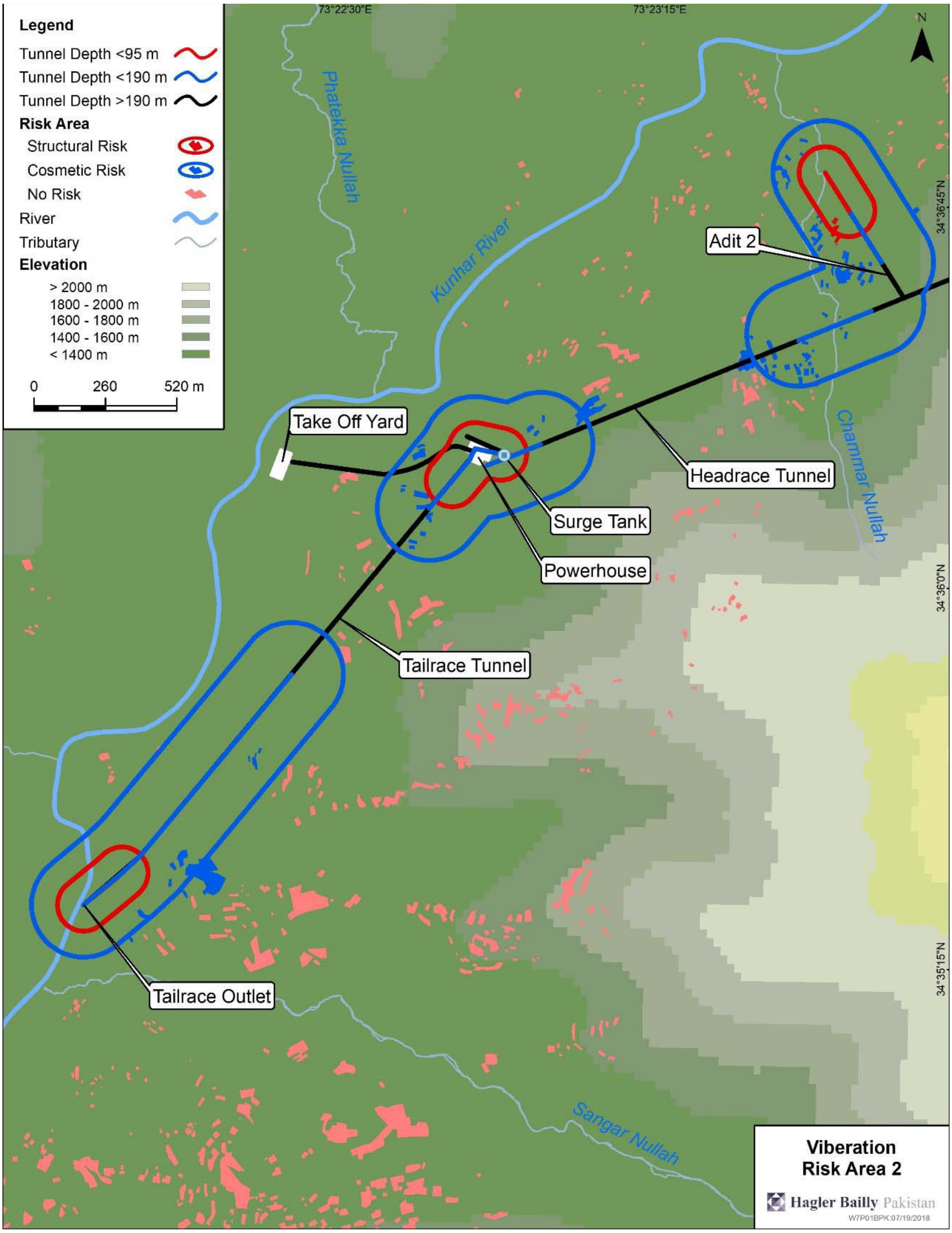


Exhibit 7.20: Vibration Risk Area 2



A survey will be undertaken in both zones, to determine the pre-blasting conditions of the buildings. The survey will be commissioned by the Supervision Consultant and will identify and record any existing damage to the structures. The survey will cover the following aspects:

- ► Overall condition of the structures, both exterior and interior.
- ► Documentation of defects observed in the structure using digital imagery along with notes, measurements and sketches.
- ► Documentation of pre-existing cracks using digital imagery along with notes, measurements and sketches.

The survey will be accompanied with consultations with the affected household to explain the extent and reason for the survey, and the process for reporting any grievances regarding vibration impacts. The households should be provided with materials that summarize the grievance redress process.

Following completion of the blasting, the survey will be repeated in the Structural Damage Risk Zone to determine the condition of the buildings and verify that they are safe for re-occupation. If the buildings are safe, the residents will be allowed to return to their houses following any necessary damage repairs. If the buildings are damaged beyond repair, compensation will be paid to the owners as per the LARP (see **Volume 8**).

If there are any claims or reports of damage in the Cosmetic Damage Risk Zone, the affected house will be surveyed against the pre-Project survey and repairs will be undertaken as appropriate.

Mitigation Plan

Following are key mitigation measures for the management of blasting:

- ► Blasting will be scheduled during the day only.
- ► Local communities will be informed of blasting timetable in advance and will be provided adequate notice of when blasts are required outside of the planned schedule.
- ► A Blasting Management Plan will be developed by the Construction Contractor. The Plan will be reviewed and approved by the Supervision Contractor before the initiation of the blasting work.
- ► Throughout the blasting activity, vibration sensors will be installed at strategic location to monitor the impact of blasting and to ensure that the vibration levels are within the adopted criteria. The monitoring plan will be part of the Blasting Management Plan.

Unlike other construction activities, it is recognized that the impact of blasting on the community can be significant or can be perceived as significant by the community. It is therefore vital that regular and meaningful contact with the community shall be maintained and their grievance shall be attended to in a timely manner. In this regard:

- ► A meaningful community engagement plan will be developed. The plan will cover identify the affected community; the key contact persons; frequency of engagement; the information to be shared; the responsibilities to manage the plan;

and the notice period to be giving to the community for various blasting related generating activities.

- The Grievance Redress Mechanism will be used to record, investigate, and respond to any complaints. Investigation of the complaints will be undertaken by the Supervision Consultant.

Vibration Monitoring

Vibration Monitoring Plan will include monitoring of vibration levels and frequency around the blasting sites. The objectives of the monitoring will be to:

- Ensure that vibration levels in the communities are within the adopted criteria levels;
- Maintain record of vibration to settle any potential conflicts; and
- Monitor changes in the vibration levels due to possible changes in the rock formation and take appropriate corrective actions.

Vibration data will be documented, reviewed, and preserved. It will be regularly shared with ADB, PEDO and EPA, KP as part of the monthly progress report.

7.5.2 Fly Rock from Blasting

Fly rock is an unexpected projection of material from the blast site to any area beyond the designated safety area. Fly rock occurs when the amount of explosive energy is greater than that required to break the mass of rock between the blast position and the free face, the excess energy projects the rock debris beyond the safety area. Uncontrolled fly rock from blasting can travel hundreds of meters, with known cases up to 1000 m. This range is for extreme cases where very little blasting control is applied, and is due to over-charging of holes or under-burdening of holes.

Use of large diameter blast holes for small benches, variation in burden due to over break of toe or back crack that results in uneven face, drilling deviation, inadequate burden and too closing spacing are the possible causes of fly rock.

Despite the fact that fly rock consumes only 1% of the explosive energy used in a blast it is more serious in nature than any other damage caused by blasting.

Impact 10: Blasting may pose a health hazard due to flying debris.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Short Term	Intermediate	High	Possible	Medium	-	High

Mitigation measures:

1. A minimum buffer of 500 m should be provided between the settlements and point of blasting.
2. Leave a layer of about 5 m of undisturbed softs above the top of the overburden blasts. This will act as a blanket to contain air blast, dust and fly rock.
3. Ensure that the holes are correctly collared with respect to the back-break/inclination of the face and also that digging alongside the initiation face well controlled.
4. Inadequate forward displacement of the front row burden arising out of the under charging of these holes will result in fly rock from vertical catering of the rear holes.
5. Where fly rock possess a serious problem, the stemming length should not be less than the hole burden. Also an effective stemming material like crushed angular rock should be used to prevent premature venting of explosion gases through the stemming column.
6. The forward fly rock could be fairly controlled to the commonly used 'inline open loop' pattern. The maximum inter-row delay interval consistent with the absence of cut off helped in minimizing the fly rock formation. As a thumb rule an inter-row delay of 4-8ms/m of burden could be used for this purpose.
7. Adequate care should be taken while connecting the delay devices in the holes/rows and the initiation sequence properly checked before firing to avoid initiation of blast holes out of sequence.
8. Blasts designed on a face length to width ratio in the range of 3 to 4 produces minimum fly rock.

Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

7.6 Hydrology and Water Quality

The major risks to local hydrology and water quality due to the Project are related to water availability and contamination:

- Impact 11: Alterations of natural passage of springs due to blasting for tunnels may disrupt the water supply for mountain spring users.
- Impact 12: Use of local water resources for construction activities may reduce the water availability for local communities
- Impact 13: Contamination of surface and groundwater due to discharge from the construction activities and sewage from the construction camps may affect agricultural productivity and human health.

7.6.1 Changes to Groundwater Patterns

Impact 11: Alterations of natural passage of springs due to blasting for tunnels may disrupt the water supply for mountain spring users.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Long Term	Intermediate	High	Possible	High	-	High
Mitigation measures: 1. Record location of the springs especially those in areas proximal to where the underground headrace tunnel will be closer to the ground level (see **Exhibit 7.21** and **Exhibit 7.22)**. 2. Monitor flow for located springs and maintain records. 3. Support the community in development of alternate water supply schemes through local NGOs 4. Ensure the availability of water to the communities and the access of the communities to the water resources being used by them is not adversely affected.								
Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Medium	Intermediate	Low	Possible	Low	-	High

Heavy construction activities especially the blasting activities for the headrace tunnel (see **Section 7.5** *Blasting and Vibration*) and excavation may cause alterations to the groundwater flow patterns in areas proximal to where the underground headrace tunnel will be close to ground level.

There are numerous settlements on the ridges across which the headrace tunnel will be constructed and those are dependent on the springs for daily water use. These changes will only cause negative impacts when they occur where people or ecological systems are using the water. Areas where the headrace tunnel is proximal to the ground is discussed in **Section 4.1.7** *(Water Resources)*. 6 mountain springs are at high risk out of which 2 springs are used by schools and hospitals. These springs are located in areas where blasting for tunnel construction will be close to the surface are shown in **Exhibit 7.21** and **Exhibit 7.22**. Three springs (2 of which are within the High-Risk area) are used by schools and hospitals (marked as red in the **Exhibit 7.22**). All of these springs should be closely monitored.

Exhibit 7.21: High Risk Areas for Mountain Springs A

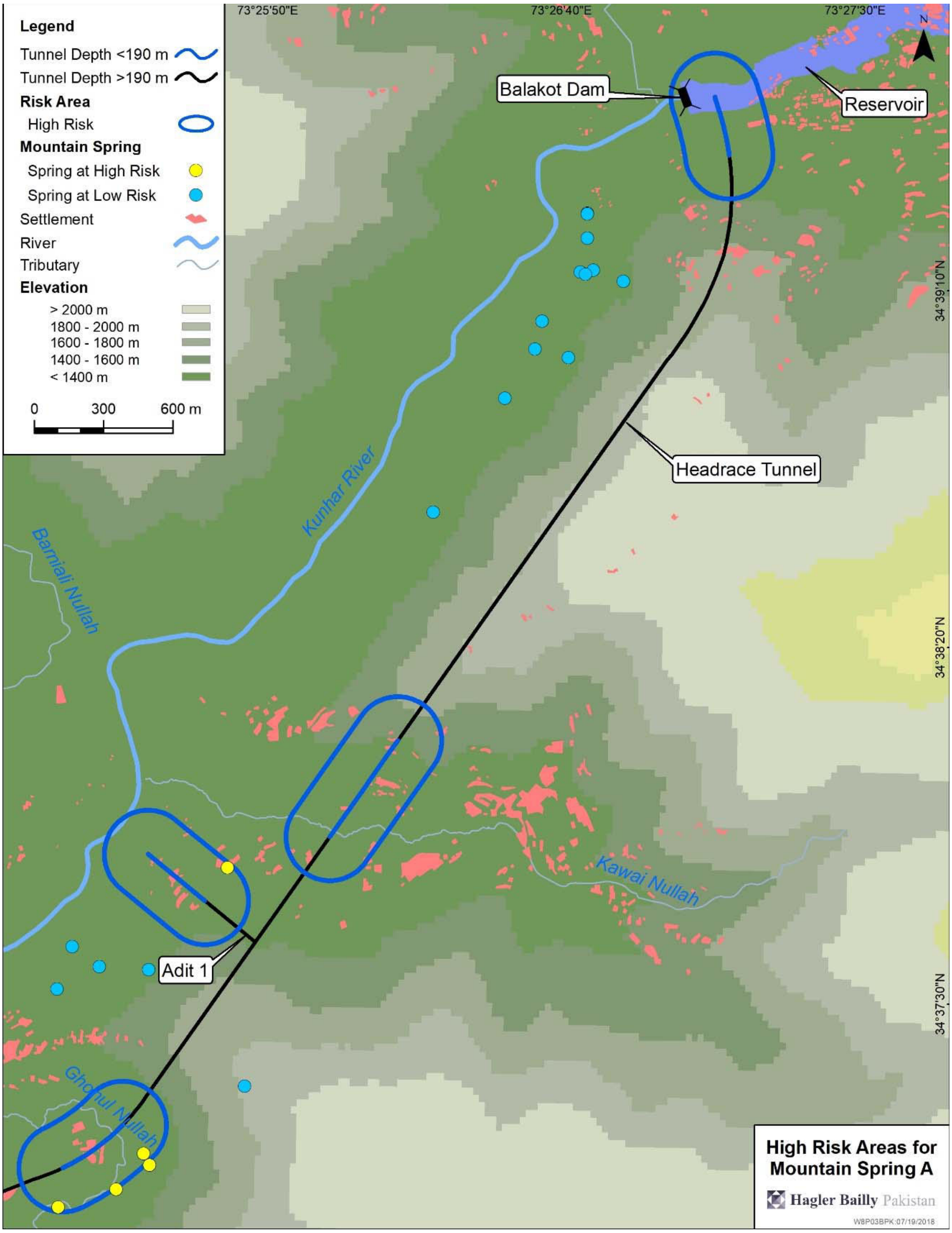
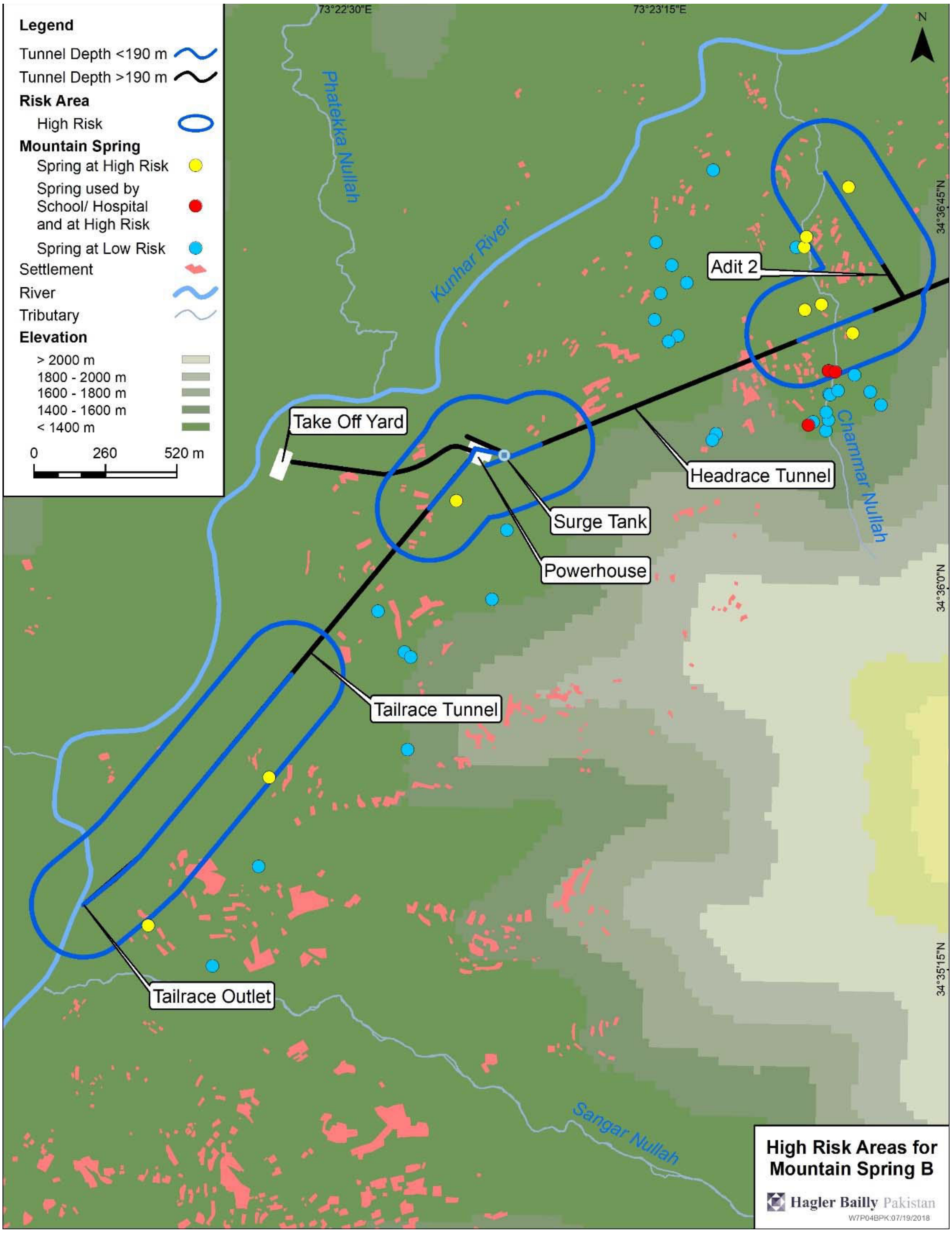


Exhibit 7.22: High Risk Areas for Mountain Springs B



7.6.2 Water Resource Depletion

Impact 12: Use of local water resources for construction activities may reduce the water availability for local communities.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Short Term	Intermediate	Medium	Possible	Medium	-	High
Mitigation measures: 1. Develop a Water Sourcing and Abstraction Plan. 2. Source water for construction from authorized abstraction sources agreed between the local communities, local government and EPC contractor. 3. Water conservation techniques will be developed and implemented by the EPC contractor. 4. Access of community to water sources shall be kept clear so that the community's ability to meet its water requirements are not compromised. 5. Exercise care while moving heavy machinery to avoid damage or blockage of natural waterways and channels. 6. Maintain records of water usage in all Project activities. 7. Incorporate the above measures in the Construction Site Environmental Management Plan (see **Section 9,** *Environmental Management Plan*).								
Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Unlikely	Low	-	High

The main source of drinking water in the area is spring water located in the hydro census (see **Section 4.1.7,** *Water Resources*). Water demand for the construction site and camp may take water away from other users if not controlled. Unauthorized abstraction from shallow springs could reduce the yield available or block access for other users, leading to resentment and increasing the risk of hardship.

7.6.3 Contamination of Surface and Groundwater from Construction Activities

Impact 13: Discharge from construction activities can potentially result in the contamination of groundwater and surface water.

Applicable Project Phase					*Construction*			
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Short Term	Small	Low	Possible	Low	-	High

Mitigation measures:

1. Develop and implement a Water Quality Management Plan.
2. Prepare and implement a Spill Prevention and Response Plan and inducted to the staff for any incident of spill.
3. Provide and use spill prevention trays at refueling locations.
4. The run off from maintenance workshops will be collected by impervious channels and be passed through oil water separators (OWS) before final disposal. The sludge and oil collected at the OWS will be disposed of properly.
5. Build separate impervious pits (with concrete walls and proper shed) at the construction sites for temporary handling and storage of contaminated soil and water if encountered during construction such as sludge from OWS.
6. Keep all fuel storage tanks and lubricating oil drums in secondary containment impervious pits with impervious shed walls.
7. Avoid on-site maintenance of construction vehicles and equipment, as far as possible.
8. Regularly inspect construction vehicles and equipment to detect leakages.
9. Store fuels and lubricants in covered and dyked areas, underlain with impervious lining.
10. Spill control kits (shovels, plastic bags and absorbent materials) will be available near fuel and oil storage areas, vehicle parking, and vehicle maintenance areas as well as at construction sites.
11. Remove contaminated soil from the site and dispose in a manner to ensure protection of water sources.
12. Construct the bottom of any soak pit or septic tank at least 100 meters away from springs and water bores.
13. Maintain records of spills and volume of removed contaminated soil.
14. Maintain record of remedial measures taken.
15. Use silt traps to prevent contamination of river and streams.
16. Incorporate the above measures in the Construction Site Environmental Management Plan (see **Section 9,** *Environmental Management Plan*).

Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Unlikely	Low	-	High

A major risk to water bodies during construction are accidental spills of fuels, lubricants, reagents and other potentially hazardous chemicals.

7.7 Construction Noise

Construction noise is a component of environmental noise associated with construction activities. Construction noise is noise that arises from an activity at a construction site. It includes:

- Noise from operation of construction machinery and equipment for the construction activities including excavation and demolition work, site preparation work, foundations and concrete placement, erection of metal structures, installation of mechanical and electrical equipment and building maintenance or repair work;
- Noise from movement of vehicles within, entering or leaving a construction site; and
- Noise from blasting.

The noise generated through these activities can be categorized as below.

- Airborne noise: Noise that travels through air and caused by general construction and construction traffic.
- Ground borne noise: Noise that is generated through rumbling sound caused by vibration due to impact induced construction activities such as blasting, pile driving and tunneling and movement of heavy transportation such as trucks.
- Air blast noise: Noise generated through blasting, also known as blast overpressure, which is the pressure wave (or pulse) transmitted through the air as the result of an explosion. Air blast may have both acoustic effects in terms of overpressure and vibration effects in terms of airborne and ground borne vibration.

Construction noise emanates from the source and propagates through the atmosphere. There are numerous factors influencing the noise level received at a sensitive receptor including:

- Directivity of the source
- Atmospheric absorption (attenuation is a function of temperature, humidity and frequency within the atmosphere)
- Meteorological influences (attenuation or enhancement due to surface temperature and humidity, vertical temperature profile, wind speed and direction)
- Ground absorption (influence of hard or soft ground types on propagation)
- Topography and structures (attenuation due to intervening buildings and terrain features.

Impact 14: Increase in ambient noise levels due to operation of construction equipment, movement of construction traffic and blasting may create nuisance for nearby communities and visiting tourists.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Short Term	Small	Low	Possible	Low	-	High

Mitigation measures:

1. Develop a Noise and Vibration Control Plan.

Noise generated from construction sites from construction activities

- Select the quietest available plant and equipment that can economically undertake the work required.
- Undertake maintenance of the equipment as simple maintenance can reduce noise levels by as much as 50%. Parts may become loose, creating more noise because of improper operation or scraping against other parts. Grinding noises may also occur as the result of inadequate lubrication.
- Equipment under use will be regularly maintained, tuned, and provided with mufflers to minimize noise levels.
- Use visual alarms in preference to audible alarms.
- Enclose noisy equipment.
- Provide noise attenuation screens, where appropriate.
- Build an enclosure around the noise source so that noise is contained. The enclosure should be free from gaps and made of dense material and be lined with noise-absorbing material like glass or polyester batts.
- Locate noisy equipment behind parking lots or parks.
- Close liaison with the community and regular monitoring of the noise levels in the community are key to successfully implementation of the above mitigation measures. Specifically, inform communities of all major construction activities three days in advance.

Construction noise from traffic

- Fit and maintain appropriate mufflers on earth-moving and other vehicles on the site.
- Mobile plants such as excavators, front-end loaders and other diesel-engine equipment should be fitted with residential class mufflers and other silencing equipment, as applicable.
- Haul roads within the site should have as low a gradient as possible, and paving should be considered if practicable where noise-sensitive receptors are likely to be affected;
- Owners and operators of existing facilities should implement special noise reduction measures, such as erecting purpose-built acoustic barriers, restricting opening hours and maintaining transport vehicle

Construction noise from on-site plant operations and equipment

- All fixed plant at the work sites will be appropriately selected, and where necessary, fitted with silencers, acoustical enclosures and other noise attenuation measures.
- Modify the equipment or the work area to make it quieter by substituting existing equipment with quieter equipment; retro-fitting existing equipment with damping materials, mufflers, or enclosures; erecting barriers; and maintenance.
- Shift to a quieter construction process for example pile driving is very loud as compared to boring which is a much quieter way to do the same work.
- Combine noisy operations to occur in the same time period. The total noise level produced will not be significantly greater than the level produced if the operations were performed separately.

- All plant and equipment should be regularly maintained.
- Move static plant and equipment as far as possible from sensitive boundaries, as work allows. A distance of four times further away lowers the noise by 12 dBA. A reduction of 10 dBA will sound half as loud.
- Sound attenuation measures should be used for plant and equipment such as baffles and specialized mufflers, acoustic enclosures or partial enclosure housings.
- Acoustic barriers need to be designed and purpose built if needed. Vegetated buffer zones can also be planted to mitigate noise from operations using suitably selected native plantings local to the area.
- Reduce workers' exposure to high noise levels by keeping moving workers away from the noise source; restricting access to areas; rotating workers performing noisy tasks; and shutting down noisy equipment when not needed.

Use earplugs to reduce workers' exposure to high noise levels.

Noise generated from the blasting in quarry areas

- Using vibratory piling instead of impact piling.
- Conveyor belts and crushing/screening equipment can be housed to provide acoustic screening.
- It is important that sound-reduction equipment fitted to machinery is used and maintained properly.
- Erect earth mounds around the site boundary can provide acoustic as well as visual screening.
- Soft ground (e.g. grassland and cultivated fields) attenuation can sometimes have a greater impact in reducing noise than barrier attenuation, especially if the ground supports sound absorbing vegetation.

Noise emissions from concrete batching

- Locate noisy equipment away from potential sources of conflict.
- Locate noisy equipment behind sound barriers or sound absorbers – for example, gravel stockpiles or constructed barriers.
- Install silencing devices to all pressure operated equipment.

Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

7.7.1 Existing Conditions

There is no continuous major anthropogenic source of noise in the communities. Intermittent sources include farm equipment and traffic. River noise is only the continuous source present at construction sites of the Project. Noise baseline conditions at the Project construction sites in the villages are between 40 dBA and 60 dBA for daytime and 37 dBA and 53 dBA for nighttime. The detailed noise levels are presented in **Section 4.1.10** (*Noise Levels*).

7.7.2 Criteria for Determining Significance

The World Bank guidelines and NEQS for noise require that the sound level in residential areas should not exceed 55 dBA during the day and 45 dBA during the night as presented in **Exhibit 7.23.** World Bank guidelines also state that noise impacts should not exceed the levels presented in **Exhibit 7.23** or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Exhibit 7.23: NEQS and IFC Guidelines on Ambient Noise Levels

Specific Environment	*Maximum Allowable Log Equivalent (Hourly Measurements), in dB A*			
	IFC-EHS limit Day (7:00-22:00)	*IFC-EHS limit Night (22:00-7:00)*	*NEQS Day (6:00-22:00)*	*NEQS Night (22:00-6:00)*
Residential, institutional, educational	55	45	55	45
Industrial	75	65	70	70
Commercial	65	55	70	70

7.7.3 Impact Analysis

The analysis presented in this section is based on the approach recommended by Federal Highway Administration of the US Department of Transportation for assessment of construction noise.[9]

Precise prediction of noise due to construction activity at given location at a given time requires the list of all equipment that is operational at the time and the following information regarding each piece of equipment:

- ► The maximum and minimum noise levels, measured at a reference distance from the equipment, during a work cycle
- ► The fraction of time it operates at maximum level during a work cycle
- ► The usage factor, i.e., the number of hours during the day when the equipment is operational
- ► The distance of the equipment from the receptor
- ► Potential noise barriers and other topographic features that attenuate the sound.
- ► Atmospheric conditions—the wind speed and direction, humidity and barometric pressure—also affect the propagation of sound, however, for short distances the effect of these is insignificant compared to other variables.

Construction noise levels at the nearest receptor in the nearby village, located approximately at 350 m from the boundary of construction site, would fluctuate depending on the type, number, distance from receptor, and duration of use of various pieces of construction equipment. In this analysis, first the noise level due to each piece of equipment, which is likely to be used in the construction, is calculated. The peak noise levels of construction equipment mainly used at a typical construction site, are shown in **Exhibit 7.24**. The list includes all equipment except vehicles and some minor pieces of equipment. Using this data, the expected noise level, $L_{eq(8\text{-}hr)}$, is calculated. The predicted noise levels are shown in **Exhibit 7.25**. It shows that the highest equivalent noise level for an 8-hour shift due to a single piece of equipment at a receptor 500 m from the source

9 Highway Construction Noise: Measurement, Prediction, and Mitigation, Reagan, J. A. and C. A. Grant, Special Report. US. Department of Transportation, Federal Highway Administration.

will be about 52 dBA. This is under no-mitigation conditions and assuming no attenuation due to ground features.

When more than one piece of equipment are working simultaneously, the noise level at the receptor will increase. Generally speaking, the noise level will increase by 3 dBA due to the first equipment. Increase due to subsequent addition of equipment will gradually decrease from 3 dBA. So if five equipment, each producing 52 dBA at the receptor, are working simultaneously, the resulting noise level will be around 59 dBA. The attenuation due to topographic factors could be up to 5 dBA. Good maintenance of equipment with installation of noise mufflers can reduce the noise by another 5 dBA.

Exhibit 7.24: Construction Equipment Noise Ranges (dBA)

Equipment	*Peak Noise Range at 15.2 m*	*Typical Peak Sound Level in a Work Cycle*[a]	*Typical 'Quieted Equipment' Sound Level*[b]	*Construction Phase*		
				Earthworks	*Structures*	*Installation*
Batching plant	82-86	84	81		Y	
Concrete mixers	76-86	85	82		Y	
Cranes	70-94	83	80		Y	Y
Excavators	74-92	85	82	Y		
Tractors and trolleys	77-94	88	85	Y	Y	Y
Water bowsers	85-93	88	85	Y	Y	Y
Graders	72-92	85	82	Y		
Bulldozers	65-95	80	75	Y		
Paver	87-89	88	80	Y		
Pumps	68-72	76	75	Y	Y	Y
Diesel generators	72-82	78	75	Y	Y	Y
Vibrators	68-82	76	75	Y	Y	
Drilling machines	82-98	90	87		Y	Y
Compressors	74-84	81	71		Y	
Dumpers	77-96	88	83	Y	Y	Y
Road rollers	73-77	75	72	Y		

Sources: Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances. USEPA; Bolt, Beranek, and Newman, 1971.

Notes:

[a] Where typical value is not cited in literature, mean of the peak noise range is assumed

[b] Quieted equipment can be designed with enclosures, mufflers, or other noise-reducing features. Where data is not available, a 3 dB reduction is assumed

It can be seen that some equipment are in compliance with the NEQS and IFC-EHS limits when they are operated on an individual basis. Night time construction activities may exceed the limits for certain construction equipment as shown in **Exhibit 7.25**. It is therefore, predicted that the resultant noise levels at the receptors when the construction work is carried out at a distance of the 350 m from the receptor could be in the range 50-55 dBA. In areas where the baseline noise level is high, say 60 dBA, the increase will be less than 2 dBA and thus barely noticeable. Note that the above statement is valid if there is a continuous non-fluctuating noise source. As the noise levels of construction equipment vary considerably, the community can easily notice the variation. However, the overall noise level, L_{eq}, is likely to be within the predicted limited.

In addition to inherent fluctuation in equipment, the other factors that can increase the noise levels at the community include, simultaneous operation of a very large number of equipment, equipment working in close vicinity of the dwellings, receptors located on elevated area thus eliminating attenuation due to topography, and receptors located downwind of the equipment.

Exhibit 7.25: Predicted Noise Level for Construction Equipment (dBA)

Equipment	*Equivalent Noise Level in an 8-hr Shift at Receptor 250-500 m from Source*	*Individual Compliance*	
		Daytime	*Nighttime*
Batching plant	59	No	No
Concrete mixers	59	No	No
Cranes	54	Yes	No
Excavators	54	Yes	No
Tractors and trolleys	49	Yes	No
Water bowsers	49	Yes	No
Graders	45	Yes	Yes
Bulldozers	45	Yes	Yes
Paver	45	Yes	Yes
Pumps	45	Yes	Yes
Diesel generators	43	Yes	Yes
Vibrators	43	Yes	Yes
Drilling machines	43	Yes	Yes
Compressors	43	Yes	Yes
Dumpers	43	Yes	Yes
Road rollers	43	Yes	Yes

7.7.4 Mitigation

Noise mitigation measures for each construction activity are presented in **Exhibit 7.26**. As the final location of the construction equipment is not known at this stage a safe buffer distance for loud construction activities is also provided in the Exhibit to guide final location of Project construction infrastructure.

Exhibit 7.26: Mitigation Measures for Controlling Noise

Source/Activity	*Zone of Impact*	*Mitigation Measures*
Noise generated from construction sites from construction activities Construction activities include removal of topsoil and overburden, excavation with machinery, drilling and blasting of rock, crushing and screening of aggregates, transport of raw materials and finished products within the site and on public roads, etc.		**Source Mitigation** ▶ Select the quietest available plant and equipment that can economically undertake the work required. ▶ Undertake maintenance of the equipment as simple maintenance can reduce noise levels by as much as 50%. Parts may become loose, creating more noise because of improper operation or scraping against other parts. Grinding noises may also occur as the result of inadequate lubrication. ▶ Equipment under use will be regularly maintained, tuned, and provided with mufflers to minimize noise levels. ▶ Use visual alarms in preference to audible alarms **Pathway Mitigation** ▶ Enclose noisy equipment. ▶ Provide noise attenuation screens, where appropriate. ▶ Building an enclosure around the noise source so that noise is contained. The enclosure should be free from gaps and made of dense material and be lined with noise-absorbing material like glass or polyester batts. ▶ Locate noisy equipment behind parking lots or parks. **Receiver Mitigation** ▶ Close liaison with the community and regular monitoring of the noise levels in the community are key to successfully implementation of the above mitigation measures. Specifically, ▶ Inform communities will of all major construction activities three days in advance, ▶ Discuss noise control measures with the community through informal and formal meetings, and ▶ Implement a complaint registering, tracking and redressal mechanism and undertake on-demand monitoring also in case of any complaints.

Source/Activity	*Zone of Impact*	*Mitigation Measures*
Construction noise from traffic Heavy vehicles on access routes can create disturbing noise entering and exiting the facility. The siting of such facilities need to consider the traffic routes the vehicles will travel, preferably not through built-up residential areas.	The EPA Guidance for the Assessment of Environmental Factors (Separation Distances between Industrial and Sensitive Land Uses) requires that a minimum separation distance of 1,000 metres be provided.[10] Main transport routes to the facility should avoid residential or sensitive use areas.	**Source Mitigation** ▶ Mobile plant such as excavators, front-end loaders and other diesel-engine equipment should be fitted with residential class mufflers and other silencing equipment, as applicable. **Pathway Mitigation** ▶ Haul roads within the site should have as low a gradient as possible, and paving should be considered if practicable where noise-sensitive receptors are likely to be affected; **Receiver Mitigation** ▶ Owners and operators of existing facilities should implement special noise reduction measures, such as erecting purpose-built acoustic barriers, restricting opening hours and maintaining transport vehicle.
Construction noise from on-site plant operations and equipment The extent to which plant and equipment may disturb neighbouring properties will depend on local circumstances and on the nature, level or frequency of the sound emitted, its duration and the time at which it is made.	The EPA Guidance for the Assessment of Environmental Factors (Separation Distances between Industrial and Sensitive Land Uses) requires a minimum separation distance of 1,000 metres.[11]	**Source Mitigation** ▶ All fixed plant at the work sites will be appropriately selected, and where necessary, fitted with silencers, acoustical enclosures and other noise attenuation measures. ▶ Modify the equipment or the work area to make it quieter by substituting existing equipment with quieter equipment; retro-fitting existing equipment with damping materials, mufflers, or enclosures; erecting barriers; and maintenance. ▶ Shift to a quieter construction process for example pile driving is very loud as compared to boring which is a much quieter way to do the same work. ▶ Combine noisy operations to occur in the same time period. The total noise level produced will not be significantly greater than the level produced if the operations were performed separately. ▶ All plant and equipment should be regularly maintained. **Pathway Mitigation**

10 Environmental guidelines for construction and demolition, department fo environment and conservation, 2009 http://www.sulo.com.au/wp-content/uploads/2013/07/Environmental_Guidelines_for_Construction_Demolition_Recycling_Facilities_Sep_2009.pdf

11 Ibid.

Source/Activity	*Zone of Impact*	*Mitigation Measures*
		▶ Move static plant and equipment as far as possible from sensitive boundaries, as work allows. A distance of four times further away lowers the noise by 12 dBA. A reduction of 10 dBA will sound half as loud. ▶ Sound attenuation measures should be used for plant and equipment such as baffles and specialized mufflers, acoustic enclosures or partial enclosure housings. ▶ Acoustic barriers need to be designed and purpose built if needed. Vegetated buffer zones can also be planted to mitigate noise from operations using suitably selected native plantings local to the area. **Receiver Mitigation** ▶ Reduce workers' exposure to high noise levels by keeping moving workers away from the noise source; restricting access to areas; rotating workers performing noisy tasks; and shutting down noisy equipment when not needed. ▶ Use earplugs to reduce workers' exposure to high noise levels.
Audible noise generated from the blasting in quarry areas Blasting (which occurs at quarries, but not in sand and gravel pits) can give rise to vibration, audible noise, flyrock and dust. Nonetheless, vibration transmitted through the ground and pressure waves through the air ("air overpressure") can shake buildings and people and may cause nuisance. Audible noise accompanies overpressure.	A buffer zone of one kilometre (1 km) is to be maintained around existing quarry sites to ensure protection of adjacent areas from quarrying activities in Draft Noise Management Guideline, 1996.[12]	**Source Mitigation** ▶ Using vibratory piling instead of impact piling. ▶ Conveyor belts and crushing/screening equipment can be housed to provide acoustic screening. ▶ It is important that sound-reduction equipment fitted to machinery is used and maintained properly; **Pathway Mitigation** ▶ Erect earth mounds around the site boundary can provide acoustic as well as visual screening. ▶ Soft ground (e.g. grassland and cultivated fields) attenuation can sometimes have a greater impact in reducing noise than barrier attenuation, especially if the ground supports sound absorbing vegetation;

12 http://www.legislation.act.gov.au/ni/2002-247/20020404-2973/pdf/2002-247.pdf

Source/Activity	Zone of Impact	Mitigation Measures
Noise emissions from concrete batching Concrete batching plants are where ingredients such as sand, cement, water and aggregate are mixed to form concrete. This consists of various activities such as storage of raw materials in bunkers and stockpiles, transfer of raw materials by front end loaders, conveyors, hoppers and loading of materials to the trucks.		**Source Mitigation** ▶ Locate noisy equipment away from potential sources of conflict ▶ Locate noisy equipment behind sound barriers or sound absorbers – for example, gravel stockpiles or constructed barriers ▶ Install silencing devices to all pressure operated equipment

7.8 Soil, Topography and Land Stability

The impacts associated with soil topography and land stability are discussed in this section. The detailed description of the geology, land use and soil quality is provided in **Section 4.1.4** (*Geology, Soils and Seismic Hazards*). The impacts are summarized below:

- Impact 15: Contamination of soil as a result of accidental release of solvents, oils and lubricants can degrades soil fertility and agricultural productivity.
- Impact 16: Land clearing, excavation, tunnel boring and other construction activities may loosen the top soil in the Project area resulting in loss of soil, accelerated soil erosion, and landslides, especially in the wet season.
- Impact 17: Increased erosion and sediment load entering river as a consequence of failure of spoil dumping sites.

7.8.1 Soil Quality

Impact 15: Contamination of soil as a result of accidental release of solvents, oils and lubricants can degrades soil fertility and agricultural productivity.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Medium	Intermediate	Medium	Possible	Medium	-	High
Mitigation measures: 1. Prepare a Spill Prevention and Response Plan and induct to the staff for any incident of spill. 2. Appropriately mark fuel tanks by content and store in dyked areas with an extra 10% of the storage capacity of the fuel tank. The area will be lined with an impervious base. 3. Install grease traps on the site, wherever needed, to prevent flow of oily water. 4. Spill cleaning kit (shovels, plastic bags and absorbent materials) will be available near fuel and oil storage areas. 5. Carry cleanup kits in all fuel trucks. 6. Fueling should only take place over impermeable surfaces, other hazmats should be stored and used over impermeable surfaces. 7. The bottom of any soak pit or septic tank shall be at least 10 m above the groundwater table. The distance can be reduced, based on the soil properties, if it is established that distance will not result in contamination of groundwater.								
Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Medium	Intermediate	Low	Unlikely	Low	-	High

Oil spills during construction process will result in contamination of soil as well as groundwater. Due to hilly nature of the Project area, soil contamination on the construction site has the potential to travel to surrounding areas and contaminate the soil. Such spills can occur during construction process when tankers will access the area for refueling of excavation and other construction machinery.

Improper handling of oils, lubricants and other such solvents may result during machinery refueling. Storage in areas with no lining and low quality storage containers poses another threat of soil contamination. The impact will be minimized by adopting mitigation measures and extra caution during refueling and machinery maintenance at on site workshops.

7.8.2 Soil Erosion

Impact 16: Land clearing, excavation, tunnel boring and other construction activities may loosen the top soil in the Project area resulting in loss of soil and possible acceleration of soil erosion and land sliding, especially in the wet season.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Short Term	Small	Low	Definite	Low	-	High
Mitigation measures: 1. Develop an Erosion Control Plan. 2. Limit vegetation loss to demarcated construction area. 3. Cover areas such as muck disposal area, batching plant, labor camp and quarry sites after the closure shall with grass and shrubs. 4. Adopt slope stabilization measures such as adequate vertical and horizontal drains, drainage along roadsides, cross drainage and retaining walls. 5. Monitor slope movements around excavation work areas. 6. Salvage, store, and reuse all topsoil at all construction sites. 7. The height of the stockpile will be minimized to the extent possible by increasing the size of the land for the stockpile. 8. Topsoil will be carefully stripped to ensure that it is not mixed with subsoil. 9. The stockpiles will be revegetated to minimize loss of soil quality, minimizing weed infestation, maintaining soil organic matter levels, maintaining soil structure and microbial activity. 10. Topsoil stockpiles will be clearly signposted for easy identification and to avoid any inadvertent losses. 11. The establishment of declared plants on the stockpiles will also be monitored and control programs implemented as required. 12. The topsoil will be treated with temporary soil stabilization and erosion control measures. 13. During removal of topsoil stockpile for restoration of project affected areas, it is preferred that the soil is removed in layers (less than 0.5 m thick) under a gradual process. 14. The top layer will be mixed with the remainder of the stockpile to ensure that living organisms are distributed throughout the topsoil material at the time of final placement. The use of micro-organism inoculates may be necessary to re-establish micro-organisms in topsoil material. 15. Select local species for plantation to restore the biodiversity of the area in consultation with Forest Department after completion of respective activities.								
Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

The top cover of soil on the slopes around the Project facilities is mainly sand and fine clay. Any excavation work during the construction activities, whether permanent or temporary, would lead to loss of soil. Excavated material collected during boring of the diversion tunnels will be used for the construction of cofferdam to divert water. Furthermore, construction will require excavation for the powerhouse, tunnels and other project facilities. These activities will result in loss of soil. Erosion of soil can also occur from removal of vegetation cover, runoff from unprotected excavated areas, muck disposal sites and quarry sites. Excavations on slopes would also decrease its stability. Given the topography of the area, unprotected excavations on sloping grounds may lead to landslides, especially during the rainy season. Major landslides will disturb the slopes of the area and may also alter the bed of Kunhar River.

It is expected that moderate level of risk is associated with the type of construction activities that are likely to take place. The current land formation is fairly stable sandstone therefore no major risk is associated with regards to slope stability. The duration of the risk is expected to be short and the spatial scale of risk is small because the excavation effects are not likely to affect areas further than 200 meters from the Project facilities. The probability of this risk is estimated to be definite due to extensive excavation activities expected for the dam, powerhouse and most importantly the tunnels.

Topsoil from the Project site will be stockpiled for use during the restoration process. As the topsoil will be stockpile for use during the restoration process, it is important that it must retain its advantageous chemical, physical, and biological properties. Generally, the soil is adversely affected during storage if the depth of the stockpile is more than 3 m. Anaerobic conditions are created in the deeper depths, which results in decrease in microbial activity in the stockpiled soil and consequently adversely affect the biological properties. The mitigation measures proposed for ensure the regeneration of biological activity in the topsoil are provided and will be followed.

7.8.3 Spoil Disposal Areas

Impact 17: Failure of spoil dumping sites resulting in increased erosion and sediment load entering river.								
Applicable Project Phase				*Construction and Operation*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Long Term	Intermediate	High	Possible	High	-	High

Mitigation measures:

1. Dumping sites should have a flood prevention design for a 20-year flood.
2. The water drainage works consist of the masonry structures, and shall be designed to drain a 5-year rainfall every 10 minutes.
3. Where constructed tailing hold structure will be of galvanized woven wire mesh gabions
4. All the five dumping sites will undergo vegetation restoration works comprising of surface leveling, covering and forest/grass planting or agricultural land rehabilitation
5. Develop a Spoil Disposal Plant that includes the following measures:

- Slope movements will be monitored around excavation work areas.
- Restore to the maximum extent possible the hydrological regime and reinstate natural drainage of the land (including provisions to maintain the water balance of the site and protect from flooding where appropriate)
- Reinstate topsoil (in case it was stripped before construction activities)
- Revegetate sites with suitable native plant species
- Drain spoil piles to prevent the concentration of flow and to prevent rill and gully erosion
- Separate organic material (e.g., roots, stumps) from the dirt fill and store separately. Place this material in long-term, upland storage sites, as it cannot be used for fill.
- Store “clean” material in a short-term disposal site (stockpile) if it will likely be re-used for fill.
- Where feasible, recycle asphalt material in embankments and shoulder backing. Place these materials where they will not enter the stream system. Asphalt that is 5 years old is considered “inert” (that is, all oils washed off).
- Do not add excess unusable material to permanently closed sites.

▶ Spread material not to be re-used in compacted layers, generally conforming to the local topography. Design the final disposal site reclamation topography to minimize the discharge of concentrated surface water and sediment off the site and into nearby watercourses. ▶ Cover the compacted surfaces with a 6-inch layer of organic or fine-grained soil, if feasible. ▶ After placement of the soil layer, track walk the slopes perpendicular to the contour to stabilize the soil until vegetation is established. Track walking creates indentations that trap seed and decrease erosion of the reclaimed surfaces. ▶ Revegetate the disposal site with a mix of native plant species. Cover the seeded and planted areas with straw compost, mulched with straw at a rate of 1 to 1 ½ tons per acre. Apply jute netting or similar erosion control fabric on slopes greater than 1:2 if site is erosive. ▶ Locate stockpiles away from drainage lines, at least 10 meters away from natural waterways and where they will be least susceptible to wind erosion. ▶ Ensure that stockpiles and batters are designed with slopes no greater than 1:2 (vertical\ horizontal). ▶ Besides these measures, erosion can also be minimized by regular rehabilitation of areas not in use for Project activities during construction. These will include regrading and immediate revegetation (using fast-growing species and different functional groups of plants for keeping soil in place) of slopes to minimize erosion. ▶ Install erosion and sediment control measures, if possible before construction commences. Identify drainage lines and install control measures to handle predicted storm water and sediment loads generated in the mini-catchment. ▶ Establish an adequate inspection, maintenance and cleaning program for sediment run-off control structures. Ensure that contingency plans are in place for unusual storm events. ▶ Continually assess the effectiveness of sediment control measures and make necessary improvements. ▶ Keep temporary disposal sites out of wetlands, adjacent riparian corridors, and ordinary high-water areas as well as high risk zones, such as 100-year floodplain and unstable slopes. ▶ Anticipate sufficient storage area with no risk for sediment delivery for piles that may slump. Stress cracks indicate that the pile is at risk of slumping. ▶ Cover the trucks that will be used for the transportation of spoil material to disposal sites.

Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Moderate	Medium Term	Intermediate	Medium	Unlikely	Low	-	High

In the event of failure of a waste dumping site, there can be a danger to downstream communities and sediment can be released into the river impacting the ecology. Sites not revegetated or rehabilitated can be a constant source of fugitive dust emissions due to wind erosion from the surface. Critical mitigation measures listed above ensure spoil units are stable for the coming decades and centuries.

Comparison of Spoil Disposal Zones

Spoil disposal zones under consideration are shown in **Section 3.5**. A comparison of these zones was done as part of the EIA based on the land use within each zone. **Exhibit 7.27** shows the different land uses including habitat types, in each zone.

Exhibit 7.27: Land Use in Spoil Disposal Zones

Disposal Zones	*Area (m^2)*	*Agriculture Land*	*Pine Forest*	*River*	*Settlement*	*Barren Land*
1	60,859	40%	19%	0%	17%	24%
2	37,316	0%	79%	0%	0%	21%

Disposal Zones	*Area (m^2)*	*Agriculture Land*	*Pine Forest*	*River*	*Settlement*	*Barren Land*
3	30,376	0%	35%	12%	0%	52%
4	220,083	41%	4%	15%	0%	39%
5	48,434	25%	0%	10%	2%	63%

The following impacts can be expected:

- The three zones 1, 4 and 5 will have significant socioeconomic impacts as compared to other zones. This is because of the presence of large percentage of settlements associated with physical displacement and agricultural land associated with economic displacement i.e. livelihood. Of the three; Zone 1 will have the highest socioeconomic impact (settlements: 17% and agricultural land: 40%) followed by Zone 4 and Zone 5.
- The two zones 2 and 3 will have significant impact on the ecology as compared to other zones. This is because of the presence of large percentage of forests associated with terrestrial ecology. Of the two; Zone 2 will have the highest impact on ecology as 79% of it is used by forests.
- The three zones 3, 4 and 5 will pose the greatest impact to river ecology as parts of the area in these is stretches of river where spoil can contaminate the water quality, if proper mitigation measures are not taken.

Based on the above discussion, spoil disposal in Zone 3 will have the least impact followed by Zone 2 as land in these zones is not used by the community for settlements or agriculture. However, Zone 2 has 79% Pine Forest and is therefore, important for terrestrial biodiversity.

7.9 Aesthetics

Visual impacts are the effects on people of the changes in available views through intrusion or obstruction and whether important opportunities to enjoy views may be improved or reduced. Visual impact to nearby receptors of the Project include:

- Impact 18: Deterioration of aesthetics and visual amenity of nearby receptors due to construction activities, including vehicular movement on roads, may cause disturbance in aesthetics for tourists, businesses and nearby communities.
- Impact 19: Deterioration of aesthetics and visual amenity of nearby receptors due to low flow in the river may affect the scenic value of the area.
- Impact 20: Permanent change in aesthetics of the area due to the reservoir, dam and powerhouse.

Section 4.1.5 (*Visual Character*) describes the existing visual (aesthetic) character of the site. The area largely consists of mountainous valleys with large trees and bushes of heights greater than 2 m. The mountainous landscape and deep gorges greatly restricts visibility to a maximum of 0.5 to 1.5 km at receptor locations. The area is a popular tourist location (see **Section 4.3.4** *River Dependent Socioeconomic Activities*) due to its aesthetic beauty due to the mountains, forests, rivers and streams.

7.9.1 Degradation of Aesthetic Value of the Area due to Construction Activities

Impact 18: Deterioration of aesthetics and visual amenity of nearby receptors due to construction activities, including vehicular movement on roads, may cause disturbance in aesthetics for tourists, businesses and nearby communities.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High
Mitigation measures: 1. Minimize disturbance to, or movement of, soil and vegetation. 2. Back fill to original levels. 3. Reshaping to match in with surrounding topography. 4. Reinstate vegetation around construction sites.								
Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

The construction phase visual impact will be local and temporary. The construction will take place at the powerhouse site and dam site. The activities during construction that will affect the aesthetics of the area include excavation, stacking of material onto stockpiles and dumping at the waste disposal areas. Borrow pits and quarry areas are to be excavated, useful material will be stacked to stockpiles whereas waste and spoils will be dumped to waste disposal areas.

Quarries and borrow areas may leave a permanent scar on the hillsides as once they are opened, will likely to continue to stay in use and as a result change the surrounding landscape. Access roads, tunnel faces[13] and adits will necessitate the clearing of vegetation for their construction. Some of the access roads to construction sites will be entirely new and permanent and some will be reconstructed to accommodate the additional construction traffic load which will also alter the landscape of the area. The tunnel faces and adits during the construction phase will be obvious cuts into the mountainsides, many of which will be likely to be visible to residents, especially those on opposing sides of the valleys. For all of these features during the construction phase there will be an impact on vegetation, as additional areas will be cleared around the feature to provide a working area. These activities will result in the creation of artificial and unnatural features in the landscape. Localized light pollution will also be an issue during construction.

[13] Working face of tunnels

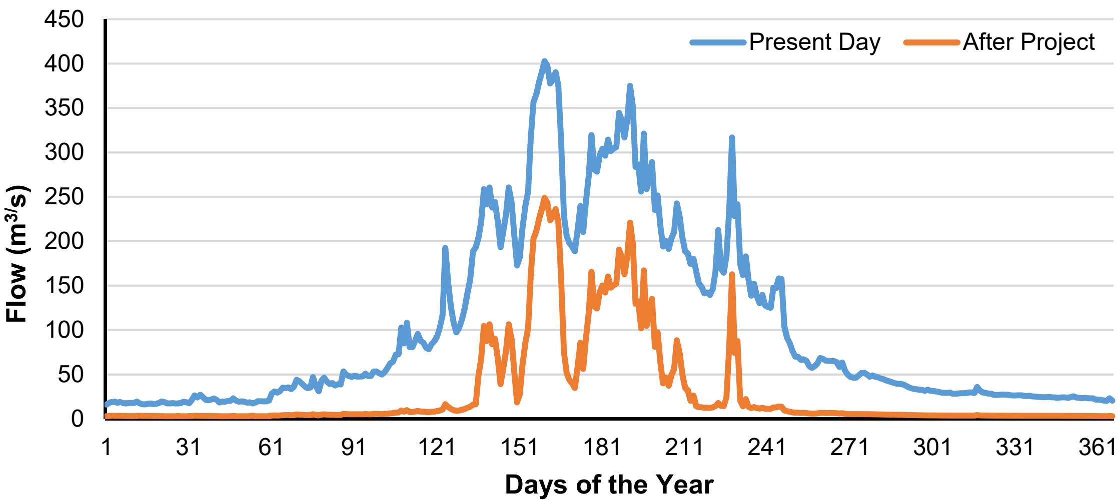
7.9.2 Degradation of Aesthetic Value of the Area due to Low Flow Section

Impact 19: Deterioration of aesthetics and visual amenity of nearby receptors due to low flow in the river may affect the scenic value of the area.								
Applicable Project Phase	*Operation*							
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Medium	Small	Low	Possible	Low	-	High
Mitigation measures: 1. Ensure environmental flow release.								
Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Medium	Small	Low	Possible	Low	-	High

The section from the dam to the tailrace will be impacted by water abstraction from the diversion tunnels. The impact will be most visible during the dry season in the winter as only environmental flow will be released downstream of the dam. In the summer overflows from the dam will be released from the spillway. However, even during this season abstraction will be at maximum.

Exhibit 7.28 shows the level of drop in the low flow section[14] for 1960. The minimum 5 day flow during the dry season is presently 17.6 m^3/s[15] which will reduce to 2.9 m^3/s after the Project begins operation. The mean flood peak in the low flow section is 330 m^3/s which will reduce to 174 m^3/s after the Project.

Exhibit 7.28: Comparison of Baseline and Post Project Hydrograph in the Low Flow Section, 1960

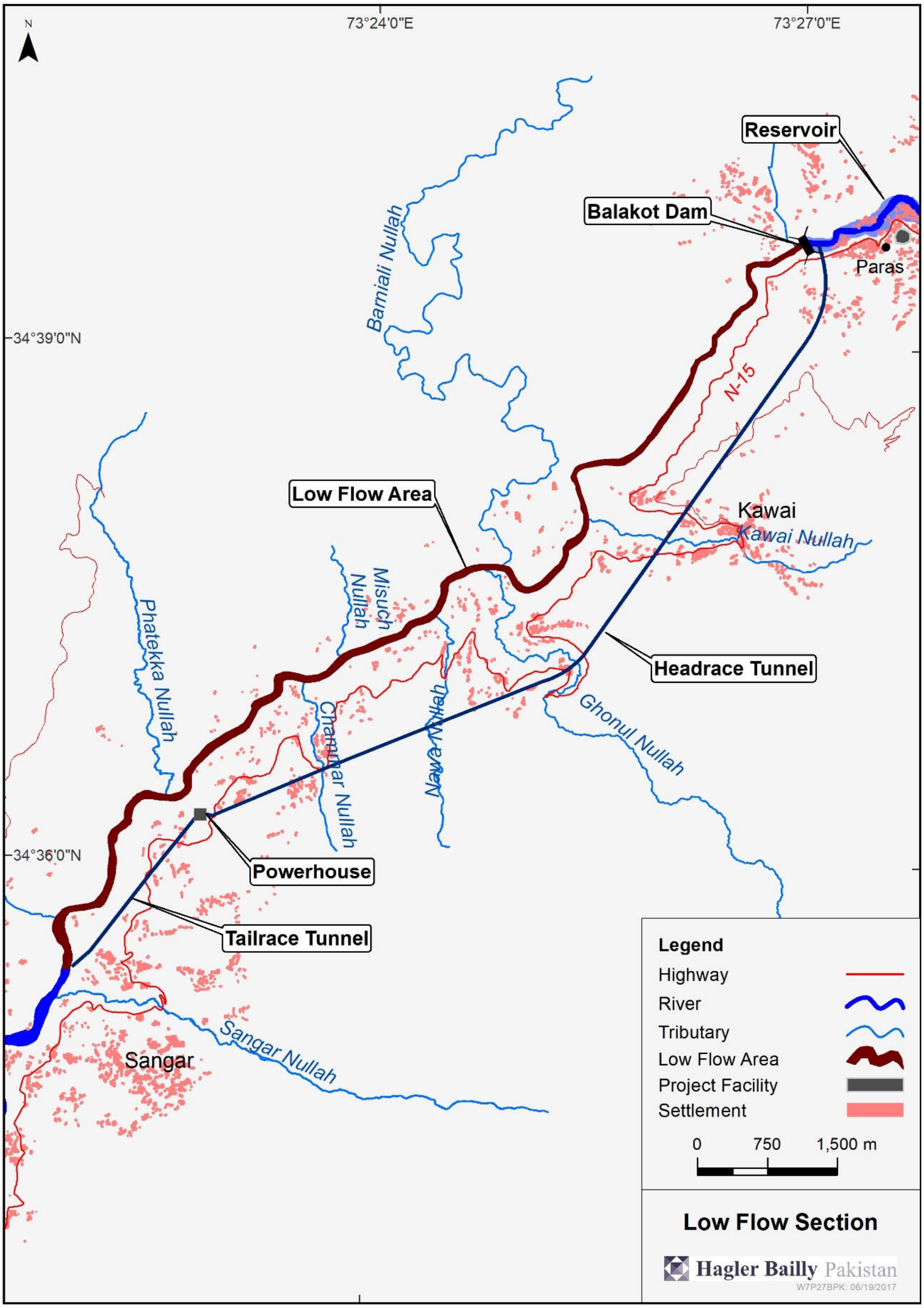


The extent of the low flow section is shown in **Exhibit 7.29.** This area has low occupancy and limited use in tourism due to poor access. Therefore, the aesthetic impact due to diversion is expected to be limited.

[14] With an EFlow of 1.5 m^3/s

[15] Median value over the 51 year hydrological period.

Exhibit 7.29: Low Flow Section



7.9.3 Permanent Change in Visual Character due to Project Facilities

Impact 20: Permanent impact in aesthetics due to proposed developments.								
Applicable Project Phase				*Operation*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Medium	Small	Low	Possible	Low	-	High
Mitigation measures: 1. Develop and implement a Site Rehabilitation and Landscaping Plan. 2. Use colors that better integrate with the landscape. 3. Disguise elements with vegetation where possible. 4. Retain as much natural vegetation as possible.								
Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Medium	Small	Low	Possible	Low	-	High

There will be a long term visual impact due to the construction of the dam and powerhouse, and the formation of the reservoir.

The impact due to the reservoir is subjective as it may be argued that a reservoir is visually appealing and the land use is compatible with the surroundings. Natural lakes in the area are popular tourist attractions.

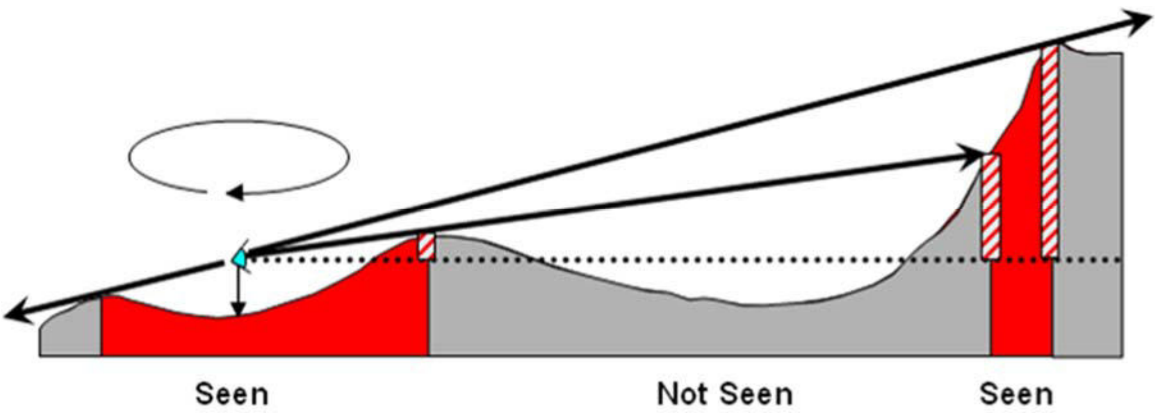
The penstock and powerhouse will be underground limiting its visual impact.

Viewshed of Proposed Project

A viewshed is the geographical area that is visible from a location. It includes all surrounding points that are in line-of-sight with that location. The areas from where the reservoir and powerhouse can be viewed was calculated through Viewshed Analysis Tool (VAT) function of ArcGIS.

The VAT uses the elevation value of each cell of the DEM to determine visibility to or from a particular cell. The VAT calculates all the points that are in line of sight (shown in **Exhibit 7.30**) and excludes all that are blocked by presence of features such as buildings, trees, and hedgerows.

Exhibit 7.30: Graphical Depiction of a Viewshed



For the analysis, a zone of visual influence was taken as 50 meters around the reservoir. This is defined as the extent of potential visibility to or from a specific area or feature. The effect of the canopy layer[16] was not incorporated, therefore, the actual viewsheds will be more limited than those presented.

The villages within 500 m of the reservoir and within the viewshed include: Balseri, Garan, Hariwala Nakka, Rah Sachcha, Shagin, Tangsan, Paras, Chuntian, Dhab, Rahter, Nihan and Tokkol.

The villages within the viewshed but further than 500 m of the reservoir include: Budhawa, Bura, Lohgi, Nakka, Shangrian, Jhabra, Bela, Uri, Chapra, Kashe and Rai Ponian. Of these, the villages Shangrian and Uri are the least Project site visible areas.

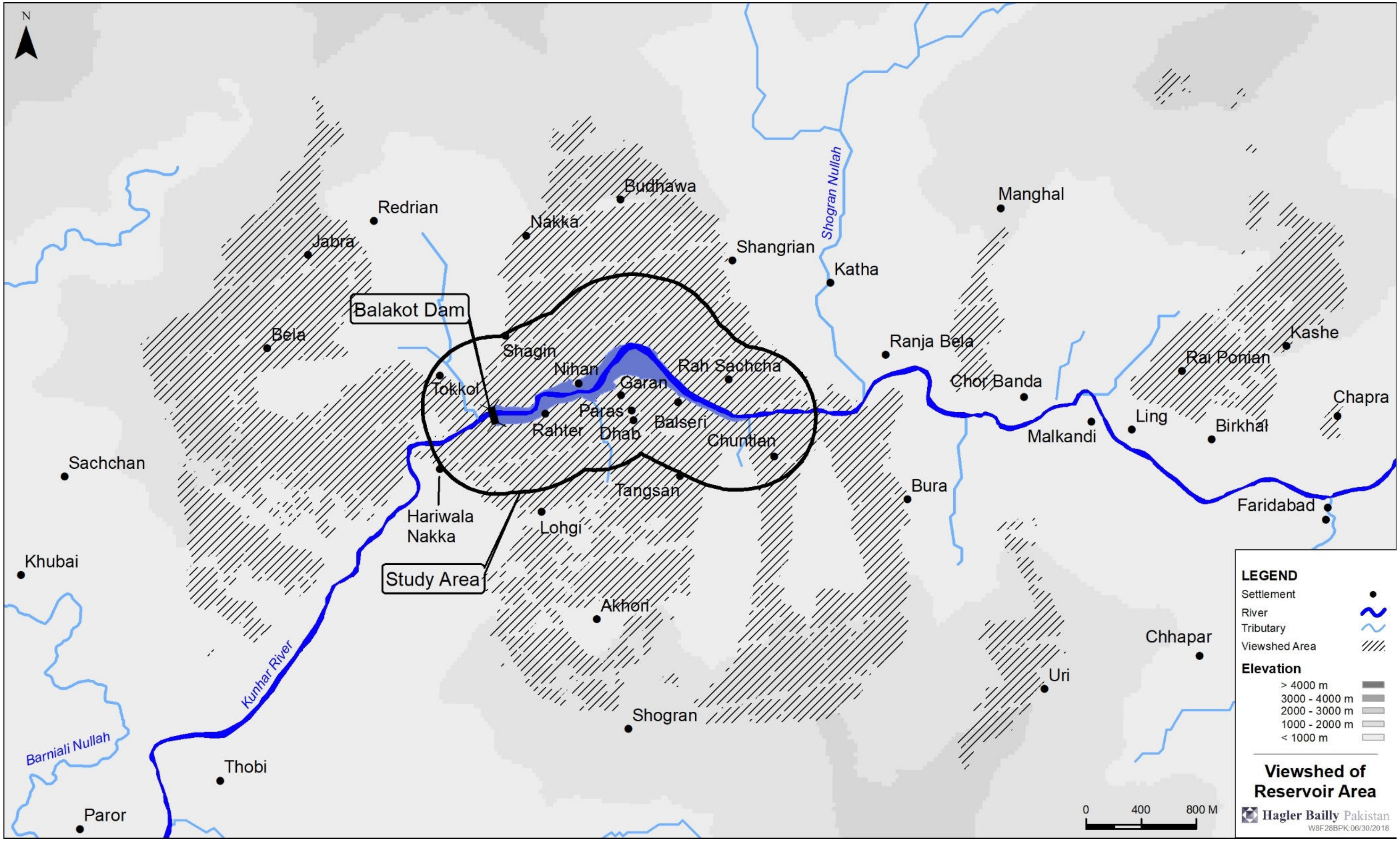
A summary of the land use and tourism potential within the 500 m buffer and viewshed of the reservoir and dam is presented in **Exhibit 7.31**. The viewshed of the reservoir and dam is shown in **Exhibit 7.32**.

Exhibit 7.31: Details of the Reservoir and Powerhouse

Parameter	*Forest*	*Agriculture*	*Settlement*	*River*
Land use distribution	74%	14%	8%	4%
Relative occupancy	Low	Medium	High	Nil
Tourism use and potential	Medium	Nil	Nil	Low

[16] Canopy layer is the uppermost layer of the forest.

Exhibit 7.32: Viewshed of the Reservoir and Dam



7.10 Traffic and Roads

There are three categories of roads that will be used to transport material and equipment to the Project facilities. These are as follows:

7.10.1 Project External Roads

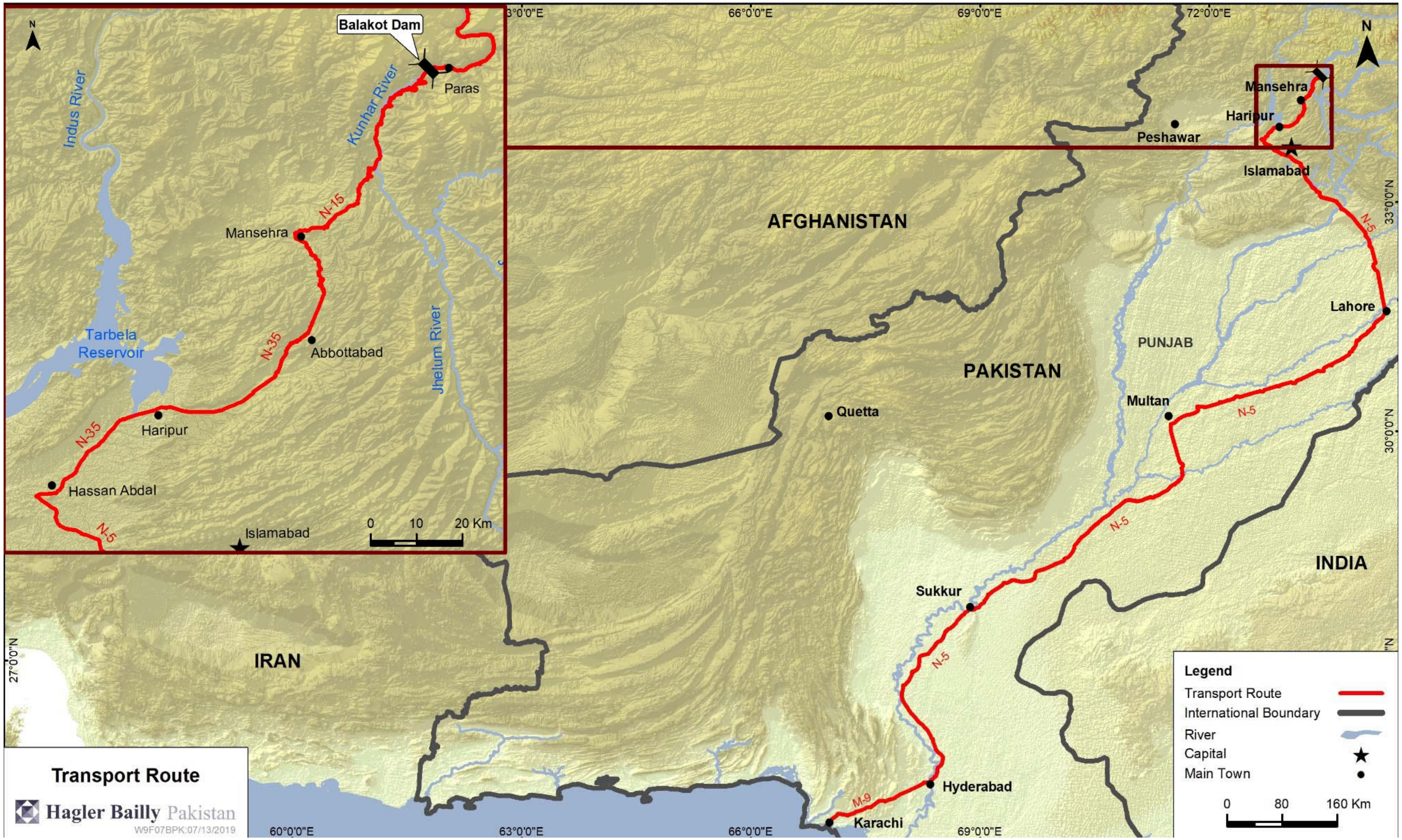
The roads connecting the major cities (Karachi and Islamabad) to the Project site and transporting materials up to the Balakot are called as Project access roads. The construction materials (cement and steel) as required for the construction of Project include:

- **Cement:** It will be required for carrying out construction of the Project structures of the order of million cubic meters. The factories that produces ordinary Portland cement, sulphate resistant cement and low alkali cement and close to the Project site are Maple Leaf Cement at Mianwali, Bestway Cement at Hattar, DG Cement at Kallar Kahar and Lafarge Cement at Kallar Kahar. Of these, the cement factory nearest to the Project is located in Hattar, District Sawabi. White cement is also produced by Anwaar Zaib Cement Factory, located near Karachi and Kohat cement factory located near Kohat. Slag cement is also required by the Project and Pakistan Steel Mills, located near Karachi is the only significant source of producing slag in Pakistan. There are other factories located around Karachi that produces Portland blast-furnace slag cement mainly in accordance with BS 146 include Dadabhoy Cement, Essa Cement, Attock Cement, Zeal Pak Cement, Pakland Cement, Javedan Cement, Thatta Cement, and Star Slag Cement Industry.
- **Steel:** Reinforced steel is required of the order of million tons. A number of re-rolling mills in the country produce reinforcing steel in the form of both plain and deformed bars of tensile strength ranging from 40 kilopound per square inch (ksi) to 60 ksi. There is no factory producing re-rolling reinforcing steel bars in the near vicinity of the Project site. The nearest location from where the reinforcing steel bars of the desired specification are available is Islamabad. Both hot and cold rolled reinforcing steel bars are available from Islamabad in desired quantity. Major source of steel billets for the re-rolling mills is Pakistan Steel Mills located near Karachi. Steel sheets of various thicknesses are also produced by the Pakistan Steel Mills at Karachi, which can be used to fabricate steel formwork. These can also be used for fabricating steel liners and other miscellaneous items required in connection with the construction activities. Alternatively, steel items can be imported from abroad. Most likely source of supply of steel could be neighboring countries such as China and Iran.

The materials and equipment purchased from China will be shipped to Karachi by sea and from Karachi transported by Project access roads to the Project area.

The transport route is shown in **Exhibit 7.33**. The alternative routes are discussed in **Section 5** *(Analysis of Alternatives).*

Exhibit 7.33: Transport Route



Construction Traffic Volume

The traffic due to the Project will be generated during the construction phase of the Project. The construction traffic volume, on the site external roads, will be due to:

- External supplies of construction material and equipment to the powerhouse and dam sited through trucks.
- Movement of construction material from one construction facility to another through trucks.
- Movement of staff among powerhouse and dam site through buses.

The construction generated traffic (**Exhibit 7.34**) will mainly consist of heavy traffic and minor contribution of light traffic due to the Project which was assumed to be 10% of heavy traffic.

Exhibit 7.34: Construction Traffic Volume

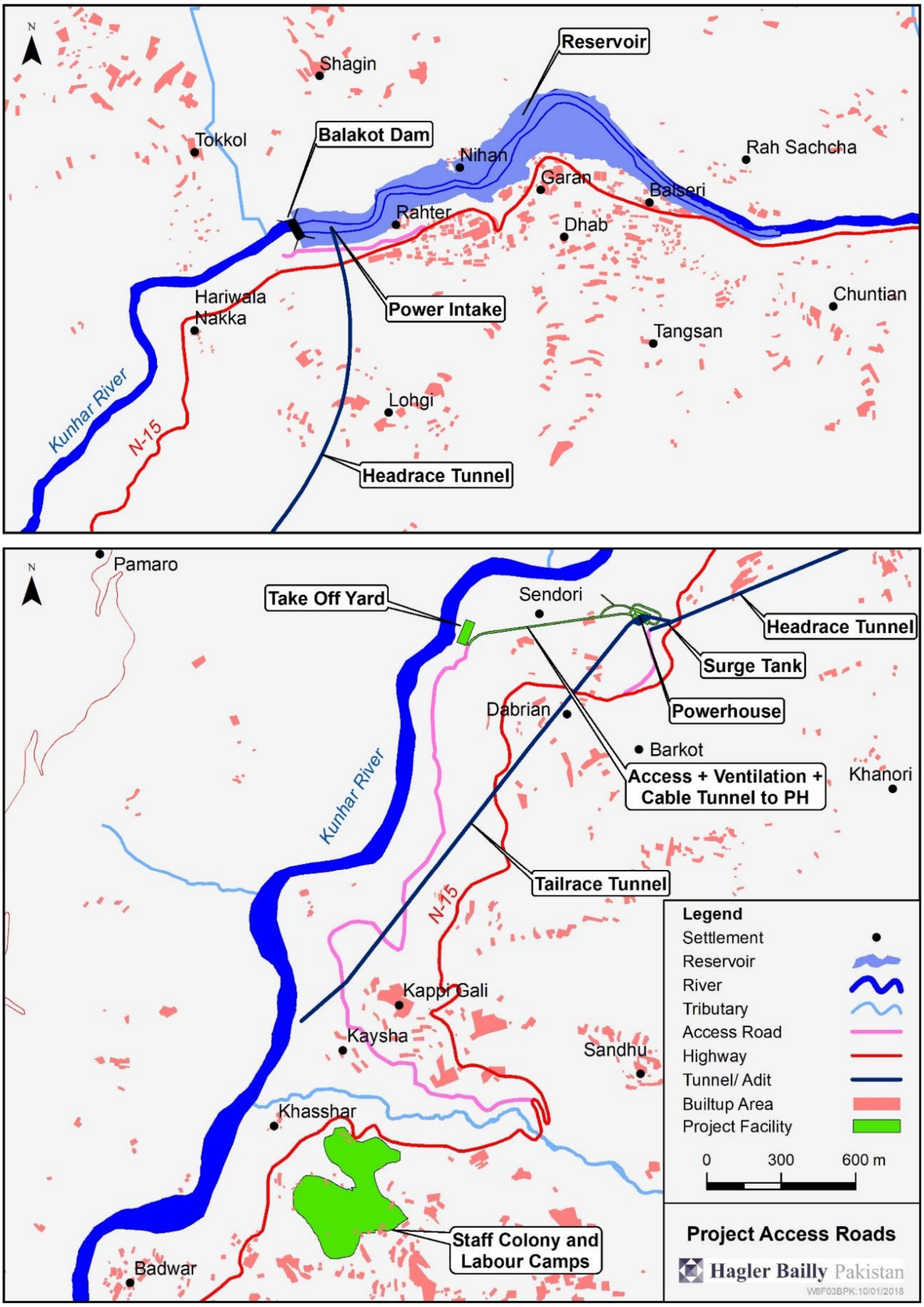
Item	*Amount (m^3)*	*Density (ton/m^3)*	*Total (million tons)*
Quarried material	250,000	2.4	0.6
Spoil material	1,100,000	1.33	1.5
Total			**2.1**

Total external traffic is 2.1 million tons as described above. This will be transported via dump trucks with a capacity of 15-20 tons a 6.5-year period of Project completion. As a worst-case scenario, the capacity of one truck is assumed to be 15 tons and 310 active days are considered. On average, there will be 70 truck trips per day. As a worst case-scenario, 40% peaking factor was used that will result in 98 truck trips per day.

7.10.2 Project Access Roads

The roads connecting the Project access roads to the Project facilities. There are three access roads planned at powerhouse site and one at dam site as shown in **Exhibit 7.35**. These Project access roads made for each specific purpose and originates from N-15. The traffic volume on these roads will be dependent on the total material required and disposed to destined sites and capacity of trucks.

Exhibit 7.35: Site Access Roads



7.10.3 Impact Analysis

The major risks of traffic on existing and proposed roads due to the Project are:

- Impact 21: Improved accessibility due to construction of Project access roads.
- Impact 22: Increase in congestion, due to increased traffic volume will cause delays.
- Impact 23: Increase in traffic volume will deteriorate the air quality.
- Impact 24: Increased risk to community safety due to increased traffic volume during the construction phase near communities.
- Impact 25: Degradation of the pavement due to use by heavy construction traffic.

Accessibility

<table>
<tr><td colspan="10">Impact 21: Improved accessibility due to construction of Project access roads.</td></tr>
<tr><td colspan="5">Applicable Project Phase</td><td colspan="5">Construction</td></tr>
<tr><td rowspan="2">Initial Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Minor</td><td>Short Term</td><td>Small</td><td>Low</td><td>Possible</td><td>Low</td><td>+</td><td>High</td></tr>
<tr><td colspan="10">Mitigation measures:
1. Consult communities during final design and location of site access roads.
2. Allow communities use of new site access roads.</td></tr>
<tr><td rowspan="2">Residual Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Minor</td><td>Short Term</td><td>Small</td><td>Low</td><td>Possible</td><td>Low</td><td>+</td><td>High</td></tr>
</table>

Land which is adjacent to roads has greater value due to the accessibility. Mountainous terrain in the area is difficult to traverse and construction of new site access roads will improve connectivity in the area.

Congestion

<table>
<tr><td colspan="10">Impact 22: Increase in congestion, due to increased traffic volume will cause delays.</td></tr>
<tr><td colspan="5">Applicable Project Phase</td><td colspan="5">Construction</td></tr>
<tr><td rowspan="2">Initial Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Minor</td><td>Short Term</td><td>Small</td><td>Low</td><td>Possible</td><td>Low</td><td>-</td><td>High</td></tr>
<tr><td colspan="10">Mitigation measures:
1. Develop and implement a Traffic Management Plan.
2. Make roundabouts for the congestion points.
3. Retain as much natural vegetation as possible to reduce the impact of smoke due to vehicles.
4. The vehicles going on the spoil routes and passing through the communities must be completely covered to avoid dust emissions.
5. Strictly implement speed limits and defensive driving policies.</td></tr>
<tr><td rowspan="2">Residual Impact Rating</td><td>Magnitude</td><td>Duration</td><td>Scale</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>+/-</td><td>Confidence</td></tr>
<tr><td>Minor</td><td>Short Term</td><td>Small</td><td>Low</td><td>Possible</td><td>Low</td><td>-</td><td>High</td></tr>
</table>

Traffic congestion is a condition that results as road use increases and is characterized by slower speeds, longer trip times, and increased vehicular queueing. There will be a significant congestion problem at Kappi Gali and Dabrian as shown in **Exhibit 7.35**. This is due to the traffic exchange between N-15 and Project access roads. There will be large traffic volume resulting in more vehicles, more time on the road, more idling and more smoke emissions.

Air Pollution

Impact 23: Increase in traffic volume will deteriorate the air quality.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High
Mitigation measures: 1. Keep speeds slow (30 km/hr) on unsealed roads. 2. Sprinkle water on unsealed roads that are used for construction traffic. 3. Retain as much natural vegetation as possible to reduce the impact of smoke due to vehicles. 4. The vehicles going on the spoil routes and passing through the communities must be completely covered to avoid dust emissions. 5. Strictly implement speed limits and defensive driving policies. 6. Promptly and properly repair and maintain roads that are subject to damage by Project activities.								
Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

The increase in traffic volume will increase environmental pollution (more noise, more emissions and more fuel consumption). It will deteriorate ambient air quality around villages and will result in high noise. As the vehicle will be in queue it continues to result in exhaust emissions and continuous engine generated noise.

There are no settlements located near access road at dam site however, the settlements Dabrian and Kappi Gali will be affected by air and noise pollution generated by Project access roads as shown in **Exhibit 7.35**.

Community Safety

Impact 24: Increased risk to community safety due to increased traffic volume during the construction phase near communities.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

Mitigation measures:

1. Develop and implement a Traffic Management Plan.
2. Identify suitable times to transport equipment.
3. Road safety awareness education will also be included during community visits or information sessions, so that communities can be familiarized with common road signs and the types of vehicles and equipment that will be moving through the area.
4. Keep speeds slow (30 km/hr) where there is traffic exchange between roads.
5. Make roundabouts for the congestion points.
6. Designate traffic wardens at roads on the transport route to manage traffic during school hours.
7. Construction traffic will not travel during school starting and ending hours on designated road segments in front of schools on the transport route.
8. Strictly implement speed limits and defensive driving policies.
9. Maintain vehicles especially brakes.

Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

As traffic volume increases the traffic flow becomes unstable and any minor disturbance can lead to major damage. The traffic generated by the Project may worsen the condition of local road surfaces, thereby decreasing road safety for communities. Increased traffic could increase road accidents and injuries, as drivers may be unfamiliar with sharing the roads with trucks, and truck drivers may have difficulty seeing at night. Increase number of vehicles on the road increases the chances of accidents due to any oil leakage going to the Project site. This potential impact would be particularly prevalent during construction, where a higher number of equipment and materials delivery vehicles would be traversing the Project area.

On N-15, congestion can be a problem for locals residing in the settlements; Dabrian and Kappi Gali.

Pavement Condition

Impact 25: Degradation of the pavement due to use by heavy construction traffic.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

Mitigation measures:

Promptly and properly repair and maintain roads that are subject to damage by Project activities.

Residual Impact Rating	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
	Minor	Short Term	Small	Low	Possible	Low	-	High

7.11 Livelihood and Well-being

During the consultation for the Project the community expressed a need for provision of transparent and merit based employment to the locals and investment in the community infrastructure. Sediment mining was identified as one of the means of livelihood in the area and there was a concern that the Project will result in loss of this resource.

A summary of the possible impacts to the livelihood and well-being of the surrounding communities is as follows:

- Impact 26: Direct, indirect and induced employment at the local levels, resulting in increased prosperity and wellbeing due to higher and stable incomes of people.
- Impact 27: Increase in the stock of skilled human capital due to transfer of knowledge and skill under the Project resulting in enhanced productivity of the local labor.
- Impact 28: Increase in recreational and subsistence fishing due to increase in catch of fish following creation of favorable habitats for the fish in the Kunhar River.
- Impact 29: Loss of income from sediment mining due to change in pattern of sediment deposition following construction of the dam.
- Impact 30: Loss of assets and livelihood as a result of land acquired for the Project.

7.11.1 Employment

Impact 26: Direct, indirect and induced employment at the local levels, resulting in increased prosperity and wellbeing due to higher and stable incomes of people.								
Applicable Project Phase			*Construction and Operation*					
Initial Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Minor	Long term	Extensive	Medium	Possible	Medium	+	High
Enhancement measures: 1. Ensure preferential recruitment of local candidates provided they have the required skills and qualifications. 2. Include an assessment of the contractor’s demonstrated commitment to domestic and local procurement and local hiring in the tender evaluation process. 3. Coordinate recruitment efforts related to non-skilled labor, including for non-skilled labor positions required by contractors. **Good practice measures:** 4. Determine what is considered to be ‘fair and transparent’ in recruitment and in distribution of jobs between different community groups, in consultation with local communities and their leaders.								
Enhanced Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Moderate	Long term	Extensive	High	Definite	High	+	Medium

In Mansehra District, education levels of the population are generally higher as demonstrated by the literacy level of more than 71% (**Section 4.3.3**, *Socioeconomic Conditions in the Study Area*), compared to KP average of 50% and Pakistan national average of 59%.[17] The skill set of the local community will be developed through vocational institutions and training centers in the Project Area. Presently, around 5% of the local community is dependent on sediment mining and on fishing. Other sources of income include businesses, daily wage labor and employments. During community consultations, some of the women expressed an interest in gaining access to office-based employment opportunities in the project jobs.

The incomes of people employed by the Project are likely to lead to improved nutritional status, better housing, access to education and improvement in overall well-being of their families. Poverty cycles in poor families could be broken if children in the families become better educated and have more livelihood options than their parents had. The Project will provide employment to several persons during the construction and operation phases. The Project will directly and through indirect and induced mechanisms contribute to alleviating poverty and vulnerability in KP, and to prosperity and well-being of the people employed by the Project.

7.11.2 Training and Skill Development

Impact 27: Increase in the stock of skilled human capital due to transfer of knowledge and skill under the Project resulting in enhanced productivity of the local labor.								
Applicable Project Phase				*Construction and Operation*				
Initial Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Minor	Long term	Intermediate	Medium	Possible	Medium	+	Low

Enhancement measures:

1. Support a 'vocational training program' to assist local people to qualify for semi-skilled positions focusing on issues such as procurement, involvement of vulnerable groups in Project opportunities and continual professional development of staff.

Good practice measures:

2. Assist local people having practical skills but lacking qualifications to obtain their certificates and thus increase their employment opportunities.
3. Support initiatives promoting a culture of learning in local communities.
4. Plan and implement training program for vulnerable groups to encourage their participation in economic opportunities created by the Project.
5. Assist employees and local communities to improve basic personal financial life skills through training and awareness campaigns, respectively.
6. Consider further training programs to prepare retrenched workers to seek employment in sectors not related to dam construction.

Residual Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Moderate	Long term	Extensive	High	Possible	High	+	Low

The Project will result in the training and skill development of local and domestic labor, especially during the construction phase of the Project. Financial and technical investment by foreign companies is generally seen as a positive opportunity for

[17] http://www.sciencedirect.com/science/article/pii/S2405883116300247 cited on June 2017

developing countries as their technology is usually more advanced compared to locally available technology.

The knowledge and skills acquired by the local community will be of value to the labor-force of the country at national and local levels. The creation and injection of highly trained workers, qualified in multiple skills, into the economy will improve the productivity of the workforce and the benefits will extend to other firms and industries. This impact can therefore stretch to micro- and macro-economic levels.

For enhancement of employment benefits at the local and domestic levels, various training programs will be implemented by PEDO. The training programs will focus on maximization of participation of local community in the construction and operational phases of the Project.

7.11.3 Enhancement of Subsistence and Recreational Fishing

Impact 28: Increase in recreational and subsistence fishing due to increase in catch of fish following creation of favorable habitats for the fish in the Kunhar River.								
Applicable Project Phase			Construction and Operation					
Initial Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Minor	Long term	Extensive	Low	Possible	Low	+	High
Mitigation measures: 1. Ensure implementation of the BAP (see **Volume 2C** of the **EIA**).								
Residual Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Minor	Long term	Extensive	Low	Possible	Low	+	Medium

Estimates for consumption of fish caught from Study Area are provided in **Section 4.3.4**, (*River Dependent Socioeconomic Activities*). Income from fishing as a percentage of total income across the zones ranges from 0.011% in Zone 5 to negligible, with an average value of 0.010% and maximum level of dependence of 0.011%. Fishing is only carried out for recreational purposes. Some people sell part of their catch, however, income from fishing is an insignificant part of their livelihood. The Fisheries Department, KP issues permits for recreational and subsistence fishing using rods and cast nets. However, bulk of the fishing at present is carried out using prohibited gill nets, a practice that cannot be considered as sustainable. Under the Business-as-Usual scenario with poor protection of the river combined with impacts of the Project (see the **Volume 2C** of the **EIA**) fish of subsistence and recreational value such as Alwan Snow Trout will practically be wiped out in 31 years both upstream and downstream of the dam. However, following implementation of the BAP and High Protection levels (see **Volume 2C** of the **EIA**) populations of these fish will be maintained at levels where it will be possible to support recreational and subsistence fishing.

7.11.4 Sediment Mining

Impact 29: Loss of income from sediment mining due to change in pattern of sediment deposition following construction of the dam.								
Applicable Project Phase	*Operation*							
Initial Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Major	Long term	Extensive	High	Definite	High	-	High
Mitigation measures: A Sediment Mining and Management Guidelines will be prepared and implemented as a part of BAP (see **Volume 2C** of the **EIA**), which will identify possible sand and gravel mining spots along the Kunhar River to meet community needs without harming the river ecology.								
Residual Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Minor	Medium	Small	Low	Possible	Low	-	Low

Sediment mining is carried out throughout the length of the main Kunhar River and its tributaries. The mineable sediment resource is being extracted to meet small-scale construction demand, involving construction and maintenance of local residential and commercial buildings as well as roads. Demand for large-scale projects is met through imports from Lawrencepur near Attock about 60 km west of Islamabad and other areas.

Sediment mining will be affected by the Project. The development of the hydropower project will result in changes in flows, including sediment flows, thereby, affecting sediment deposition. Community dependence on sediment mining is significant based on the statistics presented in earlier in **Section 4.3.4** (*River-Dependent Socioeconomic Activities*). The income, as a percentage of total income, ranges from 1.03% to 4.12% in various zones of the river with the average across the zones being 3.6%. A number of persons also depend on daily wages from sediment mining businesses for their livelihoods. Income dependence for sediment mining is of significance.

The total quantity of sediment being mined from the socioeconomic Study Area is estimated at 467,030 m^3 per year. Given a total bed load sediment flow of 2,714,000 m^3/year[18], present demand for sediment is estimated at 17% of the sediment available. The availability of sediment for meeting the demand of the communities is not likely to be an issue for foreseeable future. PEDO as a part of the BAP, will prepare and implement sediment mining management guidelines to minimize the impact of the Project and the extraction of sediment by the community on the river ecology while meeting the requirements of the community.

[18] Mirza Associates Engineering Services (Pvt.) Ltd. (Lead Consultant), December 2013, Feasibility Study of Balakot Hydropower Development Project, Volume I Main Report for Pakhtunkhwa Hydel Development Organization

7.11.5 Land Acquisition

Impact 30: Loss of assets and livelihood as a result of land acquired for the Project.								
Applicable Project Phase	*Design and Construction*							
Initial Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Major	Long term	Extensive	High	Definite	High	-	High
Mitigation Measures: See LARP (**Volume 8**)								
Residual Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Minor	Medium	Small	Low	Possible	Low	-	Low

Land acquired for the Project can potentially have serious effects on the well-being of the community. It is estimated that as about 165 households may have to relocated as a result of the Project. The LARP prepared for the Project identifies the potential social issues and proposes measures to avoid adverse impacts.

7.12 Socio-Cultural Impacts

The Project stakeholders expressed concerns on the potential sociocultural changes that can be induced by the Project including enhancement or possible degradation of social and economic landscape, and hindrance in mobility of the people due to location of Project facilities such as construction camp. Key impacts are listed below and discussed in this section:

- Impact 31: Increase in population due to in-migration of job seekers (in-migrants) leading to pressure on existing social infrastructure and services.
- Impact 32: Disputes over distribution of Project employment within and between Study Area inhabitants and the in-migrants resulting in social unrest.
- Impact 33: Potential social unrest in the Study Area due to conflicting socio-cultural norms amongst the inhabitants and in-migrants.
- Impact 34: Damage to the graveyard.

7.12.1 Pressure on Social Infrastructure and Services

Impact 31: Increase in population due to in-migration of job seekers (in-migrants) leading to pressure on existing social infrastructure and services in the Study Area.								
Applicable Project Phase	*Construction*							
Initial Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Moderate	Medium	Intermediate	Medium	Possible	Medium	-	Medium
Good practice measures: 1. Development of a Grievance Redressal Mechanism 2. Encourage local communities to use the grievance procedure for concerns related to deterioration of local services. 3. Support local government in the implementation of infrastructure projects. 4. Support NGOs specializing in development of infrastructure to assist local government.								
Residual Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Minor	Medium	Intermediate	Low	Possible	Low	-	Medium

There is a potential for an influx of job seekers in the Study Area due to the jobs created by the Project. Some service providers to the Project may open new offices in Balakot City, which is situated at a distance of about 17 km from the Project site. The potential in-migration in Balakot City due to the Project will be negligible in comparison to the present population of the city. The influx of job seekers will pose pressure on the availability of infrastructure and services, such as those pertaining to education, health care and medication, water and communication in the Project area.

7.12.2 Conflicts Due to Provision of Employment to Outsiders

Impact 32: Disputes over distribution of Project employment within and between Study Area inhabitants and the in-migrants resulting in social unrest.								
Applicable Project Phase	*Construction*							
Initial Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Moderate	Medium	Intermediate	Medium	Possible	Medium	-	High
Good practice measures: 1. Implement PEDO Stakeholder Engagement Plan including: a. maintaining regular communication with local communities and other stakeholders to minimize tensions arising from Project activities; b. maintaining a grievance procedure, and encourage and facilitate stakeholders to use the mechanism to express concerns; and c. providing sufficient resources to the community relations officers to enable them to monitor negative perceptions and associated tensions, and to address them in a timely fashion.								
Residual Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Minor	Short term	Intermediate	Low	Possible	Low	-	Medium

A potential source of conflict is real or perceived unequal access to Project opportunities. Complaints can be expected from local communities residing in the Study Area if the distribution of jobs among local communities is perceived to be unfair. Objections can also be expected if people from outside the Study Area are seen to usurp opportunities created by the Project, as the Study Area inhabitants may consider themselves as the rightful owners to the Project benefits owing to their vicinity to the Project. This increases the need for open communication between PEDO and the various community heads, as well as within the community heads themselves.

7.12.3 Conflicting Socio-Cultural Norms

Impact 33: Potential social unrest in the Study Area due to conflicting socio-cultural norms amongst the inhabitants and in-migrants.								
Applicable Project Phase	*Construction*							
Initial Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Minor	Short term	Small	Low	Possible	Low	-	Medium
Enhancement measures: 1. Refer to measures under Impact 32.								

The influx of job seekers in the Study Area could give rise to ethnic and cultural diversity in the Study Area. There could be cultural conflicts between the in-migrants and the Study Area inhabitants due to their conflicting traditions and norms. The likelihood of this impact is low given that Project facilities are not located in immediate vicinity of local communities and where the facility borders local communities, proper fencing and barriers are provided to avoid unnecessary interaction.

7.12.4 Graveyard Management

Impact 34: Submergence of the graveyards.								
Applicable Project Phase				*Construction*				
Initial Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Moderate	Medium	Intermediate	Medium	Possible	Medium	-	High
Mitigation measures: 1. Plaster the graves with mud or cement. 2. If relocation of the graveyard cannot be avoided, it shall be managed through the local religious authorities.								
Residual Impact Rating	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	+ /-	*Confidence*
	Minor	Short term	Intermediate	Low	Possible	Low	-	Medium

Three graveyards have been identified in the area that will be submerged (see **Exhibit 7.36**). Two graveyards are in Bela Balseri and one is in Nihan settlement. Culturally and religiously, a graveyard has a sanctity in the eyes of the people of the area. It is therefore important to handle this aspect recognizing its sensitivity. The hierarchy of measures to manage the graves based on the consultation with the local communities is as:

1. Plaster the graves with mud or cement.
2. If relocation of the graveyard cannot be avoided, it shall be managed through the local religious authorities

Exhibit 7.36: Graveyards in the Project Area

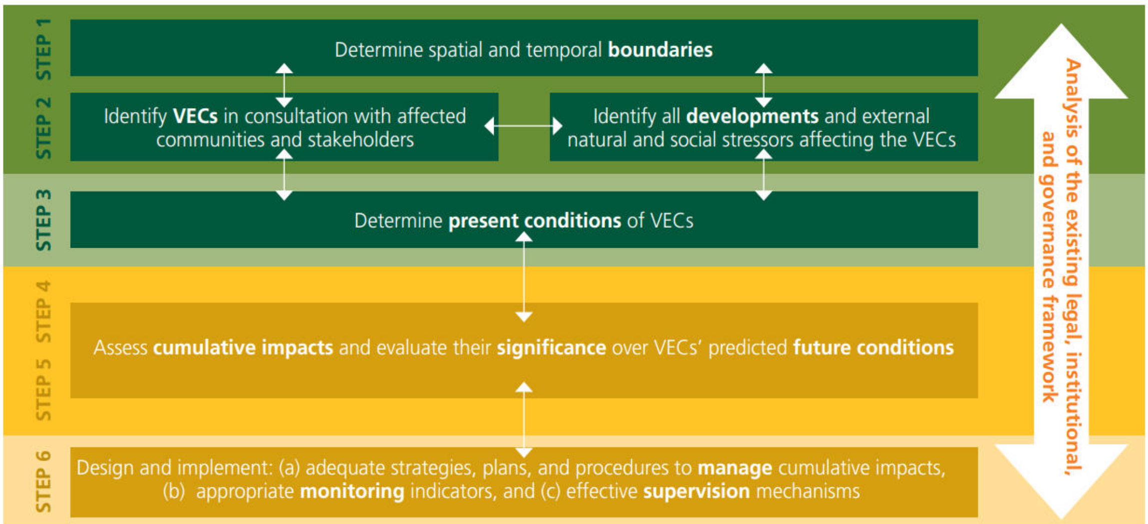
7.13 Cumulative Impact Assessment

Cumulative impacts are those that result from the incremental impact of a project or developments when assessed in combination with other existing and reasonably foreseeable future developments in a rationally set geographical and temporal scale. The overall objectives of cumulative impact assessment (CIA) studies are:

- Ensure that the proposed and likely future developments' cumulative social and environmental impacts and risks to not exceed a threshold that could compromise the sustainability of Valued Environmental and Social Components (VECs)[19];
- Ensure that the proposed and future developments' value and feasibility are not limited by cumulative social and environmental impacts and risks; and
- Support development of regional governance structures for decision making and managing cumulative impacts.

The methodology used for the CIA of the Project has been adapted from the guidelines of IFC.[20] The key steps of the study are shown in **Exhibit 7.37** below. Key in the methodology is the identification and mapping of VECs.

Exhibit 7.37: Study Steps



Source: International Finance Corporation. Good Practice Handbook—Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets. 2014

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[19] The IFC Good Practice Handbook on Good Practice Handbook—Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets. 2014 defines VECs as environmental and social attributes that are considered to be important in assessing risks; including physical features, habitats, wildlife populations (e.g. biodiversity), ecosystem services, natural processes (e.g., water and nutrient cycles, microclimate), social conditions (e.g. health, economics), or cultural aspects (e.g., traditional spiritual ceremonies).

[20] International Finance Corporation. 2014. Good Practice Handbook—Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets

The study area selected for the CIA (CIA Study Area) is shown in **Exhibit 7.38** and includes the entire length of the Kunhar River from Lulusar Lake down to its confluence with the Jhelum River, a total length of 116.3 km. Significant tributaries which are important breeding areas for fish are also included in the CIA Study Area as the tributaries and the main river constitute an integrated and interdependent ecosystem. The temporal scope of the CIA spans a periodBal of 51 years up till the year 2068 corresponding to the period for hydrological daily data is available for the Project location. This accounts for first 5 years of construction of the Project and a further 46 years of its operation. As the results for EFlow modeling show, the fish populations reach equilibrium levels in this time period and the impacts of the Project, management measures, as well as those associated with variations associated with natural hydrological cycles level off. The **Environmental Flow Assessment Report** for the **Balakot Hydropower Development Project** is provided in **Volume 2C** of the **EIA**.

7.13.1 Major Existing, Under Construction and Planned Hydropower Projects on the Kunhar River

There are a number of hydropower projects at different stages of development on the Kunhar River within the CIA Study Area. Furthest downstream, near the Kunhar – Jhelum confluence the Patrind HPP is already constructed and operating. Upstream of the Project, between Kaghan and Naran the Sukki Kinari HPP is presently under construction. Upstream of Naran Town, the Naran HPP and the Batakundi HPP are still at the planning stage. The developments, their planned capacity and current status are shown in **Exhibit 7.39.**

Exhibit 7.38: CIA Study Area

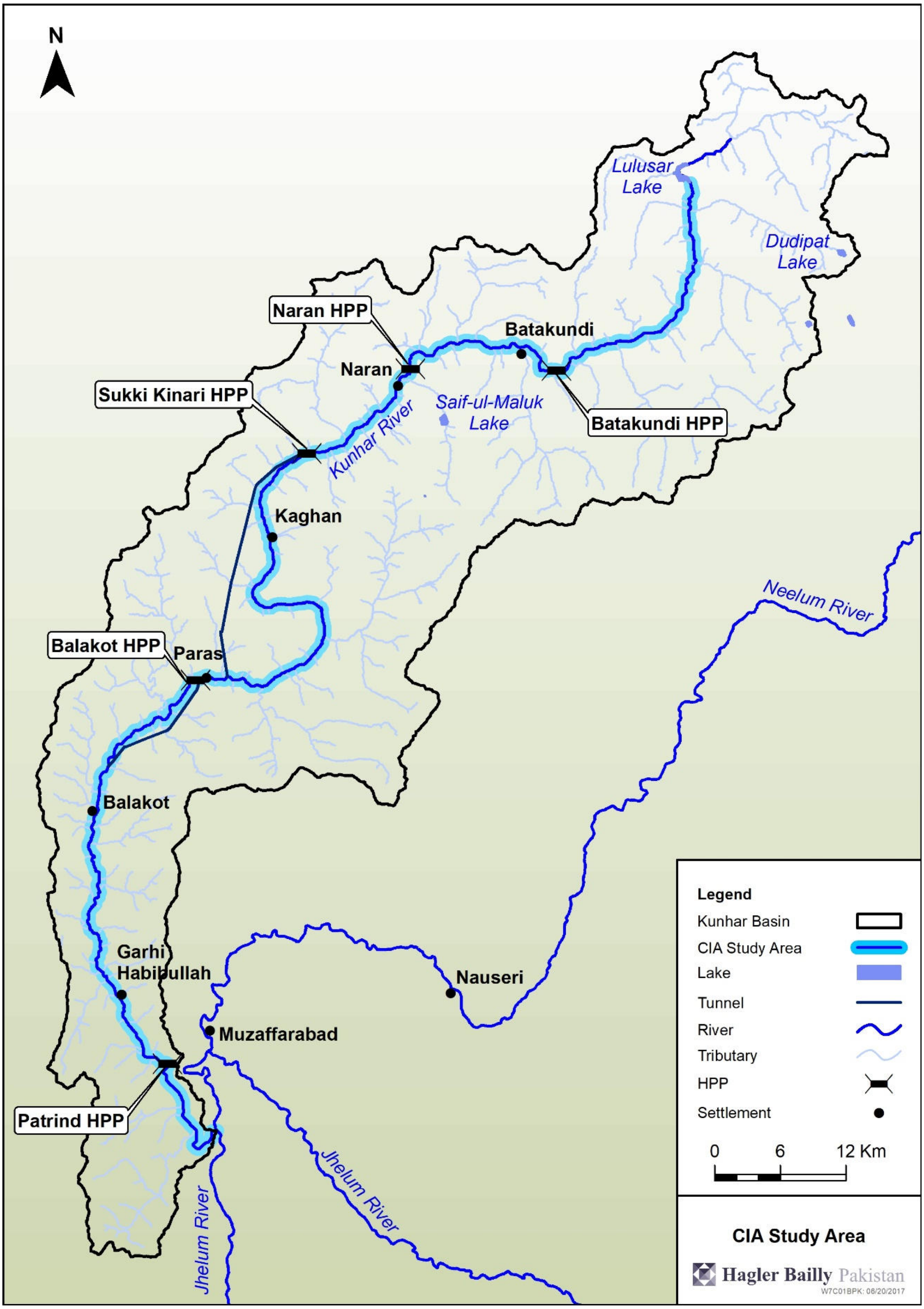
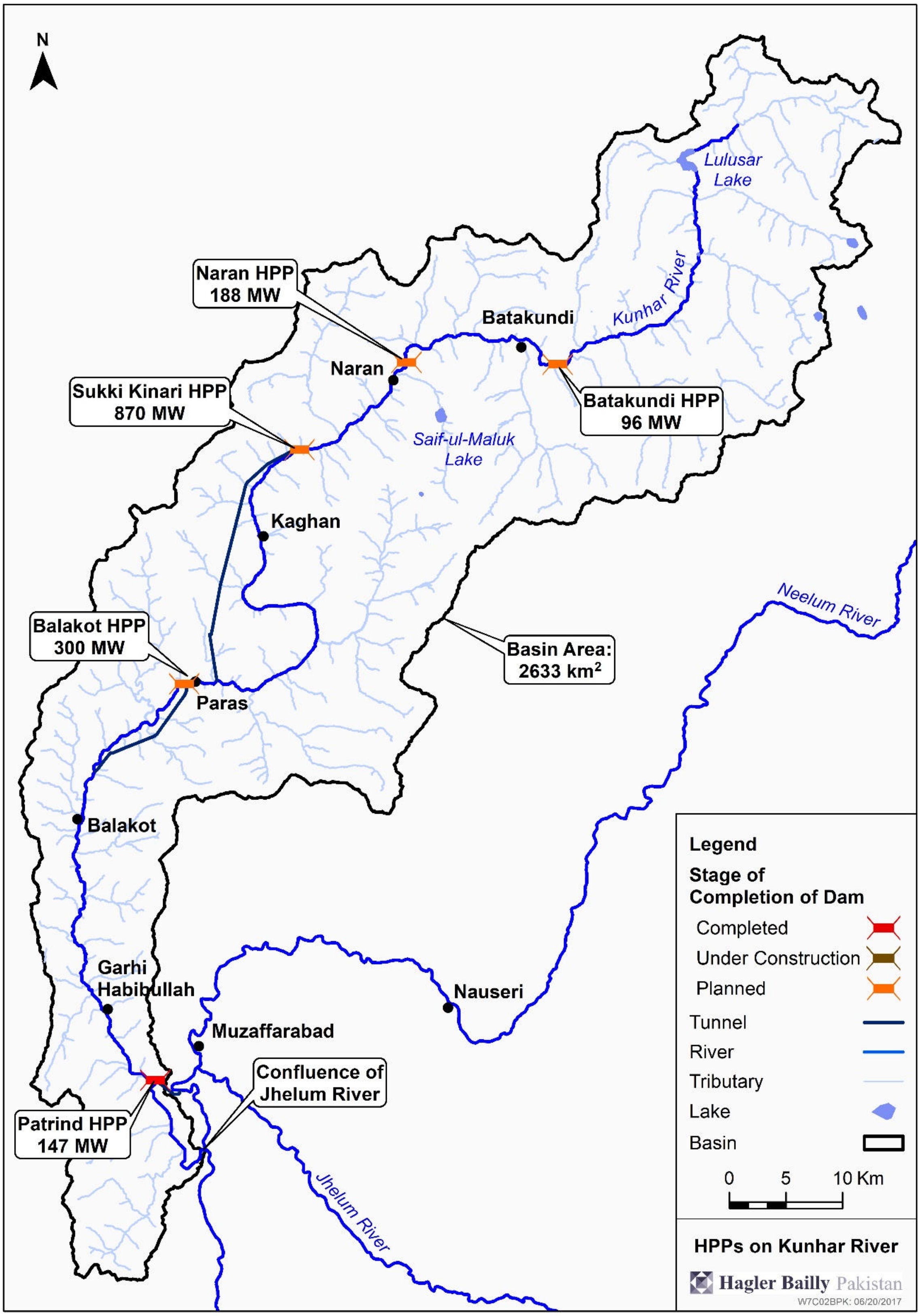


Exhibit 7.39: Locations, Capacities and Status of Major Hydropower Projects on the Kunhar River



7.13.2 Ecosystem Services Review

Ecosystem Services, as defined by the World Resources Institute (WRI), 'are the benefits that people get from nature. Examples include fresh water, timber, climate regulation, recreation and aesthetic values.[21] Ecosystem services are an important class of VECs as the livelihoods of the communities depend on them. Identification of ecosystem services was carried out through a review of the socioeconomic baseline for the Project (see **Section 4.3**, *Socioeconomic Baseline*). The following ecosystem services were identified:

- Provisioning Services: fishing, sand mining, driftwood use as a fuel, domestic uses of river water, and pumping of river water by river-side restaurants; and
- Cultural Services: tourism and recreation.

Fishing: Fishing areas along the main Kunhar River are marked in **Exhibit 4.154** in **Section 4.3.4** (*River-Dependent Socioeconomic Activities*). The fishing season lasts about six months during the summer and seasonal permits for fishing using rods and cast nets are issued by the Fisheries Department, KP. However, the number of permits issued is small and most fishing in the Kunhar River is conducted illegally as enforcement is weak. The creation of barriers and reservoirs along the river will alter river connectivity and habitat, thereby impacting fish populations in the Kunhar River Basin. According to field surveys community dependence on fishing is not significant and only 2% of households in the area engage in fishing. Income from fishing as a percentage of total income in the area is only 0.01%, with the majority of fish catch being self-consumed. Considering the very small contribution of fishing to the CIA Study Area economy, fishing as a socioeconomic activity was not categorized as a priority VEC. This is not related to the ecological importance of certain fish species in the Kunhar River, which is discussed in the next section.

Based on an analysis of data collected as part of the ESIA of Kohala HPP, fishing pressure is expected to increase as has been observed along other rivers in the basin, including Jhelum and Neelum Rivers, from 2013 to 2016. An increasing trend in fishing pressure was also highlighted by Mohammad Tanvir, Assistant Director, Mansehra of the Fisheries Department, KP.

Sediment Mining from River Bed: Sediment (sand, gravel and cobble) mining is carried out in some areas along the length of the main Kunhar River. Surveys for the socioeconomic baseline reported on sand mining activities within the socioeconomic Study Area which extends from 4 km upstream of Paras till Dalola Village. Field surveys showed that 98% of the sediment mined is extracted from the stretch of river between Shahator Village and Dalola Village, downstream of Balakot Town. An improved road network could potentially open up additional areas for sediment mining, as has been the case in other basins in the area. Sediment is mined to meet small-scale construction demand related to the construction and maintenance of local residential and commercial buildings. The sediment is mined manually using shovels and spades and is loaded onto animals, vehicles, or cable trollies, by means of which it is transported to the roadside.

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[21] Ranganathan. J, Raudsepp-Hearne C, Lucas N, Irwin F, Zurek M, Bennet K, Ash N, West P. 2008. Ecosystem Services A Guide for Decision Makers, World Resources Institute

The laborers involved in the sand mining depend on daily wages from this activity for a large part of their income.

The mining operations are of different sizes ranging from 100 m^3/year to 2,080 m^3/year. Small- and medium-scale operations are typically family businesses. Families from nearby villages' set-up sediment extraction operations which are mostly run by family members. In most cases the labor is hired locally but, in some cases, it is also provided by the family. In this way, the earning from the sediment mining operation remains primarily within the local economy. **Exhibit 4.155** in **Section 4.3.4** (*River-Dependent Socioeconomic Activities*) shows the sediment mining areas in the CIA Study Area. The development of the hydropower projects in the Kunhar Basin will result in changes in flows, including sediment flows, thereby, affecting sediment deposition. Community dependence on sediment mining as a percentage of total income is low. Surveys carried out as part of the socioeconomic baseline for the EIA of the Project found that income from sediment mining as a percentage of the total income was 3.6%, although for individual households involved in sand mining the contribution may be much higher, as there are a number of family-owned sand mining businesses. Considering the small contribution of sediment mining to the overall local economy of the area, it was not considered a priority VEC. However, with the expected increase in construction, demand for sediment is expected to grow, therefore, it will become important in future.

Based on an analysis of data collected as part of the ESIA of Kohala HPP, sediment extraction is expected to increase as has been observed along other rivers in the basin, including Jhelum and Neelum Rivers, from 2013 to 2016.

Driftwood: Fuel wood is the main source of energy for domestic cooking and heating. Respondents, interviewed as part of the ESIA of Project reported that fuel wood is collected from a number of sources, including trees growing on farmland, dead and fallen trees in forests, and driftwood along the river, mainly in spring when the water flow increases. Driftwood use as a fuel is likely to be affected by the Project. Dams will trap drift wood in normal flow conditions, which will affect the availability of driftwood downstream of any dam sites. However, there is limited dependence on driftwood collected from the riverbanks as source of fuel wood and community dependence on driftwood was therefore not considered as significant. The use of driftwood as fuel was therefore not considered a priority VEC.

Community use of River Water: River water is not fit for drinking as it carries effluents from settlements located in the catchment of the river. The main sources of water for communities are springs and streams flowing from higher elevations in the valley. There is very limited pumping of water from the river as water is generally available from springs and stream flowing down the valley slopes, and river water use for agriculture is very limited. Community use of river water was therefore not considered a priority VEC.

Recreation and Tourism: Recreational dependence on the river varies greatly from one stretch of the Kunhar River to the other (see **Section 4**, *Socioeconomic Baseline*). Although recreation and tourism is not a major socioeconomic activity in the Project area or further downstream, a large number of tourists do visit the riverside towns of Kaghan and Naran further upstream during the summer. A large number of hotels and restaurants in these areas are located at the riverside, and tourists also undertake river related activities such as fly fishing for trout. Through the provision of accommodation, food and other services local communities in these areas derive a very significant portion of their annual income from recreation and tourism. Recreation and tourism were therefore considered a priority VEC in the CIA.

7.13.3 Priority VECs

Valued Environmental Components (VECs) are defined as "*fundamental elements of the physical, biological or socio–economic environment that are likely to be the most sensitive receptors to the impacts of a proposed project or the cumulative impacts of several projects*".[22] They may include:

- Physical features, habitats, wildlife populations (e.g., biodiversity),
- Ecosystem services (e.g., fishing, timber, food, aesthetic values),
- Natural processes (e.g., water and nutrient cycles, microclimate),
- Social conditions (e.g., health, economics), or
- Cultural aspects (e.g., traditional spiritual ceremonies).[23]

While VECs may be directly or indirectly affected by a specific development, they often are also affected by the cumulative effects of several developments.

Priority VECs have been identified through the Ecosystem Services Review in **Section 7.13.3** (*Priority VECs*) and from ecological studies conducted as part of the EIA. The ecological studies identified two fish species of conservation importance in the Aquatic Study Area (which stretches both upstream and downstream of the Project infrastructure) based on their endemism and restricted range. These include the Nalbant's Loach and Kashmir Hillstream Loach. Because of the presence of these species, river ecology with emphasis on fish fauna was identified as a priority VEC. More detailed information on river ecology can be found in **Section 4.2.6**, (*Aquatic Ecology*).

The biodiversity values identified as important and the ecosystem services considered important were combined to develop a list of prioritized VECs for the purpose of this study. The prioritized VECs for this CIA are:

- River ecology with emphasis on fish fauna
- Recreation and tourism

River ecology was included as a VEC as the survival of fish fauna depends on the integrity of the river ecosystems. Recreation and tourism was included as major changes to the natural environment and aesthetics of the Kaghan and Naran area could result in a drop in tourist numbers, having a major negative impact on the local economy.

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22 Cadinale, Pablo, and Lorne Greig. 2013."Cumulative Impact Assessment and Management: Guidance for Private Sector in Emerging Markets." In *Good Practice Handbook*: International Finance Corporation and ESSA Technologies Ltd

23 Ibid

7.13.4 Overview of Changes in Flow and Inundation of Habitats

Even though these cascading hydropower projects are not net consumers of water, the timing as well as the allocation of water flow will be modified on the Kunhar River from the Batakundi HPP to the confluence of the Kunhar River with the Jhelum River as follows:

- 19.1 km or 16% of river will be lost as a result of inundation,
- 79.8 km or 69% will be impacted by reduced dry season flows, and
- 17.4 km or 15% will be impacted by peaking flows.

It can be concluded that the cumulative impacts from the operation of all HPPs will cause loss and degradation of riverine aquatic habitat along the entire length of the Kunhar River between the Batakundi reservoir and the Kunhar – Jhelum River confluence, a total length of 89.5 km.

Thus, the potential cumulative impact on river habitat is likely to be significant if not managed or mitigated.

7.13.5 Impact on Fish Fauna

This cumulative assessment is based on the assessment of environmental flows[24] (EFlows) for the Project (see **Section 5**, *Analysis of Alternatives*). The assessment takes into account the prevailing non-flow pressures on the aquatic ecosystem, including selective and non-selective fishing, sediment mining on the river bed, and nutrient enrichment in the river due to effluent disposal from communities and harvesting of riparian vegetation. Four levels of protection were assessed, which are:

- Protection Level BAU = Business as usual, increase non-flow-related pressures in line with 2017 trends, i.e., 2017 pressures double in intensity over the next 51 years.
- Protection Level 1 (Pro 1) = maintain 2017 levels of non-flow-related pressures on the river; i.e., no increase in human-induced catchment pressures over time.
- Protection Level 2 (Pro 2) = reduce 2017 levels of non-flow-related pressures by 50% over the next 5 years and then keep stable at that level for the next 46 years.
- Protection Level 3 (Pro 3) = reduce 2017 levels of non-flow-related pressures by 90% over the next 5 years and then keep stable at that level for the next 46 years.

In the case of each, results obtained from assessment of impacts under various EFlow scenarios for the Project using the DRIFT DSS model were extrapolated to the other HPPs.[25] Three scenarios were assessed in the EFlow assessment for the Project.

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[24] Environmental flows describe the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems

[25] Modeling of the impacts of an additional four HPPs using DRIFT was outside the scope of this study.

Environmental Management Scenarios

A 'Business as Usual' (BAU) scenario predicts the health of the river ecosystem in the absence of any additional dams (both planned and under construction). However, non-flow pressures discussed above are maintained at Business as Usual levels. It also considers the presence of the already constructed Patrind HPP.

A 'Baseline Management' (BM) scenario predicts the health of the river ecosystem after the construction of all five dams, with the following operational and environmental management measures in place:

- Project will operate with a constant baseload flow and an EFlow of 1.5 m^3/s
- Sukki Kinari HPP, Naran HPP and Batakundi HPP will operate following a peaking regime
- Patrind HPP will continue to operate with a baseload flow, however this has no impact on the Kunhar River as its powerhouse is located on the Jhelum River and the impacts of peaking will occur in the Jhelum River
- Protection Level 3, or Pro 3 level of protection will be implemented in the Project area of management
- Protection Level Business As Usual (BAU) will be implemented in the Patrind HPP, Sukki Kinari HPP, Naran HPP and Batakundi HPP areas of management

An 'Enhanced Management' (EM) scenario predicts the health of the river ecosystem after the construction of all five dams, with the following operational and environmental management measures in place:

- Project, Naran HPP and Batakundi HPP will operate with a constant baseload flow
- Sukki Kinari HPP will operate following a peaking regime
- Patrind HPP will continue to operate with a baseload flow, however this has no impact on the Kunhar River as its powerhouse is located on the Jhelum River and the impacts of peaking will occur in the Jhelum River
- Protection Level 3, or Pro 3 level of protection will be implemented in the areas of management of all HPPs

The estimated likely consequences of the accumulation of these impacts on the Alwan Snow Trout, Nalbant's Loach and Kashmir Hillstream Loach that illustrate the range of impacts on fish fauna are summarized in **Exhibit 7.40**. These impacts have been extrapolated from the results of the EFlow modeling carried out for the Project.

Alwan Snow Trout

BAU Scenario: The Alwan Snow Trout faces heavy selective fishing pressures, which are expected to increase significantly under the business as usual scenario. This is predicted to reduce Alwan Snow Trout populations by around 70% throughout the Kunhar River.

BM Scenario: The expected impact of all dams will result in the complete elimination of the Alwan Snow Trout in most of the Kunhar River. The only exception under this scenario is the stretch between the Project dam to Patrind reservoir, where a 25% decrease compared to current levels is expected. This stretch will continue to support Alwan Snow Trout populations because of the 1.5 m^3/s EFlow from the dam to the powerhouse, and the base flow from the power house to the Patrind reservoir.

EM Scenario: Under Enhanced Management strict protection is applied throughout the river basin and baseload flow is maintained from all dams except Sukki Kinari. However the barrier effect of the dams combined with reduced flows, especially between dams and powerhouses is enough to eliminate the Alwan Snow Trout in most of the river. River sections downstream of the Project dam continue to support fish populations largely due to the dam's EFlow. Other sections or river, such as Sukki Kinari dam to tailrace and Patrind reservoir to the Jhelum confluence retain significantly depleted populations of the Alwan Snow Trout (reduction of 65 to 70%).

Nalbant's Loach

BAU Scenario: The Nalbant's Loach is currently only found downstream of the Sukki Kinari dam site. Under the Business as Usual scenario, the Nalbant's Loach populations reduce by 60% compared to current populations. The Nalbant's Loach is sensitive to pollution, and the growing impact of runoff from human settlements and habitat degradation due to activities such as sand mining will result in the reduced population under BAU.

BM Scenario: The Baseline Management scenario representing the impact of all five dams results in the elimination of the Nalbant's Loach from most stretches of river due to the combined effect of human impacts and changes in hydrology. However, between the Project dam to the tailrace there is a 70% decline, and between Project tailrace to Patrind reservoir there is actually a 10% increase. This increase in the Nalbant's Loach population is a result of this stretch of river retaining sufficient water flow due to the EFlow from the Project dam and baseload flow from the powerhouse, combined with reduced human impacts due to the conservation measures in the Project implemented under BM.

EM Scenario: Under the Enhanced Management scenario, increased protection throughout the river basin result in other stretches retaining some of the Nalbant's Loach population. The stretch between Sukki Kinari dam and its tailrace and Patrind dam and the Jhelum confluence retain 30% of the current population. The Project dam to tailrace and Project tailrace to Patrind reservoir remain unchanged from the BM scenario.

Kashmir Hillstream Loach

BAU Scenario: The Kashmir Hillstream Loach distribution is similar to that of the Nalbant's Loach, and it is only found downstream of the Sukki Kinari dam site. Under the Business as Usual scenario, the Kashmir Hillstream Loach populations will reduce by 70% in all stretches where it is currently found. The Kashmir Hillstream Loach is sensitive to human impacts such as habitat degradation and water pollution, and growing population pressure and its associated impacts will result in the reduced population under BAU.

BM Scenario: Under the Baseline Management scenario changes in hydrology combined with human impacts result in the elimination of the Kashmir Hillstream Loach from most stretches of the Kunhar River. Downstream of Project dam, where an EFlow is maintained, 10% of the existing population will remain. Between the Project tailrace and the Patrind reservoir the combination of EFlow from the dam, baseload flow from the powerhouse and increased protection in this area are expected to result in a 10% increase in the population.

EM Scenario: Increased protection under Enhanced Management results in the Sukki Kinari dam to tailrace and Patrind Dam to confluence sections retaining 10% of the current Kashmir Hillstream Loach populations. The Project dam to tailrace (90% reduction) and Project tailrace to Patrind reservoir (10% increase) sections remain unchanged from the BM scenario.

Exhibit 7.40: Cumulative Impact of Planned HPPs on the Population of Alwan Snow Trout, Nalbant's Loach and Kashmir Hillstream Loach

Green = any increase from present day. White = 0% to -40%. Orange = -40% to -70%. Red = -70% to -100%. Grey is outside the natural range of the fish

			Alwan Snow Trout, %			Nalbant's Loach, %			Kashmir Hillstream Loach, %		
			BAU	BM	EM	BAU	BM	EM	BAU	BM	EM
Lulusar Lake to Batakundi Reservoir	River	26.8									
Batakundi reservoir	Submergence	2.8	-70	-100	-100						
Batakundi dam to tailrace	Low Flow	5.1	-70	-100	-100						
Batakundi tailrace to Narran reservoir	Peaking	9.9	-70	-100	-100						
Naran reservoir	Submergence	3.5	-70	-100	-100						
Naran dam to tailrace	Low Flow	5.5	-70	-100	-90						
Naran tailrace to Narran reservoir	Peaking	6	-70	-100	-100						
Sukki Kinari reservoir	Submergence	3.1	-70	-100	-100						
Sukki Kinari dam to tailrace	Low Flow	38.6	-70	-100	-70	-60	-100	-70	-70	-100	-90
Sukki Kinari tailrace to Project reservoir	Peaking	1.5	-70	-100	-100	-60	-100	-100	-70	-100	-100
Project reservoir	Submergence	4.5	-70	-100	-100	-60	-100	-100	-70	-100	-100
Project dam to tailrace	Low Flow	15.4	-70	-25	-25	-60	-70	-70	-70	-90	-90
Project tailrace to Patrind reservoir	Baseload	24.9	-70	-25	-25	-60	10	10	-70	10	10
Patrind reservoir	Submergence	5.2	-70	-100	-65	-60	-100	-100	-70	-100	-100
Patrind dam to Jhelum River Confluence	Low Flow	15.2	-70	-100	-65	-60	-100	-70	-70	-100	-90

Note: BAU: Business as Usual (No protection or construction of additional dams)

BM – Baseline Management

EM – Enhanced Management

7.13.6 Overall Impact on Ecosystem Integrity

This section summarizes the cumulative impact of the proposed HPPs on the overall ecosystem condition and integrity of the Kunhar River and draws from the impact on VECs outlined above. The categories used to describe the Kunhar River's Present Ecological State[26] are based on modification from the natural, with the natural condition seen as the reference condition (see **Exhibit 7.41**). The estimated cumulative impact of the proposed HPPs on overall river and tributary condition is discussed below.

Exhibit 7.41: Definitions of the Present Ecological State (PES) Categories

A	Unmodified, natural	As close as possible to natural conditions.
B	Largely natural	Modified from the original natural condition but not sufficiently to have produced measurable change in the nature and functioning of the ecosystem/community.
C	Moderately modified	Changed from the original condition sufficiently to have measurably altered the nature and functioning of the ecosystem/community, although the difference may not be obvious to a casual observer.
D	Largely modified	Sufficiently altered from the original natural condition for obvious impacts on the nature and functioning of the ecosystem/community to have occurred.
E&F	Completely modified	Important aspects of the original nature and functioning of the ecosystem community are no longer present. The area is heavily negatively impacted by human interventions.

Present Day Situation

At present, sections of Kunhar River upstream of Patrind reservoir are largely natural, and fall within Category B (see **Exhibit 9.5** for category descriptions). Downstream, sections of river between the Patrind reservoir and the Jhelum confluence are already affected by the construction and operation of Patrind dam, and these sections have therefore been placed in Category B/C.

Business-as-Usual Scenario

Under the BAU scenario (i.e. no HPPs, no environmental control measures) it is expected that there will be significant degradation of the entire stretch of river, from Lulusar Lake down to the Jhelum River confluence. This degradation would result from environmental stressors related to growing population pressure, such as increasing water pollution and habitat degradation. It is expected that the upper reaches of the river, close to Naran and upstream, would degrade to Category C/D, whereas the more populated downstream sections would degrade to Category D over time.

26 Hagler Bailly Pakistan and Southern Waters. July 2016. Environmental Flow Assessment for Kohala Hydropower Project Volume 3: Environmental Flow Assessment Technical Report. Pakistan.

Impact of Sequential Implementation of HPPs with Baseline Management

The impacts of each additional HPP are discussed below:

1. **Patrind HPP** degrades ecosystem integrity of the river from Patrind dam to Jhelum River confluence to Category E due to reduced water flow.
2. With the addition of **Sukki Kinari HPP** the entire stretch of river from Sukki Kinari reservoir down to the Jhelum confluence degrades to Category E due to a combination of peaking flows, low flows and submergence in different sections of the river.
3. **Project** will inundate an additional 2.8 km of river but will include an EFlow from the dam, a baseload flow from the powerhouse and Pro 3 level protection in the area. As a result the section of river downstream of the Project dam improves from Category E to Category C/D until the tailrace, and the section from the tailrace to Patrind Reservoir improves from Category E to Category B.
4. **Naran HPP** results in the degradation an additional 15 km of river. A stretch of 3.5 km gets inundated and the remaining 11.5 km section from the dam to the tailrace and tailrace to Sukki Kinari reservoir gets degraded to Category E due to low flow and peaking.
5. **Batakundi HPP** affects an additional 17.8 km of river, with 2.8 km inundated, and 15 km degraded to Category E as a result of low flows and peaking.

Enhanced Management Scenario

Under the Enhanced Management scenario, Project, Naran HPP and Batakundi HPP will be operated with a baseload flow, ensuring there is some water flow between their powerhouses and the next reservoir. Also, the entire Kunhar River from Lulusar Lake to the Jhelum confluence will be managed at a Pro 3 protection level, significantly reducing human impacts such as water pollution and habitat degradation. The result of these measures on ecosystem integrity is:

1. Sections of river between all of the dams to their tailrace will improve from Category E to Category C or Category C/D
2. Sections of river between tailraces and reservoirs, where there is now some water flow due to baseload flow will improve from Category E to Category B. The only exception is Sukki Kinari HPP, which will operate using a peaking regime, because of which the section between Sukki Kinari HPP tailrace and Project reservoir will remain at Category E

A score for overall ecosystem integrity in the CIA Study Area was calculated by:

- Assigning the following scores to ecological categories as defined in **Exhibit 7.41:**
  - Ecological Category F 0%
  - Ecological Category E 20%
  - Ecological Category D 40%
  - Ecological Category C 60%

- ▷ Ecological Category B 80%
- ▷ Ecological Category A 100%

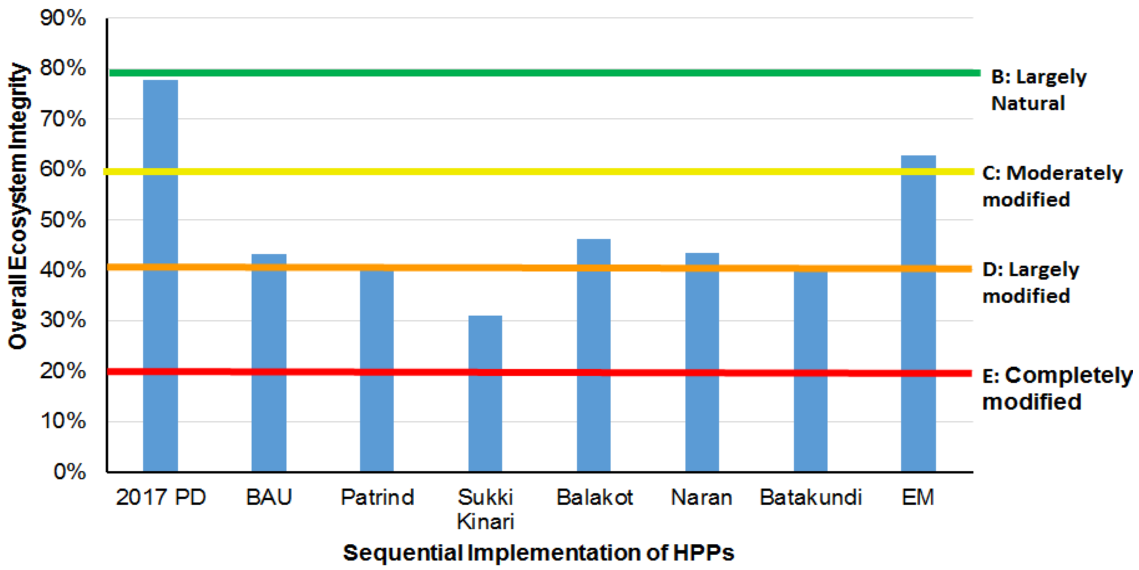
- ► Calculating a weighted average score for the CIA Study Area on the basis of the score for ecological integrity in each segment of the river and length of the segment.

Exhibit 7.42 illustrates the calculated changes in overall ecosystem integrity for the CIA Study Area with sequential implementation of the HPPs.

1. Starting with a Present Day score of 78% corresponding to ecosystem integrity of B, the ecosystem integrity deteriorates to D, or a score of about 43% under the BAU scenario without any project. This deterioration is due to poor protection and increasing pressures on the ecosystem from fishing, sediment mining, and deterioration in water quality over time.
2. With Patrind HPP added, the overall score drops to 40%, still within Category D. However with the addition of Sukki Kinari the score reduces further to 31%, which is Category D/E. This reduction is due to the impacts downstream of Sukki Kinari dam.
3. Since Project includes an EFlow, baseload flow and Pro 3 level protection (within the Project area), the addition of this HPP improves the overall ecosystem integrity to a score of 46%, or Category C/D.
4. The addition of Naran HPP brings the score down to 43% and Batakundi HPP brings it further down to 40% or Category D.

Finally, with implementation of the Enhanced Management scenario, the ecosystem integrity can be improved to a score of about 63%, corresponding to an ecological integrity slightly higher than Category C. This is a significant improvement over the BAU and BM scenarios.

Exhibit 7.42: Predicted Ecosystem Integrity in the CIA Study Area with Sequential Implementation of Hydropower Projects



7.13.7 Livelihoods Related to Recreation and Tourism

There is expected to be a significant impact on recreation and tourism in the Kaghan and Naran areas as a result of the construction and operation of Sukki Kinari HPP and Naran HPP. Of the two riverside towns, Naran is the bigger center for recreation and tourism. According to the Tourism Corporation of KP there are currently over 100 hotels operating in and around Naran. Tourism in the area is seasonal, with most tourists visiting during the months of June, July and August. During these months a very significant proportion of local residents work in tourism related activities including the running of hotels and restaurants, labor in hotels and restaurants, provision of transport services, and work as tourist guides. Through the provision of accommodation, food and other services local communities in these areas derive a very significant portion of their annual income from recreation and tourism during the three summer months.

For the most part the construction and operation of Sukki Kinari and Naran HPPs is expected to have a negative impact on tourism in the area. There will be major changes to the present day largely natural environment as a result of access road construction, dam and powerhouse construction, inundation and changes in hydrology (reduced flows, peaking), which will have a detrimental impact on the aesthetics of the area and on activities such as recreational fishing. Dam operation will also create potential safety issues since peaking operations could result in accidents and fatalities as unaware tourists are swept into the river by sudden increases in water flow downstream of powerhouses.

In an area such as Naran with a well-established tourism sector there is a very high dependency on recreation and tourism for income. Any reduction in the number of tourists will have very serious socioeconomic consequences.

Guidelines and mitigations must be prepared as a part of the Sukki Kinari HPP and Naran HPP BAP/BMPs to minimize the impact of the developments on tourism in the area.

7.13.8 Management Strategy and Measures

As defined in **Section 7.13.5** *(Impact on Fish Fauna)*, the following two management scenarios were considered for development of the strategy to manage cumulative impacts:

- Baseline Management
- Enhanced Management

The Baseline Management Scenario

The significant defining aspects and possible outcomes under this scenario are summarized below:

- The Wildlife Department, KP has limited environmental management and monitoring capacity and will rely primarily on the hydropower industry to manage environmental impacts on an individual basis.
- Non-sustainable sand and gravel mining practices will continue resulting in loss of river habitats
- The Minerals Development Department, KP (MDDKP) does not have the policy, means and resources in place to regulate the mining from the river beds.

- ► The regulatory framework is essentially that of reliance on the environmental regulator, EPA, KP, which has limited monitoring and enforcement capacity in view of the limited number of staff and technical capacity.
- ► Cities, towns, villages, and residential areas continue to discharge effluents and solid waste into the streams in the CIA Study Area.
- ► Fishing activities by local communities remain unregulated and continue non-sustainable harvesting practices.

The long term outcome of this scenario in terms of prioritized VECs will be a high level of degradation of the river habitat and ecosystems resulting in substantial and irreversible loss of ecosystem functions and services. Some parts of the river ecosystems protected under the BAP/BMP developed for hydropower projects such as Project will survive and improve due to improved protection and surveillance supported by the projects.

Under this scenario the number of tourists visiting the Kaghan and Naran area is likely to decrease as the area's aesthetics and activities such as recreational fishing are negatively affected.

The Enhanced Management Scenario

Under this scenario, the owners of hydropower projects located within the CIA Study Area would individually and collectively fulfill their environmental and social responsibilities as mandated by law, and manage their corporate and reputational risks. Principal actions and measures recommended for implementation are listed below.

Principal Actions and Measures by the KP Government:

- ► Preparing guidelines for EIAs for hydropower projects, or adopting accepted best international practices for preparation of EIAs.
- ► Preparing guidelines for BMP/BAPs, or adopting accepted best international practices for preparation of BMP/BAPs.
- ► Making preparation of BAP/BMPs mandatory for hydropower developers in the Kunhar Basin.
- ► Making it a requirement for HPPs to achieve a net gain for key fish species in the Kunhar Basin
- ► Preparing and implementing guidelines for EFlow assessments, or adopting accepted best international practices for preparation of BAP/BMPs.
- ► Regulating fishing and sediment mining activities by local communities in collaboration with industry to ensure that sustainable harvesting practices are introduced and established.
- ► Working with industry to maintain effective watch and ward (patrolling) and regulatory pressure on communities to maintain harvesting at sustainable levels.
- ► Establishing an institution to conduct research for development of measures to mitigate the impact of hydropower dams on river ecology.
- ► Establishing a watershed management program to manage water quality in the basin.

Principal Actions and Measures by the Hydropower Industry:

- ► Designing and operating HPPs to balance power generation benefits and environmental impacts including setting of environmental flows and operating powerhouses at baseload, thereby avoiding peaking operations.
- ► Preparation and implementation of Biodiversity Action/Management Plans in their respective area of impacts, inclusive of supporting protection, conducting monitoring and evaluation, and adaptive management.
- ► Maintaining and updating environmental flow assessment models to continuously improve the understanding of ecosystems and to predict the impacts of operations on river ecosystems.
- ► Setting up detailed hydrology and sediment transport models for prediction of impact of operations on deposition of sediments, and consequentially on ecosystems and ecosystem services.
- ► Supporting watershed management in the basin to reduce erosion in the catchments and flow of pollutants into the river and tributaries.
- ► Supporting research and development to mitigate impacts of hydropower projects and to improve environmental management
- ► Building up environmental management capacity to manage environmental impacts on an individual and collective basis.

The long term outcome of this scenario in terms of river ecosystems and ecosystem services will be maintenance and most likely enhancement of ecosystem functions and services in selected segments of the river, and sustainable livelihoods. Under this scenario there is a likelihood of achieving an increase of about 10% (over the current baseline) in the population of endemic fish species in certain sections of the river.

The transition from the present Baseline Management to this scenario will require extensive and sustained effort over a period of time, and will essentially consist of building upon initiatives that have already been identified and partly tested by the Wildlife Department, KP in other parts of the province. The following management approach is proposed to achieve this transition:

1. An **environmental management framework** consisting of a set of preventive measures and management measures in the CIA Study Area to maintain a balance among:
   a. Maintenance of ecosystem services that are important for local livelihoods and well-being;
   b. Protection of ecosystems and biodiversity, consistent with the policies of the government and commitments made by the country under conventions such as Ramsar and the Convention on Biological Diversity.
2. An **institutional and policy framework** that strengthens key departments in KP and defines the roles, responsibilities and mandates of participating institutions in environmental management of the CIA Study Area.

3. A **financial management framework** that generates and provides funds for environmental management and defines mechanisms for transparent and effective utilization of funds.
4. A **monitoring and evaluation framework** that relies on continuous professional, scientific and independent monitoring of the extent to which the environmental management objectives are being achieved and identifies causes of poor performance or failure.

7.13.9 Institutional Arrangements for Implementation

The suggested roles and responsibilities of identified institutions can be categorized as follows:

- *Leadership and Enforcement:* Ministry of Water and Power and the KP Government
- *Coordination and Management:* Collectively by the industry through a Hydropower Advisory Committee that is recognized by the Ministry of Water and Power and the KP Government, and includes members of the government as well as the community
- *Implementation:* The Wildlife Department, KP and the Fisheries Department, KP
- Capacity Building: WWF, HWF
- *Management Support:* EPA, KP, district administrations, and MDDKP
- *Research:* Pakistan Museum of Natural History, Pakistan Council for Research on Water Resources
- Observation and Management Support: IFC, ADB

7.13.10 Options for Financial Management

It is assumed that actions within the scope of ESIAs for which the projects have independent responsibility will be financed by the projects from their capital and operating budgets as approved by the electricity regulator. The following is an outline of the proposed financial mechanism to support implementation of collective actions proposed in the CIA. These include:

- Administrative costs for the Hydropower Advisory Committee
- Institute for Research on River Ecology
- Watershed Management Program

The proposed financial mechanism consists of:

- A Fund for environmental management titled Kunhar Basin Environmental Management Fund can be set up under the Hydropower Advisory Committee and jointly managed by the industry and the KP government.
- The Advisory Committee will decide on where to use the funds, and how to maintain accountability and transparency.

- Inflows into the Fund can include mandatory and voluntary contributions from the hydropower industry and contributions from donors.

7.13.11 Monitoring and Evaluation

Following the Pressure-State-Response framework, the framework for monitoring of changes in VECs is described in the monitoring and evaluation (M&E) framework included in the BAP of the Project (see **Volume 2C** of the **EIA**). In addition to regular reviews by industry at individual levels and sharing of the results with the stakeholders, the Management Institution should review the M&E reports at least once a year.

7.13.12 Adaptive Management

The framework for adaptive management of cumulative impacts has three components:

1. The first component consists of evaluating the accuracy of the predicted environmental impacts. The corresponding goal is to improve the predictive capability of the models such as those for air quality, hydrodynamics, sedimentation, and water quality, and methods used to identify and quantify project-induced impacts.
2. The second component consists of assessing the effectiveness of the proposed actions and measures.
3. The final component is the modification of actions and measures as needed to ensure that environmental impacts remain within a range that is acceptable to stakeholders.

Suggested indicators and their thresholds for assessing the actual impact of Project are included in the BMP/BAP, which can be expanded to rest of the CIA Study Area. The goal for this component is to implement whatever modifications are needed in actions and measures to keep the levels of observed environmental effects below the thresholds and within the range acceptable to the stakeholders.

The proposed Advisory Committee can advise the Ministry of Water and Power and the KP Government on adaptive management decisions at the basin level following the review of monitoring and evaluation reports.

7.14 Climate Change Risk

A climate change risk assessment carried out in collaboration by Aqualogous, Team Consultants and Hagler Bailly Pakistan, included as part of the Feasibility Study, indicates the following based on analysis of multiple models, as well as literature:

- General potential increase in annual precipitation associated with increase in summer Monsoon precipitation.
- Decrease in winter and spring precipitation.
- Likely increase in the Probable Maximum Flood, based on the Maximum Precipitable Water.

The changes will have consequence on dam operations covered under the scope of the Feasibility Assessment. With respect to environmental impact, i.e. impact on receptors, the following impacts with dam in place, in conjunction with climate change are likely:

- Decreased environmental flow release downstream of the dam, particularly during low flow conditions in winter, based on assessed future green-house gas emissions scenarios and climate change models utilized by the IPCC Fifth Assessment Report (AR5).
- Increase risk of dam failure due to increase in Probable Maximum Precipitable water, and thereby Probable Maximum Flood, under high green-house gas concentration scenarios (representative concentration pathway 8.5) by 2070-2100.

With respect to the risk of decreased environmental flow releases, the design is resilient to climate change, since low level outlets are available and can be utilized to release environmental flow.

In addition, with respect to increase in Probable Maximum Precipitation, based on consultation with dam engineers, the dam is already over designed and an increase of 30-35% in probable maximum precipitation peak, a conservative estimate based on a 30-35% increase in maximum precipitable water, and the dam break risk assessment considers similarly large floods, that are unlikely to cause failure of the dam. Therefore, with respect to environmental impacts on receptors, in alignment with the impact assessment methodology (**Section 7.1**), the dam is resilient to climate change.

7.15 Impact of Transmission Lines

As discussed in **Section 3.7**, NTDC will construct a transmission line to evacuate power from the Project and connect to the main transmission system on the country. The construction of this transmission line is considered an associated facility[27]. Consistent with legislation, NTDC as owner of the transmission line will prepare a separate ESIA and will submit it for approval of Environmental regulator before any work on transmission line can begin.

A preliminary assessment of environmental and social impacts was carried out using ***Google Earth™*** satellite imagery and available geographic information on the wider area in which the transmission line will be located. Given a total length of the transmission line of approximately 720 m, erection of 2 towers is likely to be required. The location of towers can be adjusted in detailed design to minimize risk of land sliding and erosion. There is no reserve forest at the location of the transmission line. Moreover, it can be observed from **Exhibit 3.13** in **Section 3** that the proposed transmission line will neither affect any built-up structure or any agricultural land.

The terrestrial biodiversity of the area is similar to the biodiversity in the Terrestrial Study Area for this ESIA. The transmission line will have impacts on terrestrial vegetation and less mobile species, mainly herpetofauna species. It will also disturb habitat of small mammals and ground nesting birds. However, no species of conservation

[27] Associated facilities are not funded as part of the project (funding may be provided separately by the borrower/client or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project.

importance are found in the terrestrial habitat in this area. Construction phase impacts on terrestrial habitats will be temporary and localized, other than the permanent changes they might introduce in the local landscape and land use. Operation phase impacts on terrestrial ecology will be minor, except on avi-fauna. The operation of power lines or transmission lines has been associated with two major negative impacts for avifauna – collision and electrocution.

Based on an initial assessment, the socioeconomic impacts of transmission line are expected to be insignificant as the proposed transmission line will not affect any of the privately-owned assets, and there are no settlements close to the route of the transmission line. No social issues such as conflicts between outsiders and locals are therefore anticipated.

Until the transmission line alignment is finalized it will not be possible to assess the associated environmental or social impacts accurately. Some of the issues that may require detailed examination and the development and implementation of effective mitigation measures are likely to include the following:

- Land acquisition,
- Impacts from influx of workers,
- Impacts on cultural and religious sites,
- Visual impacts,
- Disturbance due to movement of vehicles, construction equipment and materials,
- Noise, dust and air quality,
- Access issues,
- Vegetation clearance,
- Excavation of soil and impacts on surface water,
- Risk of slope instability,
- Disturbance to wildlife,
- Impacts of continuing right of way maintenance.

Exhibit 7.43: Summary of Impacts

ID	*Aspect*	*Impact*	*Phase*	*Stage*	*Magnitude*	*Timeframe*	*Spatial Scale*	*Consequence*	*Probability*	*Significance*	*+/-*
1	Aquatic Ecology	Change in the Ecological Integrity through implementation of the BAP (see Volume 2C of the EIA)	C, O	Init	Major	Long Term	Extensive	High	Definite	High	+
2	Aquatic Ecology	Loss of riverine ecosystem due to inundation by Project reservoir	C, O	Init	Major	Long Term	Intermediate	High	Definite	High	-
				Res	Major	Long Term	Intermediate	High	Definite	High	-
3	Aquatic Ecology	Degradation of the river ecosystem in the low flow segment downstream of the Project dam	C, O	Init	Major	Long Term	Intermediate	High	Definite	High	-
				Res	Major	Long Term	Intermediate	High	Definite	High	-
4	Aquatic Ecology	Degradation of the River Ecosystem Downstream of the Tailrace	C, O	Init	Major	Long Term	Intermediate	High	Definite	High	-
				Res	Moderate	Long Term	Intermediate	High	Definite	High	+
5	Terrestrial Ecology	Terrestrial habitat loss caused by construction related activities	C	Init	Minor	Short Term	Small	Low	Possible	Low	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-
6	Terrestrial Ecology	Decline in abundance and diversity of terrestrial flora and fauna caused by construction related activities.	C	Init	Minor	Short Term	Small	Low	Possible	Low	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-
7	Terrestrial Ecology	Project operation leading to animal disturbance, displacement and decline.	O	Init	Minor	Long Term	Small	Medium	Possible	Medium	-
				Res	Minor	Medium	Small	Low	Possible	Low	-
8	Ambient Air Quality	Increase in ambient and ground level concentration of air pollutants from construction activities and vehicular movement may cause health impacts to the community.	C	Init	Moderate	Medium Term	Small	Medium	Possible	Medium	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-
9	Blasting and Vibration	Vibration from blasting during the construction phase may disturb local communities	C	Init	Moderate	Medium Term	Intermediate	Medium	Possible	Medium	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-

ID	Aspect	Impact	Phase	Stage	Magnitude	Timeframe	Spatial Scale	Consequence	Probability	Significance	+/-
10	Blasting and Vibration	Blasting may pose a health hazard due to flying debris.	C	Init	Moderate	Short Term	Intermediate	High	Possible	Medium	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-
11	Hydrology and Water Quality	Alterations of natural passage of springs due to blasting for tunnels may disrupt the water supply for mountain spring users.	C	Init	Moderate	Long Term	Intermediate	High	Possible	High	-
				Res	Minor	Medium	Intermediate	Low	Possible	Low	-
12	Hydrology and Water Quality	Use of local water resources for construction activities may reduce the water availability for local communities.	C	Init	Moderate	Short Term	Intermediate	Medium	Possible	Medium	-
				Res	Minor	Short Term	Small	Low	Unlikely	Low	-
13	Hydrology and Water Quality	Discharge from construction activities can potentially result in the contamination of groundwater and surface water.	C	Init	Moderate	Short Term	Small	Low	Possible	Low	-
				Res	Minor	Short Term	Small	Low	Unlikely	Low	-
14	Construction Noise	Increase in ambient noise levels due to operation of construction equipment, movement of construction traffic and blasting may create nuisance for nearby communities and visiting tourists.	C	Init	Moderate	Short Term	Small	Low	Possible	Low	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-
15	Soil, Topography and Land Stability	Contamination of soil as a result of accidental release of solvents, oils and lubricants can degrades soil fertility and agricultural productivity.	C	Init	Moderate	Medium	Intermediate	Medium	Possible	Medium	-
				Res	Minor	Medium	Intermediate	Low	Unlikely	Low	-
16	Soil, Topography and Land Stability	Land clearing, excavation, tunnel boring and other construction activities may loosen the top soil in the Project area resulting in loss of soil and possible acceleration of soil erosion and land sliding, especially in the wet season.	C	Init	Moderate	Short Term	Small	Low	Definite	Low	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-

ID	*Aspect*	*Impact*	*Phase*	*Stage*	*Magnitude*	*Timeframe*	*Spatial Scale*	*Consequence*	*Probability*	*Significance*	+/-
17	Soil, Topography and Land Stability	Failure of spoil dumping sites resulting in increased erosion and sediment load entering river.	C	Init	Moderate	Long Term	Intermediate	High	Possible	High	-
				Res	Moderate	Medium Term	Intermediate	Medium	Unlikely	Low	-
18	Aesthetics	Deterioration of aesthetics and visual amenity of nearby receptors due to construction activities, including vehicular movement on roads, may cause disturbance in aesthetics for tourists, businesses and nearby communities.	C, O	Init	Minor	Short Term	Small	Low	Possible	Low	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-
19	Aesthetics	Deterioration of aesthetics and visual amenity of nearby receptors due to low flow in the river may affect the scenic value of the area.	C	Init	Minor	Medium	Small	Low	Possible	Low	-
				Res	Minor	Medium	Small	Low	Possible	Low	-
20	Aesthetics	Permanent impact in aesthetics due to proposed developments.	O	Init	Minor	Medium	Small	Low	Possible	Low	-
				Res	Minor	Medium	Small	Low	Possible	Low	-
21	Traffic and Roads	Improved accessibility due to construction of Project access roads.	C, O	Init	Minor	Short Term	Small	Low	Possible	Low	+
				Res	Minor	Short Term	Small	Low	Possible	Low	+
22	Traffic and Roads	Increase in congestion, due to increased traffic volume will cause delays.	C	Init	Minor	Short Term	Small	Low	Possible	Low	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-
23	Traffic and Roads	Increase in traffic volume will deteriorate the air quality.	C	Init	Minor	Short Term	Small	Low	Possible	Low	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-
24	Traffic and Roads	Increased risk to community safety due to increased traffic volume during the construction phase near communities.	O	Init	Minor	Short Term	Small	Low	Possible	Low	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-

ID	Aspect	Impact	Phase	Stage	Magnitude	Timeframe	Spatial Scale	Consequence	Probability	Significance	+/-
25	Traffic and Roads	Degradation of the pavement due to use by heavy construction traffic.	C	Init	Minor	Short Term	Small	Low	Possible	Low	-
				Res	Minor	Short Term	Small	Low	Possible	Low	-
26	Livelihood and Well-being	Direct, indirect and induced employment at the local levels, resulting in increased prosperity and wellbeing due to higher and stable incomes of people.	C, O	Init	Minor	Long term	Extensive	Medium	Possible	Medium	+
				Res	Moderate	Long term	Extensive	High	Definite	High	+
27	Livelihood and Well-being	Increase in the stock of skilled human capital due to transfer of knowledge and skill under the Project resulting in enhanced productivity of the local labor.	C, O	Init	Minor	Long term	Intermediate	Medium	Possible	Medium	+
				Res	Moderate	Long term	Extensive	High	Possible	High	+
28	Livelihood and Well-being	Increase in recreational and subsistence fishing due to increase in catch of fish following creation of favorable habitats for the fish in the Kunhar River	C, O	Init	Minor	Long term	Extensive	Low	Possible	Low	+
				Res	Minor	Long term	Extensive	Low	Possible	Low	+
29	Livelihood and Well-being	Loss of income from sediment mining due to change in pattern of sediment deposition following construction of the dam	O	Init	Major	Long term	Extensive	High	Definite	High	-
				Res	Minor	Medium	Small	Low	Possible	Low	-
30	Livelihood and Well-being	Loss of assets and livelihood as a result of land acquired for the Project	D, C	Init	Major	Long term	Extensive	High	Definite	High	-
				Res	Minor	Medium	Small	Low	Possible	Low	-
31	Socio-Cultural Impacts	Increase in population due to in-migration of job seekers (in-migrants) leading to pressure on existing social infrastructure and services in the Study Area.	C	Init	Moderate	Medium	Intermediate	Medium	Possible	Medium	-
				Res	Minor	Medium	Intermediate	Low	Possible	Low	-

ID	Aspect	Impact	Phase	Stage	Magnitude	Timeframe	Spatial Scale	Consequence	Probability	Significance	+/-
32	Socio-Cultural Impacts	Disputes over distribution of Project employment within and between Study Area inhabitants and the in-migrants resulting in social unrest	C	Init	Moderate	Medium	Intermediate	Medium	Possible	Medium	-
				Res	Minor	Short term	Intermediate	Low	Possible	Low	-
33	Socio-Cultural Impacts	Potential social unrest in the Study Area due to conflicting socio-cultural norms amongst the inhabitants and in-migrants.	C	Init	Minor	Short term	Small	Low	Possible	Low	-
34	Socio-Cultural Impacts	Submergence of the graveyards.	C	Init	Moderate	Medium	Intermediate	Medium	Possible	Medium	-
				Res	Minor	Short term	Intermediate	Low	Possible	Low	-

8. Grievance Redress Mechanism

Timely and effective redress of stakeholder grievances will contribute to bringing sustainability in the operations of a project. In particular, it will help advocate the process of forming and strengthening relationships between project management and the stakeholder community groups and bridge any gaps to create a common understanding, helping the project management to efficiently operate in the area.

To register and resolve the grievances of the community in this process, a Grievance Redress Mechanism (GRM) will be established. The proposed mechanism will be based on two–tear grievance redress committees—at village level and at Project level. The proposed GRM will help achieve the objectives of sustainability by dealing with the environmental and social issues of the Project in a timely manner.

The village–level GRC will be established to engage village–level community members/leaders to participate in the decision–making processes and to have “voices” of the aggrieved person/communities in the grievance redress procedures. This will also enhance local ownership of the Project. Having members based in the village, the village–level GRC will be helpful in resolving the grievances quickly often without going into lengthy documentation. The local participation will further build local capacity in dispute resolution and decision–making and provide leadership support in the implementation of the Project. Cases which are not satisfactorily resolved or affected persons remain aggrieved, the case will then be forwarded to the Project–level GRC as the prime floor for resolution of the grievances.

The purpose of the GRM is to facilitate the resolving of disputes without going into litigation. In this regards, the decision of the Project level GRC will be final within the GRM. However, if any disputant remains dissatisfied with the GRC outcome, the disputant can seek redress from a court of law.

PEDO will be responsible for:

1. Establishing the GRM at each village level and at the project level. The GRM will be established as soon as PC–1 of a project is approved.
2. PMU must ensure that the community is informed of the mechanism to redress complaints.

8.1 Grievance Redress Committees

The Grievance Redress Committees (GRCs) are to ensure accessibility, fairness and independence of the procedures. The GRCs will be established at two–levels:

1. Village GRC, with the scope limited within the village; and
2. Project GRC, covering all the project affected villages.

The composition of the two committees is shown in **Exhibit 8.1**.

Exhibit 8.1: Members of GRC

Organization	*Village GRC*	*Project GRC*
PEDO	Field staff of PMU (PEDO) Chairperson	Representative from PMU (PEDO) Chairperson
Community	One or two elders nominated by the community	One or two elders nominated by the community

8.2 GRC's Scope of Work

The scope of work of the GRC shall include:

1. The village GRC will ensure that all grievances related to social and environmental issues are registered, formally recorded, reviewed, resolved and the concerned person is informed in a timely manner.
2. The Project GRC will monitor the working of the village GRC and will work as a forum for appeal against the decision of the village GRC.
3. GRC will not consider complaints related to the procurements or with any matters pending in the court of law.
4. In resolving the disputes, the GRCs would take into consideration the following:
    - Merit of the complaints/case received for consideration;
    - Evidences to take a decision on the complaint;
    - Witness statements;
    - Plausibility of the case in the light of related project activity;
    - Applicable laws, environmental guidelines of Pakistan, initial environmental examination and environmental review document of the project, and ADB environmental guidelines;
    - Observations made on the field; and
    - Available information on previous complaints of similar nature.

8.3 Approval and Orientation of GRC Members

The GRC members will be selected according to their responsibility and personal integrity. Community members of the village level GRCs will be selected after consultation with the communities. Community members of Project level GRCs will be nominated by the affected community. All GRCs' members will be approved and notified by the Project Director.

All GRC members will attend a training and orientation meeting prior to commencement of their work. The training will be provided by competent technical experts in social/resettlement and environmental management. The training will address the policy aspects, compliance requirements, expectations of the community, and need for rapport and communication with the affected communities, and finally need for independence and transparent views in dealing with grievances.

8.4 Dissemination of GRCs

After notification of all the GRCs information regarding GRCs will be disseminated in all the concerned villages by the Environment and Social Unit of the PMU. Information dissemination will comprise the following;

- List of GRC members including address and contact numbers.
- GRC scope of work.
- Grievance redress procedure.

8.5 Grievance Redress Procedure

Following procedure will be adopted to resolve grievances received by the GRCs. The grievance mechanism will be made public through public consultations by the Environment and Social Unit of PMU and Consultant.

8.5.1 Filing of Grievances to Village GRC

For grievances related to social and environmental safeguards, the aggrieved person (or their authorized representatives) may file a grievance with the village–level GRC in one of the following ways:

1. Submit a written complaint to any member of the village GRC.
2. Given the local cultural context, any aggrieved women may submit complaints to GRCs directly or through the head of the household.

For complaints registration Complaint Registration Forms will be available with the secretary of the village level GRCs and complaints will be registered on Grievance Log.

8.5.2 Hearing and Resolution of the Cases by Village GRC

The procedure for hearing and resolution of the complaint will be as follows:

1. On receipt of a complaint:
    - Secretary of village GRC will log the complaint in a register called Complaint Register.
    - Contact other members of the GRC to conduct a meeting within 10 calendar days of the logging of the complaint.
    - If needed, request the complainant or his representative to meet the Village GRC on the appointed date to discuss his complaint.
    - Prepare all the relevant information and document relevant to the complaint prior to the meeting and provide copies to all members.
2. The GRC will meet on the appointed date during which it may:
    - Deliberate on the nature and circumstances of the complaint;
    - Investigate the complaint based on evidence provided by the complainant;
    - Meet with the complainant and other persons;

- Visit the site; and
- Take a decision.

3. If the GRC needs extra time to investigate or deliberate on the complaint, the secretary will inform the complainant of the time when a decision is expected. In any case, all complaints shall be resolved within 30 calendar days of logging.
4. Once the complaint is resolved the secretary will document the decision and prepare full documentation on the process including minutes of meeting, photographs of visits, documents reviewed, and reasons of the decision.
5. The GRC will ensure that the complainant is fully informed of the decision and is also informed about his/her right to appeal to the Project GRC and to the court of law.
6. In case follow–up action is required, the chairperson of the village GRC will ensure that the actions are taken and are documented.

8.5.3 Hearing and Resolution of the Cases by Project GRC

The procedure for hearing and resolution of the complaint by the Project GRC will be as follows:

1. On receipt of a complaint from:

- Secretary of Project GRC will request all the concerned documentation from the secretary of the concerned village GRC.
- Contact other members of the Project GRC to conduct a meeting within 15 calendar days of the logging of the complaint to the Project GRC.
- If needed, request the complainant or his representative to meet the Project GRC on the appointed date and place to discuss his complaint.
- If needed, request the members of the village GRC to meet the Project GRC on the appointed date and place.
- Prepare all the relevant information and document relevant to the complaint prior to the meeting and provide copies to all members.

2. The Project GRC will meet on the appointed date during which it may:
   - Deliberate on the nature and circumstances of the complaint;
   - Investigate the complaint;
   - Meet with the complainant and other persons;
   - Visit the site; and
   - Take a decision.
3. If the GRC needs extra time to investigate or deliberate on the complaint, the secretary will inform the complainant of the time when a decision is expected. In any case, all complaints shall be resolved within 45 calendar days of logging with the Project GRC.

4. Once the complaint is resolved the secretary will document the decision and prepare full documentation on the process including minutes of meeting, photographs of visits, documents reviewed, and reasons of the decision.
5. The GRC will ensure that the complainant is fully informed of the decision and is also informed about his/her right to appeal to the court of law.
6. In case follow–up action is required, the chairperson of the Project GRC will ensure that the actions are taken and are documented.

8.5.4 Maintenance and Evaluation of Data by PMU

The Project Director (PD) PMU will ensure that it receives copies of all complaints, meeting notices, decisions, and documentations related to proceedings of the village and Project GRCs

The PMU will maintain complete record of the complaints in a database or tabular form consisting of the following fields:

- Project name
- Village, union council, tehsil, and district
- Name of complainant
- Nature of complaint like environment (trees cutting, Noise, Dust, Waste, Air–Water–Soil Pollution etc.), social (damage to infrastructure, land, privacy, Favoritism/Nepotism issues, etc), Gender (gender equality, empowerment, privacy etc.) and non–compliance to the Govt. /Donor provided guidelines.
- Date of logging of complaint with village GRC
- Date of first meeting of village GRC
- Information on members attended, number of meetings, meeting with complainant, and site visit.
- Date of decision of village GRC
- Follow–up actions, responsibilities, and completion with dates
- Date of logging of complaint with Project GRC
- Date of first meeting of Project GRC
- Information on members attended, number of meetings, meeting with complainant, and site visit.
- Date of decision of Project GRC
- Follow–up actions, responsibilities, and completion with dates

The PMU will prepare periodic report on the GRM reporting on, for example:

- Number of complaints received and resolved by village GRC, Project GRC and nature of complaint;
- The average time of it took to resolve the complaint; and
- The fraction to complaints that were resolved at the village GRC level.

9. Environmental Management Plan

9.1 Introduction

The Pakhtunkhwa Energy Development Organization (PEDO) intends to construct a 310 megawatt (MW) run-of-river hydropower plant (the “Project”) with related infrastructure at Balakot, Mansehra district of Khyber Pakhtunkhwa (KP), Pakistan. The Project called Balakot Hydropower Development Project (BHDP) is located on the Kunhar River about 18.6 km upstream of the town of Balakot.

A feasibility study (FS) of the Project[1] was prepared in 2013. The Asian Development Bank (ADB) is evaluating the Project for financing under its Hydropower Investment Development Program. As part of the evaluation of the Project, ADB has acquired the services of two consultants—Aqualogus - Engenharia e Ambiente, Lda (“Aqualogus”) to review and update the FS, and Hagler Bailly Pakistan (Pvt.) Ltd. (“HBP”) as Safeguard Consultants to prepare the documents required for ensuring that the project meets the environmental and social safeguards of the ADB, and also conforms to environmental legislation of KP.

9.1.1 Project Location

Exhibit 9.1 shows the location of the Project. The Project is located on the Kunhar River in the Khyber Pakhtunkhwa (KP) province of Pakistan, in the 12 km stretch from Paras to Sangar Village. The dam site (34° 39' 36.510" N, 73° 27' 1.340" E) will be located near the village of Paras in the Mansehra District of KP, about 18.6 km upstream of the town of Balakot. The Powerhouse site (34° 36' 15.143" N, 73° 22' 49.943" E) will be located 8 km upstream of Balakot, near Kappi Gali Village. The headrace tunnel extending approximately 9 km will divert water from the reservoir created by the dam to the powerhouse.

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1 Mirza Associates Engineering Services (Pvt.) Ltd. (Lead Consultant), December 2013, Feasibility Study of Balakot Hydropower Project, Volume I Main Report for Pakhtunkhwa Hydel Development Organization

Exhibit 9.1: Project Location

9.1.2 Introduction to the Environmental Management Plan

The Environmental Management Plan (EMP) summarizes the organizational requirements, management and monitoring plans to ensure that the necessary measures are taken by PEDO to avoid potentially adverse effects and maximize potential benefits of the Project and to operate in conformance with applicable laws and regulations of KP, as well as the policies of international financial organizations such as ADB.

Due to the nature and applicability of the EMP it will also be used for contractual purposes through its inclusion as a part of the bid documents for the EPC contractor who has to adhere to it along with other regulatory requirements. The strict implementation of the EMP and project management's strict enforcement of the adequate construction practices and standards will greatly reduce the negative impacts of the Project.

The EMP presented in this section is a component of the overall Environmental and Social Management System (ESMS), for which a framework is provided in **Section 9.2**.

The EMP is based on the baseline conditions (see **Section 4**, *Description of the Environment*), the impact assessment (see **Section 7**, *Anticipated Environmental Impacts and Mitigation Measures*), and the results of discussions with the stakeholders (see **Section 6**, *Information Disclosure, Consultation, and Participation*). The EMP is prepared for all the identified environmental impacts during design, construction, and operation of various Project activities. The methodology followed for preparing the EMP includes the following:

- Deriving mitigation/protection measures for identified impacts using impact evaluation methodology.
- Rationalizing and combining series of mitigation, compensation and enhancement measures from each identified impacts and risks to prepare overall measures.
- Developing a mechanism for monitoring the proposed mitigation measures.
- Estimating budget requirements for implementation, mitigation and monitoring measures.
- Identifying responsibilities of various agencies involved in the Project for implementation and monitoring of mitigation measures.

Additionally, a Biodiversity Action Plan (BAP) has been prepared for enhancement and conservation of biodiversity of the Kunhar River (see **Volume 2C** of the **EIA**), the implementation of which will involve support from KP Wildlife and Fisheries Departments, and NGOs.

9.2 Environmental and Social Management System

This section describes the framework for the Environmental and Social Management System (ESMS) for the Project.

This section will be revised following discussion with PEDO.

It is the responsibility of each project company affiliated with PEDO's PMU to establish its own ESMS to define the ESHS principles, objectives, and protection measures that ensure the Project does not cause unacceptable impacts. Contractors in turn will adopt the

Project Company's ESMS; however, PEDO PMU retains ultimate responsibility for the EHS performance of all contractors.

The basic elements of the ESMS for the Project are outlined in **Exhibit 9.2** with more detail on each element, and how it applies, given in the following sections. The elements of the ESMS are discussed under the headings of the "plan-do-check-act" business performance improvement cycle. Emergency planning and response and stakeholder engagement are elements of the ESMS that apply to all steps of the "plan-do-check-act" cycle as shown in **Exhibit 9.2**.

9.2.1 Planning Elements

Leadership and Accountability

Policy

The Project is being undertaken in accordance with PEDO's policies. PEDO will periodically review the scope and effectiveness of these policies. The policies will be documented, maintained, implemented and communicated to PEDO employees, contractors, suppliers and the public.

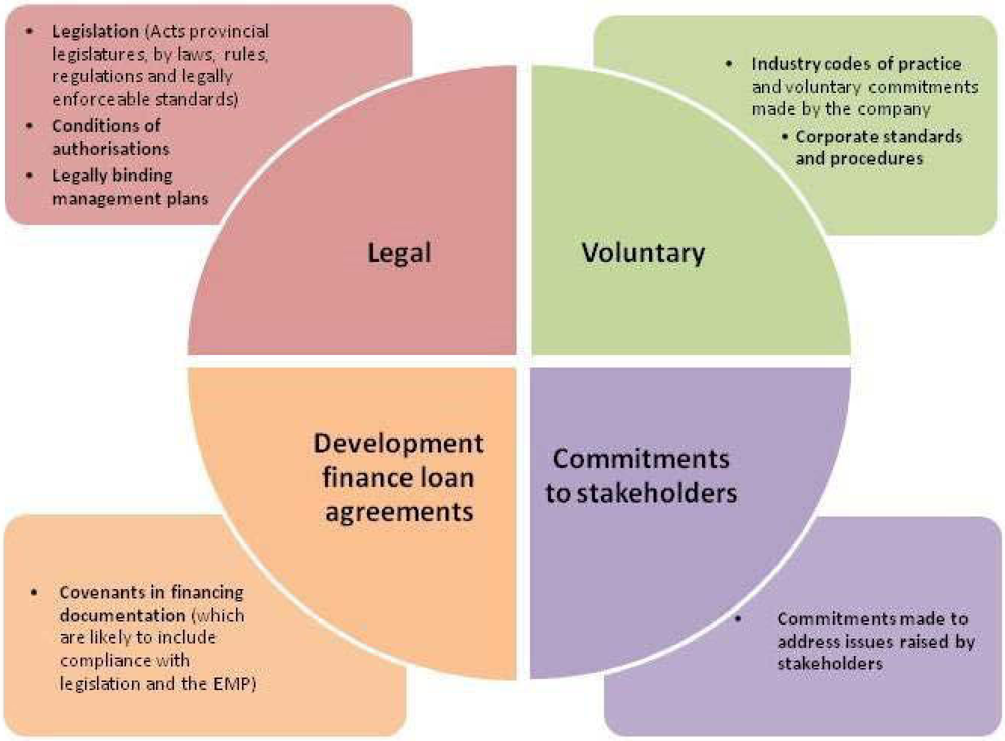
Legal Requirements and Other Obligations

The Project's ESMS takes into account of both legal and other obligations imposed on the Project. The various types of obligations that need to be considered are shown conceptually in **Exhibit 9.3**.

Exhibit 9.2: Elements of the Project ESMS

Steps of the "plan-do-check-act" cycle	Elements of the ESMS for the Project		Elements applying to all steps of the cycle	
	Elements	**Primary function**		
Plan (Chapter 2, *Planning Elements***)**	**Leadership and accountability**	Produce and communicate a statement of PEDO commitment to environmental and social management Establish, document, implement, maintain and improve the Project ESMS	↔ **Stakeholder engagement** An ongoing process, throughout the life of the project. Serves to build and maintain a constructive relationship with communities affected by the Project	**Emergency planning, response and recovery** Maintain emergency response preparedness through the identification of potential environmental emergencies, development of response plans and allocation of response and recovery resources.
	Legal and other requirements	Identify and provide access to legal requirements and other obligations		
	Aspect identification and impact assessment	Identify aspects ("mechanisms" by which project activities impact on the environment) and assess associated impacts throughout the Project life (the EIA falls under this element of the ESMS)	↔	
	Objectives, targets and plans	Define objectives, targets, criteria and actions for the management of potential impacts (the EMP falls under this element of the ESMS)		
Do (Chapter 3, *Implementation Elements***)**	**Roles and responsibility**	Provide sufficient management sponsorship of human and financial resources Establish roles and responsibilities for implementation		
	Contractors, suppliers and vendors	Consider environmental and social impact management and performance in the selection and management of third party services		
	Competence, training and awareness	Make personnel aware of their responsibilities and enable them to be capable and competent in meeting their responsibilities		
	Communication	Maintain internal and external communications to enable effective environmental management	↔	
	Operational controls and maintenance	Implement operational controls and maintain equipment to uphold environmental performance and compliance and to manage impacts and risks		
	Documentation and record keeping	Control and maintain documents and records associated with environmental and social management		
Check (Chapter 4, *Check Elements***)**	**Assessing, correcting and improving performance**	Monitor environmental and social management and performance and take measures to continually improve performance	↔	
	Non-conformance and incident reporting	Promptly report non-conformances and incidents are promptly reported and take corrective and preventative actions to reduce the likelihood of recurrence		
	EMP and ESMS reporting	Report on compliance with the EMP and ESMS performance to senior management, regulatory authorities and affected communities	↔	
Act (Chapter 5, *Act Elements***)**	**Governance/ management review**	Require site, regional and senior management to review the suitability, adequacy and effectiveness of the ESMS and identify improvement actions to facilitate continuous improvement		
	Management of change	Modify the ESMS in response to changes in the Project and to changes in the organization, personnel, operations and processes	↔	
↔	*The arrows show where there is integral relationship between stakeholder engagement and other elements of the ESMS.*			

Exhibit 9.3: Types of Obligations Relevant to the ESMS



PEDO will identify, document and maintain a register of legal requirements and other obligations applicable to the Project. It will also:

- manage recurring legal and other obligations (such as inspections, sampling, analysis and reporting);
- track developing legislation and regulations that may apply to operations and activities to anticipate and prepare for compliance;
- inform employees and others working on behalf of the company of existing and emerging obligations that apply to their job responsibilities; and
- consider the register in the setting and review of objectives, targets and plans for management of impacts.

Aspect Identification and Impact Assessment throughout the Project Life

A key element of ESMS is identification of aspects and assessment impacts. The EIA is a part of this element of the ESMS. The impacts identified in the EIA in **Section 7** (*Anticipated Environmental Impacts and Mitigation Measures*) are addressed in this EMP

Procedures will be set up, implemented and maintained for identification of significant environmental aspects and undertaking of impact and risk assessments on an ongoing basis through the Project life. These will address:

- aspects not covered by this EIA;

- any impact arising that was not predicted by the EIA or did not develop as predicted by the EIA; and
- any changes in the Project or new developments arising subsequent to the completion of this EIA.

Objectives, Targets and Plans for Management throughout the Life of the Project

This element of the ESMS pertains to the setting of objectives and targets for environmental and social management, and plans for the achievement of these objectives and targets at corporate and Project levels. The EMP embodies this element of the ESMS at the Project level.

The primary purpose of the EMP is to guide environmental and social management throughout the life of the Project. The core of the EMP is a statement of environmental and social management objectives and associated management measures. The EMP will be supported by other documentation, such as the original Project design and specific management plans and operating procedures.

The preliminary EMP commitments are derived from the following sources:

- inherent design or management measures described in the EIA and Project Feasibility Study;[2]
- mitigation and enhancement measures identified in the EIA, which are required to manage identified impacts; and
- good practice management measures, which may not significantly alter the impact rating but are considered standard industry practice for the management of such impacts.

9.2.2 Implementation (do) Elements

Effective implementation and functioning of the EMP depends on adequate human and financial resources, clearly defined responsibilities for environmental and social management, appropriate training and good communication. An outline of how these features will be managed for the Project is presented below.

Roles and Responsibility

PEDO will define, document and communicate the environmental and social management roles and responsibilities of Project personnel, including contractors, Owners Engineers, and others working on behalf of the company, in all phases of Project implementation from detailed design through to closure, before the start of each phase. Personnel with specific roles and responsibilities will have the authority, and be held accountable for, carrying out these.

The basic roles required to implement the EMP, and establish and maintain the ESMS, are shown in **Exhibit 9.4**. These roles need to be reviewed and incorporated into the organizational structures for the various phases of the Project from detailed design through to closure. A key requirement is for the senior environmental management

[2] China Water Resources Beifang Investigation, Design and Research Co. Ltd. (BIDR), Revised Technical Report To Updated Feasibility Study, April 2016

professional to report directly to the on-site senior manager (the Operations/General Manager).

Exhibit 9.4: Key Roles for Environmental and Social Management

Roles	*Relevant Responsibilities*
Project Director for the Project Management Unit (PMU) of the Project	▶ Endorse the environmental and social management policy and require it to be communicated to the public ▶ Allocate adequate human and financial resources to enable effective functioning and continual improvement of the ESMS ▶ Establish and maintain a governance system
Project site management and PMU's senior management	**Compliance** ▶ Confirm necessary authorizations (licenses/ permits) have been obtained for the Project ▶ Confirm compliance with legal requirements and other obligations pertaining to environmental and social management ▶ Commit contractors and suppliers to meeting relevant environmental and social obligations by means of specific conditions in the contracts of appointment **Roles and responsibility** ▶ Define, document and communicate environmental and social management roles, responsibilities and authorities ▶ Provide sufficient appropriately trained human resources and adequate financial resources to enable effective functioning and continual improvement of the ESMS ▶ Hold personnel responsible for meeting their assigned responsibilities **Communication and reporting** ▶ Confirm there is adequate ongoing stakeholder engagement ▶ Confirm obligations for reporting to regulatory authorities, development financiers and affected communities are met **Management review** ▶ Provide leadership in the pursuit of environmental and social management ▶ Examine and review the ESMS periodically to determine its suitability, adequacy and effectiveness ▶ Support action to enhance the ESMS and make improvements in environmental and social management performance
Environmental management	**ESMS** ▶ Establish the ESMS, with assistance from the senior management, division managers and community relations managers ▶ Liaise with division managers regarding environmental management roles, responsibilities and authorities throughout operational divisions

Roles	*Relevant Responsibilities*
	▶ Coordinate monitoring and evaluation activities and confirm corrective actions (an action taken to address a non-conformance) are taken to address incidents and non-conformances (a failure to comply with the Project's ESMS) ▶ Report progress in implementation and functioning of the ESMS to senior management, development financiers, regulatory authorities and stakeholders **EMP** ▶ Keep the EMP up to date and confirm it addresses all relevant environmental and social obligations ▶ Present the EMP in an appropriate format for communication with regulatory authorities and other stakeholders ▶ Present the EMP in an appropriate format for communication with parties responsible for Project execution ▶ Compile EMP compliance reports ▶ "Sign-off" actions in the EMP and non-conformances once they have been completed
Community relations management	▶ Assist the Environmental Management team with ongoing reporting to stakeholders on EMP and supporting management plans, and progress with implementation of management measures ▶ Assist Environmental Manager and division managers with stakeholder communication where awareness and/ or co-operation of stakeholders are required to implement management measures ▶ Manage the community grievance mechanism
Division management (management that oversees certain specified sections in an organization)	▶ Confirm the ESMS and EMP are established, communicated, implemented and maintained in their respective areas ▶ Provide leadership in the pursuit of environmental and social management ▶ Identify ways to improve environmental and social performance through daily monitoring of their activities and evaluating implementation ▶ Review monitoring results, incidents and corrective actions taken ▶ Evaluate adequacy and effectiveness of awareness and skills training programs pertinent to environmental and social management ▶ Maintain internal communication of environmental and social matters between the Environmental Manager, Community Relations Manager and other personnel, and promote environmental and social awareness. ▶ Examples of key responsibilities of specific Division Managers include: ▷ Human resources—Organize in association with the Environment Manager and Community Relations Manager environmental and social related training, maintain linkages between the ESMS and human resources management

Roles	Relevant Responsibilities
	systems, as necessary, and manage worker grievance mechanism. ▷ Finance—Track budget/spend data used in implementing and maintaining ESMS in association with the Environment Manager and Community Relations Manager ▷ Purchasing—With the support of environment and community relations teams, assess contractors' and suppliers' environmental and social compliance and control purchase and disposal of hazardous materials ▷ Maintenance—Implement preventive maintenance program for equipment ▷ Health, safety and security—With the support of community relations teams, confirm safeguarding of personnel and property is carried out without adverse impacts on local communities
All personnel and contractors	▶ Work in accordance with the EMP and supporting documents ▶ Report problems or deviations from the ESMS or EMP to division managers and/or environmental managers, as instructed.

PEDO Management can assign part of its responsibilities to Owner's Engineer for construction phase of the Project. All such assignments shall be explicitly included in the contract agreement between PEDO and the Owner's Engineer. Moreover, all associated reporting, documenting, and cost shall also be agreed and written in the contract agreement.

Contractors, Suppliers and Vendors

Environmental and social performance, programs and risk management will be considered in the selection and management of contractors, suppliers and vendors. Contracts will address potential environmental and social liabilities and responsibilities including:

- use of competent, trained staff, including subcontractors;
- consequences for failing to meet obligations;
- monitoring of performance;
- required job-specific, site-specific training;
- compliance with PEDO policies and site standards and applicable legal requirements;
- responsibility for chemicals brought on-site and wastes generated on-site, including closure activities where appropriate; and
- identification of a lead responsible person for both PEDO and the contractor.

Contractors, including their employees and associated subcontractors, will be made aware of the environmental risks, associated controls, procedures and standards relevant to their work on-site. The activities and performance of contractors will be monitored through

Owner Engineer's Environmental & Social Development Cell (ESDC) against the terms of the contracts.

Training

Personnel, including contractors' personnel, working for or on behalf of the Project will receive training to maintain awareness of relevant environmental and social aspects, impacts and risks associated with the Project and corresponding controls. The training will also maintain awareness of the environmental benefits of improved personal performance and the potential consequences of departure from specified procedures. Visitors to Project sites will receive relevant environmental and social awareness training as part of site induction training.

Personnel, including contractors' personnel, will be made aware of the particular environmental and social management responsibilities that apply specifically to their jobs. Training needs analyses will be undertaken and personnel will be given adequate training to meet these responsibilities.

The training program comprises the following elements:

- identification of training needs for all employees specific to their varying responsibilities;
- development of a training plan and schedule to address defined needs;
- verification of training programs to confirm consistency with organizational requirements;
- training of employees and documentation of training received;
- evaluation of training effectiveness; and
- review and modification of training programs, as required.

Personnel with direct responsibility for implementation of the EMP and functioning of the ESMS will have additional training to:

- provide them with the knowledge and skills necessary to perform their work;
- maintain their knowledge of relevant environmental and social obligations; and
- enable them to implement specific measures required under the EMP in a competent and efficient manner.

Training requirements and completed training will be documented. Procedures to evaluate the effectiveness of such training will be implemented.

Communication

To effectively implement environmental and social management, the relevant managers will maintain lines of internal communication and provide information regarding the EMP, ESMS and environmental and social management performance, incidents, best practices, lessons learned and concerns to personnel electronically, on notice boards and/or in newsletters. Such communication will be used to inform the personnel of their individual responsibilities with respect to the ESMS and to raise awareness on specific matters. External stakeholder engagement is discussed in **Section 6** *(Stakeholder Engagement)*.

A grievance redress mechanism will be established (**Section 8**, *Grievance Redress Mechanism*) and will provide a means for Project personnel, including contractors' personnel, to anonymously raise environmental and social concerns (this grievance mechanism will be separate from the system dealing with employee grievances that need to be handled by the human resources department).

Operational Controls

Operational controls will be implemented to maintain performance and compliance, and to manage impacts and risks. Operational controls may include:

- administrative controls such as performance standards;
- standard operating procedures and work instructions; and
- engineered controls such as pollution control equipment.

Written operational controls are required where their absence could lead to deviation from environmental obligations or objectives and targets. Written operational controls will be part of the EMP supporting documentation.

The adequacy, suitability, and effectiveness of operational controls will be reviewed regularly.

Documentation on the design basis and operating criteria/limits for equipment having the potential to impact environmental performance will be maintained.

Operating equipment, as well as environmental monitoring and measurement devices, will be maintained consistent with manufacturers' specifications and best management practice to reduce the potential for environmental incidents and adverse environmental impacts.

Documentation and Record Keeping

Elements of the ESMS will be documented and controlled in accordance with a document control system. Records demonstrating compliance with legal requirements and conformance with the ESMS will also be maintained. PEDO will establish, implement and maintain procedures for:

- ESMS document control detailing how the creation, review and updating of various types of documents will be managed and who will be responsible; and
- record identification, storage, protection, retrieval, retention and disposal.

Documentation and record keeping controls will include:

- measures to enable relevant documents (including those of external origin deemed necessary for planning and operation of the ESMS) and records to be readily available and identifiable (labelled, dated and properly filed), legible and protected from damage;
- review, revision and approval of documents for adequacy by authorized personnel at least once a year;

- making current versions of relevant documents available at locations where operations essential to the effective functioning of the ESMS are performed;
- suitably identifying obsolete documents retained for legal and knowledge preservation purposes; and
- identification and segregation of confidential and privileged information.

9.2.3 Check Elements

Checks are required to confirm the existence of an effective ESMS and compliance with the EMP. Checks include monitoring, site inspections and formal audits. Linked to this, measures need to be taken to remedy non-conformances and to continually improve environmental performance. These are also classified as “check” elements of the ESMS.

Assessing, Correcting and Improving Performance

Monitoring Programs

The aim of monitoring programs are to:

- provide measurements of environmental and social impacts of the Project;
- ascertain and demonstrate compliance with conditions of approval and other legislation;
- provide sufficient evidence to address any claims made against the Project in respect of environmental and social matters;
- track performance of the ESMS and progress in the implementation of the EMP;
- track and measure key indicators and other performance measures over time to improve the Project’s performance and reduce the likelihood of environmental incidents; and
- inform decision processes for determining management actions.

The monitoring programs cover the physical, biological and social components of the operation and are integrally linked with the assessment criteria stated in the EMP. Where appropriate and possible, the sampling parameters and locations used in the EIA baseline studies have been retained to provide data continuity.

The monitoring program identifies monitoring parameters, sampling locations, sampling frequency and duration and detection limits (where appropriate). It includes control sites, where relevant. The focus and extent of monitoring is commensurate with the risk of impacts occurring, the sensitivity of the surrounding areas and the affected communities’ perceptions of risks to their health and environment. For some types of monitoring, thresholds or targets are available, for example the emission and ambient limits. In other cases, the monitoring results will be compared to the baseline data set gathered as part of this EIA. Lastly, where neither thresholds nor baseline data are available, the initial data collection may form the baseline for future data collection.

Data will be documented and interpreted. Temporal and spatial trends in the data will be discerned and compliance with relevant thresholds will be evaluated. Monitoring reports will be produced to meet internal and external reporting requirements. If monitoring results indicate non-conformance with stipulated thresholds or if a significant deteriorating trend is observed, it will be recorded as a non-conformance and handled by the non-conformance and incident procedure.

Preliminary monitoring programs have been prepared and are presented in the EMP. These provide a framework of monitoring to evaluate performance and assist in predicting and managing impacts. In conjunction with the development of supporting documentation for the EMP, detailed monitoring plans, with appropriate sampling protocols where relevant, may need to be developed. These more detailed supporting documents would include the criteria against which the monitoring results will be compared and the actions required if the criteria or thresholds are exceeded. The supporting documents may also cover:

- sample or data collection methods;
- sample handling, storage and preservation;
- sample or data documentation;
- quality control;
- data reliability (calibration of instruments, test equipment, and software and hardware sampling);
- data storage and backup, and data protection;
- interpretation and reporting of results; and
- verification of monitoring information by qualified and experienced external experts.

The frequencies and locations of monitoring may need to be adjusted depending on final Project design and ongoing review of results obtained by the monitoring programs. Therefore, the programs will be reviewed on a regular basis (at least annually) and adjusted, where necessary. Changes to the EMP or obligations register may also result in changes to the monitoring program.

Site Inspections

Site inspections will be undertaken regularly in relevant areas of the Project. The inspections will focus on compliance with the EMP and conformance with the ESMS. The inspections will play an important role in increasing awareness of EMP and ESMS requirements.

Continuous observation and monitoring by site and HSE managers and other responsible parties for compliance with the EMP and conformance with the ESMS will be part of their core responsibilities.

Minor non-conformances will be discussed during the inspection and recorded as a finding in the inspection report. Major non-conformances will be reported as incidents. Inspection results will be disclosed at management meetings.

Formal Audits

Formal audits will be undertaken at planned intervals in accordance with the requirements of PEDO, PEDO's owners and regulatory authorities. Procedures for audits will be established, implemented and maintained. These will cover the audit criteria, scope, frequency and methods, and will address the responsibilities and requirements for planning and conducting audits, reporting results and retaining associated records.

Negative findings arising from an audit will be dealt with in accordance with the non-conformance and incident procedure. Results from audits and evaluations of compliance with legal requirements will be reported to site and senior management and subject to management reviews.

Non-conformances and Incident Reporting

Non-conformances include the following:

- exceedances of relevant thresholds as identified during routine monitoring;
- non-conformances with the requirements of the EMP or supporting documentation identified during an internal inspection;
- non-conformances identified during an audit or by regulatory authorities, including legal non-conformances;
- events, such as spills, resulting in potential or actual environmental harm;
- events that did or could result in injury to staff, visitors to site or surrounding communities; and
- significant complaints or grievances received from any source.

Corrective and preventive actions will be identified and implemented in response to these non-conformances. These actions will address the root cause of the non-conformance and will reduce or prevent repeated non-conformances.

A process will be established for the identification, investigation and tracking of non-conformances, including:

- prioritizing and classifying non-conformances based on the type and severity of the non-conformance;
- recording of non-conformances and the results of corrective and/or preventive actions, including the actions necessary to mitigate or remedy any associated impacts;
- defining results expected from the corrective and/or preventative actions;
- confirming the corrective and/or preventive actions taken to eliminate the causes of the non-conformance are appropriate to the magnitude of problem and commensurate with the impacts encountered;
- reviewing the effectiveness of the corrective and/or preventive actions taken; and
- implementing and recording required changes in the EMP or monitoring program resulting from corrective and preventive action.

Serious non-conformances will be classified as incidents. Incidents will be promptly reported to appropriate management. PEDO will prepare a guideline on:

- the types of incidents reportable to internal management at the site, Project and corporate levels, as well as to regulatory authorities and other external stakeholders; and
- standards to be observed when reporting incidents.

The investigation of incidents and evaluation of effectiveness of existing controls and response actions will be undertaken at a level commensurate with the severity of the incident.

EMP and ESMS Reporting

Progress on compliance with the EMP and functioning of the ESMS (environmental and social performance) will be reported to:

- Project site and PEDO senior management;
- development financiers, if required in terms of the loan agreement;
- regulatory authorities, as required; and
- affected communities and other stakeholders who have an interest in the Project.

9.2.4 Act Elements

Governance/ Management Review

PEDO's senior management will review the EMP and ESMS on a periodic basis to determine its suitability, adequacy and effectiveness. Each management review will initiate a new plan-do-check-act cycle with enhancement of the ESMS and continuous improvements in environmental and social management performance. The management review will cover:

- progress and closure of actions from previous management reviews;
- monitoring programs findings/ the extent to which objectives and targets have been met;
- findings of audits;
- incidents and the status of corrective and/or preventative actions;
- impact and risks assessments;
- changing circumstances, including changes to operations, Pakistan legislation or guidelines, ownership, socio-political circumstances;
- legal compliance and compliance with other obligations;
- stakeholder concerns, requests or complaints;
- adequacy of policies, EMP, monitoring plans, support documents and overall functioning of the ESMS to meet operational and corporate requirements; and
- recommendations for improvement.

Management of Change

Changes to the Project can be expected throughout the life of the Project. These can range from changes to operations and infrastructure, new developments (such as an expansion), changes to personnel and the Company, changes in legislation and changes to the environment of the Project (such as a new settlement established near Project infrastructure). These changes could result in changes to the significance of environmental and social impacts and risks. This may necessitate updates to existing authorizations/ permits, changes to the EMP, which may have to be approved by regulatory authorities, and general changes to the ESMS framework.

A procedure for the management of change will be established and maintained by PEDO. This will:

- observe the corporate owners' requirements for the management of change;
- identify proposed changes that could alter environmental or social impacts and risks and/ or require new authorizations/ permits or changes to existing authorizations/ permits; and
- define the impact and risk assessments appropriate to different types of changes, which need to be undertaken by competent personnel.

Changes will not be made without the required authorizations/permits in place. The measures identified as necessary to mitigate impacts and risks will be implemented. The various elements of the ESMS will be modified as required in response to the change,

A procedure specifically for changes to the policy/s, EMP, monitoring plans and supporting documentation will be established. This will detail:

- how the changes are to be recorded;
- who has responsibility for overseeing changes and checking they do not conflict with any planning conditions or other obligations;
- the process of review and sign off in response to changes; and
- how changes to the EMP should be communicated internally and externally.

9.3 Stakeholder Engagement

Stakeholder engagement provides stakeholders with opportunities to express their views on project risks, impacts and impact mitigation measures and involves appropriate consideration of the views and responses by project management. **Exhibit 9.5** shows that stakeholder engagement applies to each of the steps of the ESMS "plan-do-check-act" cycle and is an integral part of several ESMS elements. The relationship between stakeholder engagement and these elements is explained further in **Exhibit 9.5**.

Exhibit 9.5: General Overview of the Relationship between Stakeholder Engagement and the ESMS elements

Steps of the "plan-do-check-act" cycle ESMS Elements that Stakeholder Engagement is Integral to		
	ESMS Elements	*Role of Stakeholder Engagement*
Plan	EIA	During the EIA, the focus of stakeholder engagement has been the involvement of stakeholders in project-planning and project-approval decision-making processes. It facilitated identification of stakeholder's concerns so they could be addressed in the Project design and/or EMP. It forms the basis for stakeholder engagement throughout the life of the Project.
	EMP	Stakeholders will be involved in the review and approval of the preliminary EMP. Throughout the life of the Project, there should be ongoing reporting to stakeholders on progress in the implementation of the EMP and supporting management plans that are of interest to them. The EMP and supporting management plans may need to be revised in response to stakeholders' concerns.
	SEP	A stakeholder engagement plan is to be developed. It will detail national regulation and good practices on stakeholder engagement, a summary of previous stakeholder engagement undertaken for this Project, required additional consultations, and the structure for future stakeholder engagement.
Do	Communication	Communication with stakeholders will be required to implement some management actions. The communication will be required to raise awareness and/or co-operation of potentially affected communities and other stakeholders. PEDO will determine effective communication methods for making affected communities aware of actions they may need to take to avoid exposure to operation-related hazards and how they can maximize on opportunities resulting from the operation.
Check	Assessing, correcting and improving performance	Participatory monitoring is desirable. This entails involvement of stakeholders, particularly affected communities, in monitoring and verifying information to check that impact mitigation measures are appropriate.
		Grievances will be handled as incidents and managed through the incident procedure to enable the grievance to be received, documented, addressed and results fed back to the complainants. This procedure will protect the confidentiality of the persons raising the complaint, where necessary. The feedback will be easily accessible and understandable to members of the affected community and/or staff.
	Reporting	Stakeholders affected by the Project will be informed of progress in the implementation of the management plans and of the effectiveness of management measures.

PEDO has established an initial program of stakeholder engagement for the Project and this will continue throughout the life of the Project. Currently, this program includes disclosure of information and consultation with stakeholders as part of the EIA process.

When the Project enters the construction phase, and throughout the remaining life of the Project, stakeholder engagement will include:

- a grievance mechanism, for receiving concerns about the Project's environmental and social performance and for facilitating the resolution of the concerns (the grievance mechanism applies to Project stakeholders, including potentially affected communities and Project personnel.
- reporting on the implementation of the EMP and relevant supporting management plans;
- opportunities for stakeholders to respond to the information received; and
- constructive dialogue on environmental and social issues and performance.

The stakeholder engagement process will be documented, including:

- maintenance of a stakeholder database with stakeholder details;
- records of information disclosed to stakeholders;
- records of stakeholder engagements; and
- records of inputs from stakeholders and responses to these.

9.3.1 Emergency Preparedness and Response

The Project will implement and maintain an Emergency Preparedness and Response Plan (EPRP).

Purpose and Applicability

This framework is intended to guide the means by which PEDO and its contractors will ensure that they are prepared for emergency situations and can respond effectively should they arise. For each stage of a project's project life cycle, PEDO and/or contractor will develop and implement an ERPR that meets the requirements of this framework. PEDO will identify the party responsible for preparing the EPRP. It is expected that most emergencies during construction would take place on the site, so the Plan prepared for the construction period would primarily (but not exclusively) address on-site emergencies. During operation, on the other hand, dam failure or other emergencies could cause significant downstream impacts, so the Plan for the operations period would address a combination of on-site and off-site emergencies and actions.

Approach and Activities

EPRPs for new projects will initially be developed based on the Environmental and Social Impact Assessment or other assessment document that identifies on-site and off-site risks during the project life cycle that could result from an accident or other emergency situation, and on a detailed assessment of site activities. The EIA and/or other documents would typically identify specific risk-reduction measures as well, which would become part of the EPRP. EPRPs for existing projects will initially be based on due diligence assessments that evaluate risks of ongoing construction and/or operations, and again will include a detailed assessment of site activities. EPRPs will also be informed by and based upon the best judgment of qualified professionals and the experience gained from ongoing activities. EPRPs will become part of the Project's Environmental Management Plan.

The EPRP will identify various emergency situations that could realistically occur, which could include:

- Fire or explosion
- Road or site traffic accident
- Spills of hazardous materials such as fuels, chemicals, oil, paint, etc.
- Landslides, mudslides, or rockfalls
- Equipment failure
- Earthquakes (primarily during operation)
- Cofferdam failure
- Partial or complete dam failure (impacts of dam break provided as **Appendix T**)
- Floods
- Turbine or blade failure.
- Site lockdown due to breach of security, external attack, or other event.

The EPRP will call for close coordination with local authorities regarding preparing and responding to emergencies that could affect local people or communities. Particularly if there could be serious off-site impacts, EPRPs will describe the coordination process, including PEDO support for community emergency preparedness and response training.

EPRPs will include details for the following elements, which could be different for various types of accidents:

- Organizational and individual responsibilities for both emergency preparedness and for emergency response, which could be very different. This would include roles and responsibilities of responders and decision-makers.
- Measures that need to be taken to prepare for potential emergencies, including equipment, supplies, warning signals, dedicated communication lines, etc.
- Details on how relevant authorities, the public, and third-party emergency response agencies will be informed of potential risks due to emergency situations resulting from project activities, and on agreements that have been reached for cooperative responses to emergencies.
- Contact details of all dedicated and non-dedicated emergency response personnel on the site and personnel who are available off-site.
- Contact details of relevant authorities and third parties who will need to notified for various types of emergencies (nearby residents, landowners, fire brigades, local law enforcement, military, etc.).

- Detailed information on internal and external equipment, personnel, facilities, funding, expert knowledge, and materials that will be required to respond to specific types of emergencies. The EPRP will also need to identify the specialized expertise that may be needed to respond to specific emergencies.
- Procedures for using, inspecting, testing, and maintaining emergency response equipment, which may include equipment under the control of third parties (for example, the local fire brigade or emergency medical teams).
- Clear procedures and protocols for notifications and communications to and within the contractor (if any), local and other authorities, potentially affected people, and other parties.
- Emergency response procedures to be followed, and by whom, for various emergency situations.
- Locations of holding/areas for workers and off-site collection points for others, and conditions under which they would be used.
- Pro forma incident report forms.

The EPRP should call for a root-cause analysis following any emergency or near-emergency situation in order to identify improvements in future preparedness or response. The EPRP, or a separate planning process, should also include measures to ensure business continuity and contingency, including:

- Identifying and making contingency arrangements to exploit replacement supplies or facilities – which could include buildings, electricity, water supplies, equipment and vehicles, fuel, etc. -- to allow business continuity.
- Maintaining backups of critical information, including relevant EPRPs that form the EMP, in a secure but accessible location to ensure continuity or restoration of site activities, including implementation of mitigation measures.

Monitoring, Recordkeeping, and Reporting

The EPRP will describe records that must be kept to document various activities required to maintain emergency preparedness, and the person(s) responsible for maintaining the records. The EPRP will also describe how notice and details of any imminent or actual emergency will be communicated within the contractor (if any), local authorities, potentially affected people, and other parties.

The EPRP will require periodic inspection/monitoring of the Project site(s) and records, with a focus on areas where accidents or other occurrences could lead to emergency situations. The EPRP will need to specify:

- The locations, activities, and records that must be inspected.
- The frequency of inspection.
- The required qualifications of persons who will conduct the monitoring.
- Records that must be kept and the person responsible for keeping the records.

- Special hazards of inspection, including appropriate cross-references to the Occupational Health and Safety Plan for required and recommended risk reduction measures.
- Reports that will be prepared, to whom the reports are to be submitted for review, and the length of time records will be kept. This could include summary reports or detailed technical reports, and could be submitted to company or PEDO management, government agencies, or lenders.

The EPRP will describe how remedial actions will be identified and implemented in the event that monitoring reveals shortcomings in emergency preparedness or in recordkeeping, and how follow-up monitoring will be implemented until the requirements of the EPRP are fully met.

Implementation

The EPRP will identify and describe the responsibilities of all parties, including PEDO, contractors, and competent authorities. The EPRP must also identify the roles and responsibilities of individual positions within PEDO and the contractor. This will include the chain of command for directing response activities in case of various types of emergencies. This should be shown in an organogram that includes as much detail as possible, down to the individual person/position.

Training

The EPRP will identify training requirements for staff and managers of PEDO and/or contractors, including who will be responsible for conducting the training and who must be trained in what skills. Training will also extend to third parties who may be called upon to respond to emergencies. Training will focus on the assigned responsibilities of the trainees in preparing for emergencies and for responding to emergencies if they occur, and will cover technical and administrative skills needed to perform assigned responsibilities. The EPRP will need to provide for emergency preparedness and response training should be closely coordinated with occupational health and safety training. The EPRP should call for at least the following topics to be part of emergency preparedness and response training.

- Providing information necessary for trainees to understand the possible effects of various types of emergencies and an opportunity to contribute effectively, as appropriate, to decisions concerning preparedness and response.
- Providing specific information on appropriate behavior and safety measures to be adopted in case of various types of emergencies.
- The specific responsibilities of the person being trained in case of various types of emergencies.
- Scheduled and unscheduled drills and practice in responding to various types of emergencies, including site evacuation, and procedures to monitor drills closely to verify that staff and managers are aware of their responsibilities and are able to complete them.

Relationship to other Plans

The emergency preparedness and response plan is related to the following plans:

- Spill Prevention and Response Plan.
- Waste Management Plan.
- Blasting and Explosives Control Plan.
- Stakeholder Engagement Plan.
- Dam Safety Review Procedure.
- Site Security Plan.
- Occupational Health and Safety Plan.

Revision

The EPRP will be reviewed by PEDO or the contractor as appropriate, at least annually and whenever there is a significant change in Project or site conditions, or when it is determined that any measure intended to prevent or reduce the probability of emergency situations is or may be insufficient to achieve its purpose. The EPRP will also be reviewed following the root-cause analysis that is completed after any emergency or near-emergency. It will be revised when necessary to update or improve emergency preparedness and response, and when it is determined necessary to ensure compliance with applicable standards and good international industry practice.

9.4 Mitigation and Management Plan

This section summarizes, as the mitigation and management plan, the mitigation measures for the Project as prescribed in the EIA. It divides the responsibilities for implementation of these measures and describes additional management plans that must be developed to facilitate implementation.

9.4.1 Environmental and Social Mitigation

The mitigation plan includes the following:

- **Impact Reference** – this specifies the impact/s for which the mitigation measure is proposed. The impact reference can be used to look up, if required, details on the assessment of the specific impact in **Section 7** (*Anticipated Environmental Impacts and Mitigation Measures*). A summary is provided in **Exhibit 9.6**.
- **Mitigation Measure** – this summarizes the required mitigation measures as given in the above referenced chapter to keep environmental impacts at an acceptable level.
- **Implementation Measure** – these are additional measures that are required for the correct execution of the mitigation measures.
- **Monitoring Indicators** – these are indicators that should be tracked to ensure compliance.

The mitigation plans are given in **Exhibit 9.7** to **Exhibit 9.9.**

Mitigation measures are further divided by responsibility and are presented in the exhibits indicated in the list below. Each table indicates the management unit which the mitigation measure is expected to fall under. This is to facilitate implementation so that managers can locate their responsibilities completely and efficiently.

Design Phase

- Project Design and Construction Planning (**Exhibit 9.10**)

Construction Sites

- Dam Site Construction Manager (**Exhibit 9.11** and **Exhibit 9.12**)
- Powerhouse Site Construction Manager (**Exhibit 9.11** and **Exhibit 9.13**)
- Headrace Tunnel Construction Manager (**Exhibit 9.11** and **Exhibit 9.14**)
- Waste Dump Area Manager (**Exhibit 9.11**)
- Quarry Area Manager (**Exhibit 9.11**)
- Workshop Manager (**Exhibit 9.15**)
- Batching Plant Manager (**Exhibit 9.16**)
- Construction Camp Manager (**Exhibit 9.17**)
- Spoil Disposal Site Manager (**Exhibit 9.18**)

Construction Support

- Transport Fleet Manager (**Exhibit 9.18**)
- Labor Manager (**Exhibit 9.20**)

Other

- Community Liaison Officer (**Exhibit 9.21**)
- Project Environmental Manager (**Exhibit 9.22**)
- PEDO (**Exhibit 9.23**)
- Owner's Engineer (OE) (**Exhibit 9.24**)

A transmission line connecting the Project to the national transmission system is categorized as an Associated Facility (see **Section 3**). NTDC, the owner of the transmission line, will carry out a separate EIA for this transmission line. Mitigation measures described in the EIA of transmission line will be reviewed as part of implementation of EMP.

Exhibit 9.6: Impacts Assessed during the EIA

Impact Reference	Impact
1	Improvement of the river ecosystem through implementation of the BAP
2	Loss of riverine ecosystem due to inundation by Project Reservoir.
3	Degradation of the river ecosystem downstream of the dam.
4	Alteration of the river ecosystem downstream of the Tailrace.
5	Terrestrial habitat loss caused by construction related activities.
6	Decline in abundance and diversity of terrestrial flora and fauna caused by construction related activities.
7	Project operation leading to animal disturbance, displacement and decline.
8	Increase in ambient and ground level concentration of air pollutants from construction activities and vehicular movement may cause health impacts to the community.
9	Vibration from blasting during the construction phase may disturb local communities.
10	Blasting may pose a health hazard due to flying debris.
11	Construction activities may be cause alterations to groundwater flow patterns.
12	Use of local water resources for construction activities may reduce the water availability for the local communities.
13	Discharge from construction activities can potentially result in the contamination of soil, groundwater and surface water
14	Increase in ambient noise levels due to operation of construction equipment, movement of construction traffic and blasting may create nuisance for nearby communities and visiting tourists.
15	Contamination of soil as a result of accidental release of solvents, oils and lubricants can degrades soil fertility and agricultural productivity.
16	Land clearing, excavation, tunnel boring and other construction activities may loosen the top soil in the Project area resulting in loss of soil and possible acceleration of soil erosion and land sliding, especially in the wet season.
17	Failure of spoil dumping sites resulting in increased erosion and sediment load entering river.
18	Deterioration of aesthetics and visual amenity due to construction activities.
19	Degradation of aesthetic value of the area due to low flow section.
20	Permanent impact in aesthetics due to proposed developments.
21	Improved accessibility due to construction of Project internal roads.
22	Increase in congestion, due to increased traffic volume will cause delays.
23	Increase in traffic volume will deteriorate the air quality.
24	Increased risk to community safety due to increased traffic volume during the construction phase near communities.
25	Degradation of the pavement due to use by heavy construction traffic.

Impact Reference	*Impact*
26	Direct, indirect and induced employment at the local levels, resulting in increased prosperity and wellbeing due to higher and stable incomes of people.
27	Increase in the stock of skilled human capital due to transfer of knowledge and skill under the Project resulting in enhanced productivity of the local labor.
28	Increase in recreational and subsistence fishing due to increase in catch of fish following creation of favorable habitats for the fish in the Kunhar River.
29	Loss of income from sand and gravel mining due to change in pattern of sediment deposition following construction of the dam.
30	Loss of assets and livelihood as a result of land acquired for the Project.
31	Increase in population due to in-migration of job seekers (in-migrants) leading to pressure on existing social infrastructure and services in the Study Area.
32	Disputes over distribution of Project employment within and between Study Area inhabitants and the in-migrants resulting in social unrest.
33	Potential social unrest in the Study Area due to conflicting socio-cultural norms amongst the inhabitants and in-migrants.
34	Submergence of community graveyards.

Exhibit 9.7: Design Phase Mitigation Plan

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
5	Terrestrial habitat loss caused by construction related activities	▶ Minimize disturbance to, or movement of, soil and vegetation ▶ Minimize project footprint. ▶ Retain as much natural vegetation as possible. ▶ Locate construction facilities based on a knowledge of the soil, slope and vegetation cover of the area to avoid disturbance to the natural environment.	During detailed design	EPC Contractor	Measures included in design documents
6	Decline in abundance and diversity of terrestrial flora and fauna caused by construction related activities.	▶ Locate vehicle yards away from open soils and top soil stockyard ▶ Maximize use of locally-sourced aggregate and borrow material ▶ Minimize contact of non-local aggregate and borrow material with native soil. ▶ Minimize disturbance to, or movement of, soil and vegetation.	During detailed design	EPC Contractor	Measures included in design documents
10	Blasting may pose a health hazard due to flying debris.	▶ A minimum buffer of 500 m should be provided between the settlements and point of blasting.	During detailed design	EPC Contractor	Measures included in design documents
11	Construction activities may be cause alterations to groundwater flow patterns.	▶ Record location of the springs especially those in areas proximal to where the underground headrace tunnel will be closer to the ground level	During detailed design	Supervision Consultant	Record of springs
12	Use of local water resources for construction activities may reduce the water	▶ Prepare a Water Sourcing and Abstraction Plan specifying the source, owner, total yield, current usage, allowable quantity and the duration for which water can be obtained.	During detailed design	EPC Contractor	Agreements between community, government and contractor

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
	availability for the local communities.	▶ To the extent possible avoid, and where unavoidable, minimize the use of water from local sources (springs) for the Project where local abstraction is unavoidable: ▶ Undertake an assessment of the local source identifying its total yield and current usage. If the abstraction from a single source extends three months, the assessment shall be repeated ▶ Fix the allowable quantity to not more than 50% of the available yield (total yield minus current usage) ▶ Enter into a formal agreement with the owner for the water source (or government if it is a public source).			Water Sourcing and Abstraction Plan
14	Increase in ambient noise levels due to operation of construction equipment, movement of construction traffic and blasting may create nuisance for nearby communities and visiting tourists.	▶ Use visual alarms in preference to audible alarms. ▶ Locate noisy equipment behind parking lots, parks or behind sound barriers or sound absorbers – for example, gravel stockpiles or constructed barriers. and away from potential sources of conflict ▶ Using vibratory piling instead of impact piling. ▶ Erect earth mounds around the site boundary can provide acoustic as well as visual screening.	During detailed design	EPC Contractor	Measures included in design documents
17	Failure of spoil dumping sites resulting in increased erosion and sediment load entering river.	▶ Dumping sites should have a flood prevention design for a 20-year flood. ▶ A spoil management plan should be developed as described in **Section 9.4.3** which will implement measures to prevent this.	During detailed design	EPC Contractor	Measures included in design documents
20	Permanent impact in aesthetics due to proposed developments.	▶ Develop and implement a Site Rehabilitation and Landscaping Plan. ▶ Use colors that better integrate with the landscape. ▶ Disguise elements with vegetation where possible.	During detailed design	EPC Contractor	Measures included in design documents

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Retain as much natural vegetation as possible.			
21	Improved accessibility due to construction of Project internal roads.	▶ Consult communities during final design and location of site access roads.	During detailed design	EPC Contractor	
22	Increase in congestion, due to increased traffic volume will cause delays.	▶ Make roundabouts for the congestion points. ▶ Retain as much natural vegetation as possible to reduce the impact of smoke due to vehicles. ▶ Consult National Highway Authority for implementation of the above measures	During detailed design	EPC Contractor	Measures included in design documents
30	Loss of assets and livelihood as a result of land acquired for the Project.	▶ See LARP (**Volume 8**)	Before construction	PEDO/Land Acquisition Collector	See LARP (**Volume 8**)
34	Submergence of the graveyard.	▶ Plaster the graves with mud or cement. ▶ If relocation of the graveyard cannot be avoided, it shall be managed through the local religious authorities	During detailed design	PEDO	Measures included in LARP
34	Impact of climate change in possible enhancing of flood impacts such as during possible overtopping of spillway	▶ Ensure minimal damage to dam structure from small amount of overtopping of spillway through design.	During detailed design	PEDO	Measures included in Climate Risk Rerport

Exhibit 9.8: Construction Phase Mitigation Plan

IR	*Impact*	*Mitigation Measure*	*When*	*Responsibility*	*Monitoring Indicators*
	Construction Impacts	▶ The site specific environmental management plan (SSEMP) (see **Section 9.5.3**) for each site will outline areas to be cleared, vegetated areas to be protected or fenced, slopes to be stabilized and solid waste disposal locations. ▶ Submit all SSEMP to Owner's Engineer for approval.	At start of construction	Site Managers of EPC	SSEMPs prepared before initiation of construction
1	Improvement of the river ecosystem through implementation of the BAP	▶ Implement the BAP (see **Volume 2C** of the **EIA**)	As given in BAP	As given in BAP	As given in BAP
2	Loss of riverine ecosystem due to inundation by Project Reservoir	▶ Implement the BAP (see **Volume 2C** of the **EIA**)	As given in BAP	As given in BAP	As given in BAP
3	Degradation of the river ecosystem in the low flow segment downstream of the Project dam	▶ Offsets to loss of biodiversity by implementation of the BAP (see **Volume 2C** of the **EIA**).	As given in BAP	As given in BAP	As given in BAP
4	Degradation of the River Ecosystem Downstream of the Tailrace	▶ Implement the BAP (see **Volume 2C** of the **EIA**).	As given in BAP	As given in BAP	As given in BAP
5	Terrestrial habitat loss caused by construction related activities.	▶ Provide awareness training to staff and contractors on: prevention of injury of animals; identification of likely species found on site; identifications of animal hazards (such as venomous snakes); and what to do if dangerous animals are encountered.	During construction	EPC Contractor	SSEMPs prepared before initiation of construction Visual confirmation of replantation

IR	*Impact*	*Mitigation Measure*	*When*	*Responsibility*	*Monitoring Indicators*
		▶ Solid waste should only be disposed of at designated sites and a Waste Management Plan developed and implemented. ▶ Prepare an Environmental Training Plan that contains awareness training to staff and contractors on: prevention of injury of animals; identification of likely species found on site; identifications of animal hazards (such as venomous snakes); and what to do if dangerous animals are encountered. Also see guidelines for the Environmental Training Plan in IR 5. ▶ Encourage personnel to report sightings of wildlife of conservation importance or incidents of poaching to PEDO. ▶ Minimize disturbance to, or movement of, soil and vegetation. ▶ Prevent soil damage and erosion. ▶ Prevent Alien Invasive Species (AIS) establishment on exposed stored soil (do not store bare soil near known sources of AIS). The habitat most at risk is the Riparian Habitat. The species that are highest risk include Parthenium Weed, Common Weed and Castor Oil Plant. ▶ Train and raise awareness regarding AIS among Project staff and contractors. ▶ Retain as much natural vegetation as possible. ▶ Solid waste should only be disposed of at designated sites. ▶ Minimize the project footprint, clearly delineate and restrict access beyond work sites and other areas to be disturbed. ▶ Within the quarry and borrow areas, activities will be restricted to areas at a distance from perennial water			Waste Management Plan Environmental Training Plan

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		channels so as to avoid disturbances to them including the risk of siltation.			
6	Decline in abundance and diversity of terrestrial flora and fauna caused by construction related activities.	▶ Large flood lights should not be installed outside 50 m of the Project fence. ▶ Lights should be directed towards Project facilities and not towards the natural habitats. ▶ Regulations for Project staff and contractors to avoid illegal poaching to be incorporated in contract documents. ▶ Provide awareness training to staff and contractors on: prevention of injury of animals; identification of likely species found on site; identifications of animal hazards (such as venomous snakes); and what to do if dangerous animals are encountered. ▶ Incorporate regulations for Project staff and contractors to avoid illegal poaching in contract documents. ▶ Provide adequate knowledge to the workers on relevant government regulations and punishments for illegal poaching. ▶ Encourage personnel to report sightings of wildlife of conservation importance or incidents of poaching to PEDO. ▶ Project staff and contractors to report kills of large mammals particularly designated species of conservation concern. ▶ Train and raise awareness regarding AIS among Project staff and contractors. ▶ The Contractor shall prepare an Environmental Training Plan for all construction workers: the Plan shall address the following items:	Before and during construction	EPC Contractor	Environmental Training Plan Training Schedule Evidence of trainings and attendance lists Provision of required regulations in contract documents. Evidence of tree planting to required levels and yearly survival records.

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ All Contractor's employees shall be required to comply with environmental protection procedures and they shall be able to provide evidence that they attended the training sessions detailed in the Plan; ▶ The Plan shall educate all construction workers on the following issues but not limited to them: fire arm possession, traffic regulations, illegal logging and collection of non-timber forestry products, non-disturbance of resettlement communities, hunting and fishing restrictions, waste management, erosion control, health and safety issues, all prohibited activities, the Code of Conduct requirements and disciplinary procedures, and general information on the environment in which they will be working and living; ▶ Establishment of penalties for those who violate the rules; ▶ Proposed methods for conducting the training program, which shall include formal training sessions, posters, data in newsletters, signs in construction and camp areas and 'tool box' meetings. ▶ Equipment emitting excessive noise in comparison with other similar equipment will not be allowed to operate. ▶ Equipment under use will be regularly maintained, tuned, and provided with mufflers to minimize noise levels. ▶ Equipment in poor state of maintenance, particularly without effective noise control will be checked to determine if it can be improved, and replaced with less noisy equipment as soon as practicable.			

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Blowing of horn will be prohibited on all sensitive areas except under emergency conditions. ▶ Compensatory trees will be planted. The EPC Contractor will plant a minimum of ten trees for each tree removed in acquired land. ▶ PEDO will monitor and maintain the vegetation until it is established. ▶ Implementation of the BAP.			
8	Increase in ambient and ground level concentration of air pollutants from construction activities and vehicular movement may cause health impacts to the community.	▶ Develop and implement an Air Pollution Control Plan ▶ Prepare a site-specific environmental management plan (see **Section 9.5.3**) for each construction site and must outline areas to be cleared, vegetated areas to be protected or fenced, solid waste disposal locations, and sprinkling locations. Fugitive and exhaust emissions from transport vehicles ▶ Cover all trucks hauling soil, sand, and other loose materials or require all trucks to maintain at least two feet of freeboard (i.e., the minimum required space between the top of the load and the top of the trailer). ▶ Install and maintain all vehicles and machinery with appropriate emission control equipment. ▶ Regularly maintain vehicles and equipment to keep emissions in check. ▶ Smoke from internal combustion engines should not be visible for more than ten seconds. ▶ To the extent possible, use new and low emission equipment and vehicles. ▶ Purchase best quality fuel and lubes and where possible use lead free oil and lubes.	Before and during construction	EPC Contractor	SSEMP documents prepared before initiation of construction Air Pollution and Control Plan Continuous observation for non-compliance Vehicle and equipment maintenance logs

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Sprinkle water on all unsealed roads used by Project vehicles that are within 200 m of any settlement. ▶ Cover loads and long-term piles of friable material to reduce fugitive dust emission. ▶ Reduce traffic speeds on all unpaved surfaces to 15 miles per hour or less. ▶ Paved roads shall be swept frequently if soil material has been carried onto adjacent paved, public thoroughfares from the Project site. ▶ Install wheel washers where vehicle exit onto paved road from unpaved. ▶ Wheel washing of vehicles leaving the site. ▶ Wash vehicles/equipment prior to each trip. ▶ Use catalytic converters on vehicles, an emission control device, used to convert harmful pollutants to less harmful pollutants e.g. it converts the nitrogen oxides back into nitrogen and oxygen. ▶ Appropriate maintenance of vehicles and machinery. Fugitive dust emissions from blasting ▶ Indicate the limits of a clearing land with highly visible markers. ▶ Leave a layer of about 5 m of undisturbed softs above the top of the overburden blasts. This will act as a blanket to contain air blast, dust and fly rock. ▶ Sprinkle water on the area where blasting is done to settle down the particulate matter emissions. Fugitive dust emissions from quarry areas ▶ Indicate the limits of a clearing land with highly visible markers.			

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Avoid earth stripping or moving in periods of dry and windy weather. ▶ Carry out dust generating activities where maximum protection can be obtained through topography or in areas where prevailing winds will blow dust away from sensitive areas/uses. ▶ Water spraying of conveyors/conveyor transfer points, stockpiles and roads. ▶ Covering of fine dry loads or spraying of loads prior to exiting the site, and if necessary regular cleaning of public roads in the vicinity of the entrance. Fugitive dust emissions from concrete batching plants ▶ Suspend earthwork operation when wind speed exceeds 20 km/hr. in areas within 500 m of any settlement. ▶ The whole process of weighing and mixing would be performed in a fully enclosed environment. ▶ The mixers would all equipped with dust collectors, no dust emission would be expected. ▶ Siting the concrete batching plant out of prevailing high winds minimizing dust emissions. ▶ The prevailing wind direction should be considered to ensure that bunkers and conveyors are sited in the leeward direction to minimize the effects of the wind. ▶ The provision of natural or artificial wind barriers – such as trees, fences and landforms – to help control the emission of dust from the plant should be considered. ▶ Batching plants should be sited on land that is not flood prone.			

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Batching plant should be kept as near to natural sinks to minimize emissions to ambient environment ▶ All stacks to be vertical and at least 3 m above ground Fugitive dust emissions from aggregate production and handling system ▶ Suspend operation when wind speed exceeds 20 km/hr. in areas within 500 m of any settlement. ▶ The prevailing wind direction should be considered to ensure that aggregate handling systems located in the leeward direction to minimize the effects of the wind. ▶ Sprinkle water on all exposed surfaces, particularly those close and up-wind of settlements. Wind-blown dust from exposed surfaces such as bare land and waste dumping sites ▶ Cover all exposed surfaces, particularly those close and up-wind of settlements. ▶ All grading operations on a project should be suspended when winds exceed 20 miles per hour. ▶ Minimize disturbance to, or movement of, soil and vegetation. ▶ Sprinkle water on all exposed surfaces, particularly those close and up-wind of settlements. ▶ Retain as much natural vegetation as possible. Wind-blown dust from stockpiles of dusty materials such as sand and other minerals ▶ On-site dirt piles or other stockpiled PM should be covered, wind breaks installed and water and/or soil stabilizers employed to reduce wind-blown dust emissions.			

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Adequately wet, cover with plastic, or provide with wind shield all stockpiles to reduce dust emission. ▶ Sprinkle water on all exposed surfaces, particularly those close and up-wind of settlements. ▶ Minimize disturbance to, or movement of, soil and vegetation. ▶ Prevent soil damage and erosion. ▶ Retain as much natural vegetation as possible.			
9	Vibration from blasting during the construction phase may disturb local communities.	▶ Develop a Blasting and Explosives Management Plan and Vibration Monitoring Plan. ▶ Conduct a pre-construction survey of structures at risk of vibration impacts households. ▷ In the initial stages, the blasting induced vibration shall be measured as a function of maximum instantaneous charge and distance from the blasting site. This data shall be then used to refine the Blasting Induced Vibration Risk Zones on the basis of the adopted criteria. ▷ Using, the refined Blasting Induced Vibration Risk Zones maps and the tunnel boring schedule, the Supervision Consultant in consultation with the PEDO and the Construction Contractor, shall identify the houses that will be affected and the impact duration and schedule. ▷ For the houses that will fall in the Structural Damage Risk Zone, a temporary relocation plan will be developed. An amendment to the Land Acquisition and Resettlement Plan (LARP) (see **Volume 8**) will be commissioned for this purpose. Before start of blasting, all residents of houses in the Structural Damage Risk Zone will be relocated as per the LARP.	During Construction	EPC Contractor	Blasting and Explosives Control Plan document Blasting timetable available in nearby villages Results of preconstruction survey Availability of GRM

IR	*Impact*	*Mitigation Measure*	*When*	*Responsibility*	*Monitoring Indicators*
		▷ A survey will be undertaken in both zones, to determine the pre-blasting conditions of the buildings. The survey will be commissioned by the Supervision Consultant and will identify and record any existing damage to the structures. The survey will cover the following aspects: o Overall condition of the structures, both exterior and interior. o Documentation of defects observed in the structure using digital imagery along with notes, measurements and sketches. o Documentation of pre-existing cracks using digital imagery along with notes, measurements and sketches. ▶ Following completion of the blasting, the survey will be repeated in the Structural Damage Risk Zone to determine the condition of the buildings and verify that they are safe for re-occupation. If the buildings are safe, the residents will be allowed to return to their houses following any necessary damage repairs. If the buildings are damaged beyond repair, compensation will be paid to the owners as per the LARP (**Volume 8**). If there are any claims or reports of damage in the Cosmetic Damage Risk Zone, the affected house will be surveyed against the pre-Project survey and repairs will be undertaken as appropriate. ▶ Following are key mitigation measures for the management of blasting: ▷ Blasting will be scheduled during the day only. ▷ Local communities will be informed of blasting timetable in advance and will be provided			

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		adequate notice of when blasts are required outside of the planned schedule. ▷ A Blasting Management Plan will be developed by the Construction Contractor. The Plan will be reviewed and approved by the Supervision Contractor before the initiation of the blasting work. ▷ Throughout the blasting activity, vibration sensors will be installed at strategic location to monitor the impact of blasting and to ensure that the vibration levels are within the adopted criteria. The monitoring plan will be part of the Blasting Management Plan. ▷ Unscheduled blasting will be strictly prohibited in any case. ▶ Meaningful contact with the community shall be maintained and their grievance shall be attended to in a timely manner. In this regard: ▷ A meaningful community engagement plan will be developed. The plan will cover identify the affected community; the key contact persons; frequency of engagement; the information to be shared; the responsibilities to manage the plan; and the notice period to be giving to the community for various blasting related generating activities. ▷ The Grievance Redress Mechanism will be used to record, investigate, and respond to any complaints. Investigation of the complaints will be undertaken by the Supervision Consultant. ▶ Develop a Vibration Monitoring Plan that will include monitoring of vibration levels and frequency around the blasting sites. The objectives of the monitoring will be to:			

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▷ Ensure that vibration levels in the communities are within the adopted criteria levels; ▷ Maintain record of vibration to settle any potential conflicts; and ▷ Monitor changes in the vibration levels due to possible changes in the rock formation and take appropriate corrective actions.			
10	Blasting may pose a health hazard due to flying debris.	▶ A minimum buffer of 500 m should be provided between the settlements and point of blasting. ▶ Leave a layer of about 5 m of undisturbed softs above the top of the overburden blasts. This will act as a blanket to contain air blast, dust and fly rock. ▶ Ensure that the holes are correctly collared with respect to the back-break/inclination of the face and also that digging alongside the initiation face well controlled. ▶ Inadequate forward displacement of the front row burden arising out of the under charging of these holes will result in fly rock from vertical catering of the rear holes. ▶ Where fly rock possesses a serious problem, the stemming length should not be less than the hole burden. Also, an effective stemming material like crushed angular rock should be used to prevent premature venting of explosion gases through the stemming column. ▶ The forward fly rock could be fairly controlled to the commonly used 'inline open loop' pattern. The maximum inter-row delay interval consistent with the absence of cut off helped in minimizing the fly rock formation. As a thumb rule an inter-row delay of 4-8ms/m of burden could be used for this purpose.	During Construction	EPC Contractor	Blasting and Explosives Control Plan document Blasting timetable available in nearby villages Results of preconstruction survey Availability of GRM

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Adequate care should be taken while connecting the delay devices in the holes/rows and the initiation sequence properly checked before firing to avoid initiation of blast holes out of sequence. ▶ Blasts designed on a face length to width ratio in the range of 3 to 4 produces minimum fly rock.			
11	Alterations of natural passage of springs due to blasting for tunnels may disrupt the water supply for mountain spring users.	▶ Record location of the springs especially those in areas proximal to where the underground headrace tunnel will be closer to the ground level i.e high risk areas (see **Exhibit 7.20** and **Exhibit 7.21**). ▶ Monitor flow for located springs and maintain records. ▶ Support the community in development of alternate water supply schemes through local NGOs ▶ Ensure the availability of water to the communities and the access of the communities to the water resources being used by them is not adversely affected.	During construction	EPC Contractor	Flow records of identified springs
12	Use of local water resources for construction activities may reduce the water availability for the local communities.	▶ Develop a Water Sourcing and Abstraction Plan ▶ Source water for construction from authorized abstraction sources agreed between the local communities, local government and EPC contractor. ▶ Water conservation techniques will be developed and implemented by the EPC contractor. ▶ Access of community to water sources shall be kept clear so that the community's ability to meet its water requirements are not compromised. ▶ Exercise care while moving heavy machinery to avoid damage or blockage of natural waterways and channels. ▶ Maintain records of water usage in all Project activities.	Before and during construction	EPC Contractor	Agreements documents for water use. Water Sourcing and Abstraction Plan Water use record documents

IR	*Impact*	*Mitigation Measure*	*When*	*Responsibility*	*Monitoring Indicators*
		▶ Incorporate the above measures in the Construction Site Environmental Management Plan (see **Volume VI**).			
13	Discharge from construction activities can potentially result in the contamination of soil, groundwater and surface water.	▶ Develop and implement a Water Quality Management Plan ▶ Prepare and implement a Spill Prevention and Response Plan and inducted to the staff for any incident of spill. ▶ Provide and use spill prevention trays at refueling locations ▶ The run off from maintenance workshops will be collected by impervious channels and be passed through oil water separators (OWS) before final disposal. The sludge and oil collected at the OWS will be disposed off properly. ▶ Build separate impervious pits (with concrete walls and proper shed) at the construction sites for temporary handling and storage of contaminated soil and water if encountered during construction such as sludge from OWS. ▶ Keep all fuel storage tanks and lubricating oil drums in secondary containment impervious pits with impervious shed walls. ▶ Avoid on-site maintenance of construction vehicles and equipment, as far as possible. ▶ Regularly inspect construction vehicles and equipment to detect leakages. ▶ Store fuels and lubricants in covered and dyked areas, underlain with impervious lining. ▶ Spill control kits (shovels, plastic bags and absorbent materials) will be available near fuel and oil storage	During Construction	EPC Contractor	Water Quality Management Plan documents Spill Prevention and Response Plan document Visual implementation of mitigation measures such as use of spill prevention trays and proper storage of fuel storage. Record of spills and remedial actions taken

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		areas, vehicle parking, and vehicle maintenance areas as well as at construction sites. ▶ Remove contaminated soil from the site and dispose in a manner to ensure protection of water sources. ▶ Construct the bottom of any soak pit or septic tank at least 100 meters away from springs and water bores. ▶ Maintain records of spills and volume of removed contaminated soil. ▶ Maintain record of remedial measures taken. ▶ Use silt traps to prevent contamination of river and streams. ▶ Incorporate the above measures in the Construction Site Environmental Management Plan (see Volume VI).			
14	Increase in ambient noise levels due to operation of construction equipment, movement of construction traffic and blasting may create nuisance for nearby communities and visiting tourists.	▶ Develop a Noise and Vibration Control Plan Noise generated from construction sites from construction activities ▶ Select the quietest available plant and equipment that can economically undertake the work required. ▶ Undertake maintenance of the equipment as simple maintenance can reduce noise levels by as much as 50%. Parts may become loose, creating more noise because of improper operation or scraping against other parts. Grinding noises may also occur as the result of inadequate lubrication. ▶ Equipment under use will be regularly maintained, tuned, and provided with mufflers to minimize noise levels. ▶ Use visual alarms in preference to audible alarms. ▶ Enclose noisy equipment.	During Construction	EPC Contractor	Noise and Vibration Control Plan document Maintenance record of equipment Records of community meetings regarding noise. Noise level monitoring in nearby communities

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Provide noise attenuation screens, where appropriate. ▶ Build an enclosure around the noise source so that noise is contained. The enclosure should be free from gaps and made of dense material and be lined with noise-absorbing material like glass or polyester batts. ▶ Locate noisy equipment behind parking lots or parks. ▶ Close liaison with the community and regular monitoring of the noise levels in the community are key to successfully implementation of the above mitigation measures. Specifically, inform communities of all major construction activities three days in advance. Construction noise from traffic ▶ Fit and maintain appropriate mufflers on earth-moving and other vehicles on the site. ▶ Mobile plants such as excavators, front-end loaders and other diesel-engine equipment should be fitted with residential class mufflers and other silencing equipment, as applicable. ▶ Haul roads within the site should have as low a gradient as possible, and paving should be considered if practicable where noise-sensitive receptors are likely to be affected; ▶ Owners and operators of existing facilities should implement special noise reduction measures, such as erecting purpose-built acoustic barriers, restricting opening hours and maintaining transport vehicle Construction noise from on-site plant operations and equipment ▶ All fixed plant at the work sites will be appropriately selected, and where necessary, fitted with silencers,			

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		acoustical enclosures and other noise attenuation measures. ▶ Modify the equipment or the work area to make it quieter by substituting existing equipment with quieter equipment; retro-fitting existing equipment with damping materials, mufflers, or enclosures; erecting barriers; and maintenance. ▶ Shift to a quieter construction process for example pile driving is very loud as compared to boring which is a much quieter way to do the same work. ▶ Combine noisy operations to occur in the same time period. The total noise level produced will not be significantly greater than the level produced if the operations were performed separately. ▶ All plant and equipment should be regularly maintained. ▶ Move static plant and equipment as far as possible from sensitive boundaries, as work allows. A distance of four times further away lowers the noise by 12 dBA. A reduction of 10 dBA will sound half as loud. ▶ Sound attenuation measures should be used for plant and equipment such as baffles and specialized mufflers, acoustic enclosures or partial enclosure housings. ▶ Acoustic barriers need to be designed and purpose built if needed. Vegetated buffer zones can also be planted to mitigate noise from operations using suitably selected native plantings local to the area. ▶ Reduce workers' exposure to high noise levels by keeping moving workers away from the noise source; restricting access to areas; rotating workers			

IR	*Impact*	*Mitigation Measure*	*When*	*Responsibility*	*Monitoring Indicators*
		performing noisy tasks; and shutting down noisy equipment when not needed. ▶ Use earplugs to reduce workers' exposure to high noise levels. Noise generated from the blasting in quarry areas ▶ Using vibratory piling instead of impact piling. ▶ Conveyor belts and crushing/screening equipment can be housed to provide acoustic screening. ▶ It is important that sound-reduction equipment fitted to machinery is used and maintained properly. ▶ Erect earth mounds around the site boundary can provide acoustic as well as visual screening. ▶ Soft ground (e.g. grassland and cultivated fields) attenuation can sometimes have a greater impact in reducing noise than barrier attenuation, especially if the ground supports sound absorbing vegetation. Noise emissions from concrete batching ▶ Locate noisy equipment away from potential sources of conflict. ▶ Locate noisy equipment behind sound barriers or sound absorbers – for example, gravel stockpiles or constructed barriers. ▶ Install silencing devices to all pressure operated equipment.			
15	Contamination of soil as a result of accidental release of solvents, oils and lubricants can degrades soil fertility and agricultural productivity.	▶ Prepare a Spill Prevention and Response Plan and induct to the staff for any incident of spill. ▶ Appropriately mark fuel tanks by content and store in dyked areas with an extra 10% of the storage capacity of the fuel tank. The area will be lined with an impervious base.	During Construction	EPC Contractor	Spill Prevention and Response Plan document Visual verification of conformance

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Install grease traps on the site, wherever needed, to prevent flow of oily water. ▶ Spill cleaning kit (shovels, plastic bags and absorbent materials) will be available near fuel and oil storage areas. ▶ Carry cleanup kits in all fuel trucks. ▶ Fueling should only take place over impermeable surfaces, other hazmats should be stored and used over impermeable surfaces. ▶ The bottom of any soak pit or septic tank shall be at least 10 m above the groundwater table. The distance can be reduced, based on the soil properties, if it is established that distance will not result in contamination of groundwater.			
16	Land clearing, excavation, tunnel boring and other construction activities may loosen the top soil in the Project area resulting in loss of soil and possible acceleration of soil erosion and land sliding, especially in the wet season.	▶ Develop an Erosion Control Plan. ▶ Limit vegetation loss to demarcated construction area. ▶ Cover areas such as muck disposal area, batching plant, labor camp and quarry sites after the closure shall with grass and shrubs. ▶ Adopt slope stabilization measures such as adequate vertical and horizontal drains, drainage along roadsides, cross drainage and retaining walls. ▶ Monitor slope movements around excavation work areas. ▶ Salvage, store, and reuse all topsoil at all construction sites. ▶ The height of the stockpile will be minimized to the extent possible by increasing the size of the land for the stockpile.	During Construction	EPC Contractor	Erosion Control Plan document

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Topsoil will be carefully stripped to ensure that it is not mixed with subsoil. ▶ The stockpiles will be revegetated to minimize loss of soil quality, minimizing weed infestation, maintaining soil organic matter levels, maintaining soil structure and microbial activity. ▶ Topsoil stockpiles will be clearly signposted for easy identification and to avoid any inadvertent losses. ▶ The establishment of declared plants on the stockpiles will also be monitored and control programs implemented as required. ▶ The topsoil will be treated with temporary soil stabilization and erosion control measures. ▶ During removal of topsoil stockpile for restoration of project affected areas, it is preferred that the soil is removed in layers (less than 0.5 m thick) under a gradual process. ▶ The top layer will be mixed with the remainder of the stockpile to ensure that living organisms are distributed throughout the topsoil material at the time of final placement. The use of micro-organism inoculates may be necessary to re-establish micro-organisms in topsoil material. ▶ Select local species for plantation to restore the biodiversity of the area in consultation with Forest Department after completion of respective activities.			
17	Failure of spoil dumping sites resulting in increased erosion and sediment load entering river	▶ Dumping sites should have a flood prevention design for a 20-year flood. ▶ The water drainage works consist of the masonry structures, and shall be designed to drain a 5-year rainfall every 10 minutes.	During construction	EPC Contractor	Spoil Disposal Plan Document

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Where constructed tailing hold structure will be of galvanized woven wire mesh gabions ▶ All the five dumping sites will undergo vegetation restoration works comprising of surface leveling, covering and forest/grass planting or agricultural land rehabilitation ▶ Develop a Spoil Disposal Plan that includes the following measures: ▷ Slope movements will be monitored around excavation work areas. ▷ Restore to the maximum extent possible the hydrological regime and reinstate natural drainage of the land (including provisions to maintain the water balance of the site and protect from flooding where appropriate) ▷ Reinstate topsoil (in case it was stripped before construction activities) ▷ Revegetate sites with suitable native plant species ▷ Drain spoil piles to prevent the concentration of flow and to prevent rill and gully erosion ▷ Separate organic material (e.g., roots, stumps) from the dirt fill and store separately. Place this material in long-term, upland storage sites, as it cannot be used for fill. ▷ Store “clean” material in a short-term disposal site (stockpile) if it will likely be re-used for fill or shoulder widening projects. ▷ Where feasible, recycle asphalt material in embankments and shoulder backing. Place these materials where they will not enter the stream system. Asphalt that is 5 years old is considered “inert” (that is, all oils washed off).			

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▷ Do not add excess unusable material to permanently closed sites. ▷ Spread material not to be re-used in compacted layers, generally conforming to the local topography. Design the final disposal site reclamation topography to minimize the discharge of concentrated surface water and sediment off the site and into nearby watercourses. ▷ Cover the compacted surfaces with a 6-inch layer of organic or fine-grained soil, if feasible. ▷ After placement of the soil layer, track walk the slopes perpendicular to the contour to stabilize the soil until vegetation is established. Track walking creates indentations that trap seed and decrease erosion of the reclaimed surfaces. (See figure on next page.) ▷ Revegetate the disposal site with a mix of native plant species. Cover the seeded and planted areas with straw compost, mulched with straw at a rate of 1 to 1 ½ tons per acre. Apply jute netting or similar erosion control fabric on slopes greater than 1:2 if site is erosive. ▷ Locate stockpiles away from drainage lines, at least 10 metres away from natural waterways and where they will be least susceptible to wind erosion ▷ Ensure that stockpiles and batters are designed with slopes no greater than 1:2 (vertical\ horizontal). ▷ Besides these measures, erosion can also be minimized by regular rehabilitation of areas not in use for Project activities during construction. These will include: Re-grading and immediate re-vegetation (using fast-growing species and			

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		different functional groups of plants for keeping soil in place) of slopes to minimize erosion. ▷ Install erosion and sediment control measures, if possible before construction commences. · Identify drainage lines and install control measures to handle predicted storm-water and sediment loads generated in the mini-catchment. ▷ Design and install appropriate erosion and sediment run-off control measures appropriate to site conditions to handle a one-in-two-year storm event (two-year ARI with intensity of six hours), for temporary structures, and a one-in-fifty year storm event, for permanent structures. ▷ Establish an adequate inspection, maintenance and cleaning program for sediment run-off control structures. Ensure that contingency plans are in place for unusual storm events. ▷ Continually assess the effectiveness of sediment control measures and make necessary improvements. ▷ Keep temporary disposal sites out of wetlands, adjacent riparian corridors, and ordinary high-water areas as well as high risk zones, such as 100-year floodplain and unstable slopes. ▷ Anticipate sufficient storage area with no risk for sediment delivery for piles that may slump. Stress cracks indicate that the pile is at risk of slumping. ▷ Cover the trucks that will be used for the transportation of spoikl material to disposal sites. ▷ A spoil management plan should be developed as described in **Section 9.4.3** which will implement measures to prevent this.			

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
18	Deterioration of aesthetics and visual amenity of nearby receptors due to construction activities, including vehicular movement on roads, may cause disturbance in aesthetics for tourists, businesses and nearby communities.	▶ Minimize disturbance to, or movement of, soil and vegetation. ▶ Back fill to original levels. ▶ Reshaping to match in with surrounding topography. ▶ Reinstate vegetation around construction sites.	During detailed design	EPC Contractor	Covers used to disguise equipment, where appropriate.
20	Permanent impact in aesthetics due to proposed developments.	▶ Develop and implement a Site Rehabilitation and Landscaping Plan. ▶ Use colors that better integrate with the landscape. ▶ Disguise elements with vegetation where possible. ▶ Retain as much natural vegetation as possible.	During detailed design	EPC Contractor	Site Rehabilitation and Landscaping Plan
22	Increase in congestion, due to increased traffic volume will cause delays.	▶ Develop and implement a Traffic Managemnet Plan. ▶ Make roundabouts for the congestion points. ▶ Retain as much natural vegetation as possible to reduce the impact of smoke due to vehicles. ▶ The vehicles going on the spoil routes and passing through the communities must be completely covered to avoid dust emissions. ▶ Strictly implement speed limits and defensive driving policies.	During construction	EPC Contractor	Traffic Management Plan
23	Increase in traffic volume will deteriorate the air quality.	▶ Keep speeds slow (30 km/hr) on unsealed roads. ▶ Sprinkle water on unsealed roads that are used for construction traffic.	During construction	EPC Contractor	Traffic Management Plan

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Retain as much natural vegetation as possible to reduce the impact of smoke due to vehicles. ▶ The vehicles going on the spoil routes and passing through the communities must be completely covered to avoid dust emissions. ▶ Strictly implement speed limits and defensive driving policies. ▶ Promptly and properly repair and maintain roads that are subject to damage by Project activities.			
24	Increased risk to community safety due to increased traffic volume during the construction phase near communities.	▶ Develop and implement a Traffic Management Plan. ▶ Identify suitable times to transport equipment. ▶ Road safety awareness education will also be included during community visits or information sessions, so that communities can be familiarized with common road signs and the types of vehicles and equipment that will be moving through the area. ▶ Keep speeds slow (30 km/hr) where there is traffic exchange between roads. ▶ Make roundabouts for the congestion points. ▶ Designate traffic wardens at roads on the transport route to manage traffic during school hours. ▶ Construction traffic will not travel during school starting and ending hours on designated road segments in front of schools on the transport route. ▶ Strictly implement speed limits and defensive driving policies. ▶ Maintain vehicles especially brakes.	During construction	EPC Contractor	Traffic Management Plan
25	Degradation of the pavement due to use	Promptly and properly repair and maintain roads that are subject to damage by Project activities.	During construction	EPC Contractor	Number of observations of pavement damage in

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
	by heavy construction traffic				areas with heavy Project-related traffic.
26	Direct, indirect and induced employment at the local levels, resulting in increased prosperity and wellbeing due to higher and stable incomes of people.	**Enhancement measures**: ▶ Ensure preferential recruitment of local candidates provided they have the required skills and qualifications. ▶ Include an assessment of the contractor's demonstrated commitment to domestic and local procurement and local hiring in the tender evaluation process. ▶ Coordinate recruitment efforts related to non-skilled labor, including for non-skilled labor positions required by contractors. **Good practice measures**: ▶ Determine what is considered to be 'fair and transparent' in recruitment and in distribution of jobs between different community groups, in consultation with local communities and their leaders.	During construction	EPC Contractor	Contractual documents Number and ratio of local employees to non-local employees
27	Increase in the stock of skilled human capital due to transfer of knowledge and skill under the Project resulting in enhanced productivity of the local labor.	▶ Support a 'Vocational Training Program' to assist local people to qualify for semi-skilled positions focusing on issues such as procurement, involvement of vulnerable groups in Project opportunities and continual professional development of staff. ▶ Assist local people having practical skills but lacking qualifications to obtain their certificates and thus increase their employment opportunities. ▶ Support initiatives promoting a culture of learning in local communities. ▶ Plan and implement training program for vulnerable groups to encourage their participation in economic opportunities created by the Project.	During construction	EPC Contractor	Vocational Training Program document including annual schedule. Budget allocation for trainings. Documentary evidence including photographs and attendance lists of trainings.

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
		▶ Assist employees and local communities to improve basic personal financial life skills through training and awareness campaigns, respectively. ▶ Consider further training programs to prepare retrenched workers to seek employment in sectors not related to dam construction.			
28	Increase in recreational and subsistence fishing due to increase in catch of fish following creation of favorable habitats for the fish in the Kunhar River.	▶ Implementation of the BAP (see **Volume 2C** of the **EIA**)	As given in BAP	As given in BAP	As given in BAP
29	Loss of income from sand and gravel mining due to change in pattern of sediment deposition following construction of the dam.	▶ Sediment Mining and Management Guidelines are prepared and will be implemented as a part of the BAP, which will identify possible sand and gravel mining spots along the Kunhar River to meet community needs without harming the river ecology.	During construction	EPC Contractor	Sediment Mining and Management Plan document Locations visually earmarked for mining promotion and protection as identified in the Sediment Mining and Management Plan.
30	Loss of assets and livelihood as a result of land acquired for the Project.	▶ See LARP (**Volume 8**)	Before construction	PEDO/Land Acquisition Collector	See LARP (**Volume 8**)
31	Increase in population due to in-migration of job seekers (in-migrants) leading to pressure on existing social infrastructure	▶ Development of a Grievance Redressal Mechanism ▶ Encourage local communities to use the grievance procedure for concerns related to deterioration of local services.	During construction	EPC Contractor	Grievance register and records Influx Management Plan

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
	and services in the Study Area.	▶ Support local government in the implementation of infrastructure projects. ▶ Support NGOs specializing in development of infrastructure to assist local government.			
32	Disputes over distribution of Project employment within and between Study Area inhabitants and the in-migrants resulting in social unrest.	▶ Implement PEDO Stakeholder Engagement Plan including: ▶ maintaining regular communication with local communities and other stakeholders to minimize tensions arising from Project activities; ▶ maintaining a grievance procedure, and encourage and facilitate stakeholders to use the mechanism to express concerns; and ▶ providing sufficient resources to the community relations officers to enable them to monitor negative perceptions and associated tensions, and to address them in a timely fashion..	During construction	EPC Contractor	Stakeholder Engagement Plan Minutes of community and stakeholder consultations Provision in budget for activities.
33	Potential social unrest in the Study Area due to conflicting socio-cultural norms amongst the inhabitants and in-migrants.	▶ Refer to measures under IR 25 (above).		EPC Contractor	
34	Submergence of graveyards.	▶ Plaster the graves with mud or cement. ▶ If relocation of the graveyard cannot be avoided, it shall be managed through the local religious authorities.	Before construction	PEDO	Photographic evidence

Exhibit 9.9: Operation Phase Mitigation Plan

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
1	Improvement of the river ecosystem through implementation of the BAP	▶ Implementation of the BAP (see **Volume 2C** of the **EIA**).	Operation	PEDO	As given in BAP.
2	Loss of riverine ecosystem due to inundation by Project Reservoir	▶ Implementation of the BAP (see **Volume 2C** of the **EIA**).	Operation	PEDO	As given in BAP.
3	Degradation of the river ecosystem in the low flow segment downstream of the Project dam	▶ Implementation of the BAP (see **Volume 2C** of the **EIA**).	Operation	PEDO	As given in BAP.
4	Degradation of the River Ecosystem Downstream of the Tailrace	▶ Implementation of the BAP (see **Volume 2C** of the **EIA**).	Operation	PEDO	As given in BAP.
7	Project operation leading to animal disturbance, displacement and decline.	▶ Large flood lights should not be installed outside 50 m of the Project fence. ▶ Direct lights towards Project facilities and not towards the natural habitats. ▶ Dispose solid waste only at designated sites. ▶ Incorporate regulations for Project staff and contractors to avoid illegal poaching in contract documents. ▶ Encourage personnel to report sightings of wildlife of conservation importance or incidents of poaching to PEDO. ▶ Provide adequate knowledge to the workers on relevant government regulations and punishments for illegal poaching. ▶ Provide awareness training to staff and contractors on: prevention of injury of animals; identification of likely species	Operation	PEDO	As given in BAP.

IR	*Impact*	*Mitigation Measure*	*When*	*Responsibility*	*Monitoring Indicators*
		found on site; identifications of animal hazards (such as venomous snakes); and what to do if dangerous animals are encountered. ▶ Implement the BAP (see **Volume 2C** of the **EIA**).			
19	Deterioration of aesthetics and visual amenity of nearby receptors due to low flow in the river may affect the scenic value of the area	▶ Ensure environmental flow release.	Operation	PEDO	Environmental flow release records
21	Improved accessibility due to construction of Project access roads.	▶ Allow communities use of new site access roads.	Operation	PEDO	—
26	Direct, indirect and induced employment at the local levels, resulting in increased prosperity and wellbeing due to higher and stable incomes of people.	**Enhancement measures:** ▶ Ensure preferential recruitment of local candidates provided they have the required skills and qualifications. ▶ Include an assessment of the contractor's demonstrated commitment to domestic and local procurement and local hiring in the tender evaluation process. ▶ Coordinate recruitment efforts related to non-skilled labor, including for non-skilled labor positions required by contractors. **Good practice measures:** ▶ Determine what is considered to be 'fair and transparent' in recruitment and in distribution of jobs between different community groups, in consultation with local communities and their leaders.	Operation	PEDO	Target documents

IR	Impact	Mitigation Measure	When	Responsibility	Monitoring Indicators
28	Increase in recreational and subsistence fishing due to increase in catch of fish following creation of favorable habitats for the fish in the Kunhar River.	▶ Ensure implementation of the BAP (see **Volume 2C** of the **EIA**).	Operation	PEDO	Interviews with local fishermen and results of monitoring and evaluation as part of the **BAP** (see **Volume C**)
29	Loss of income from sand and gravel mining due to change in pattern of sediment deposition following construction of the dam.	▶ Sediment Mining and Management Guidelines are prepared and will be implemented as a part of the BAP, which will identify possible sand and gravel mining spots along the Kunhar River to meet community needs without harming the river ecology.	Operation	PEDO	Sediment Mining and Management Plan document Locations visually earmarked for mining promotion and protection as identified in the Sediment Mining and Management Plan.

Exhibit 9.10: Design and Construction Planning EMP Responsibilities

Impact Reference	*Mitigation Measures*
5	Minimize project footprint
5	Locate construction facilities based on a knowledge of the soil, slope and vegetation cover of the area to avoid disturbance to the natural environment.
5,6	Minimize disturbance to, or movement of, soil and vegetation.
5,6	Prevent establishment of alien invasive species (AIS) on exposed stored soil (do not store bare soil near known sources of AIS).
5,6	Retain as much natural vegetation as possible.
6	Source goods/materials locally where possible.
12	Source water for construction from authorized abstraction sources agreed between the local communities, local government and EPC contractor.
34	Plaster the graves with mud or cement. If relocation of the graveyard cannot be avoided, it shall be managed through the local religious authorities.
20	Develop and implement a Site Rehabilitation and Landscaping Plan.
22	Make roundabouts for the congestion points.

Exhibit 9.11: General Construction Site Manager EMP Responsibilities

Impact Reference	*Mitigation Measures*
	Site Construction
5, 6, 13, 15, 16, 17	Minimize disturbance to, or movement of, soil and vegetation.
5, 6	Prevent soil damage and erosion.
5,6	Prevent establishment of AIS on exposed stored soil (do not store bare soil near known sources of AIS).
5, 6, 13, 15, 16, 17	Retain as much natural vegetation as possible.
5. 6. 13, 15, 17	Solid waste should only be disposed of at designated sites.
6,7	Large flood lights should not be installed outside 50 m of the Project fence.
6,7	Lights should be directed towards Project facilities and not towards the natural habitats.
8	Water will be sprinkled on all exposed surfaces, particularly those close and up-wind of the settlements.
17	Slope movements will be monitored around excavation work areas.

Impact Reference	*Mitigation Measures*
17	Slope stabilization measures will be adopted such as adequate vertical and horizontal drains, drainage along roadsides, cross drainage and retaining walls.
5, 17	Vegetation loss will be limited to demarcated construction area.
	Resource Use
12	Access of community to water sources shall be kept clear so that the community's ability to meet its water requirements are not compromised.
11, 13	Care will be taken while moving heavy machinery to avoid damage or blockage of natural waterways and channels.
12	Records of water usage will be maintained.
12	Water conservation techniques will be developed and implemented by the EPC contractor.
12	Water for construction will be sourced from authorized abstraction sources agreed between the local communities, local government and EPC contractor.
	Spill Control
13, 15	Spill prevention trays will be provided and used at refueling locations
13, 15	Regular inspections will be carried out to detect leakages in construction vehicles and equipment.
13, 15	Fuels and lubricants will be stored in covered and dyked areas, underlain with impervious lining.
13, 15	Spill control kit (shovels, plastic bags and absorbent materials) will be available near fuel and oil storage areas.
13, 15	Contaminated soil will be removed from the site and disposed in a manner to ensure protection of water sources
13, 15	Emergency plan for spill management will be prepared and inducted to the staff for any incident of spill.
13, 15	The bottom of any soak pit or septic tank will be constructed at least 100 meters away from springs and water bores
13, 15	Record of spills and volume of removed contaminated soil will be maintained.
13, 15	Record of remedial measures taken will be maintained.
	Maintenance
14	Equipment under use will be regularly maintained, tuned, and provided with mufflers to minimize noise levels.
13, 15	On-site maintenance of construction vehicles and equipment will be avoided, as far as possible.
	Noise Control
14	Equipment in poor state of maintenance, particularly without effective noise control will be checked to determine if it can be improved, and replaced with less noisy equipment as soon as practicable.

Impact Reference	Mitigation Measures
14	Equipment emitting excessive noise in comparison with other similar equipment will not be allowed to operate.
10	Schedule blasting outside of hours when people are most disturbed by noise (such as at night).
10	Unscheduled blasting will be strictly prohibited in any case.
	Closure and Completion
18, 19	Areas such as muck disposal area, batching plant, labor camp and quarry sites after the closure shall be covered with grass and shrubs.
16	Back fill to original levels.
18, 19, 20	Reshape to match in with surrounding topography.
16	Vegetation reinstatement around the dam site. Trees will be planted to replace those submerged by the reservoir.

Exhibit 9.12: Dam Site Construction Site Manager Additional EMP Responsibilities

Impact Reference	Mitigation Measure
	Aesthetics
18, 19	Disguise elements with vegetation where possible.
18, 19	Use colors that integrate with the landscape.
18, 19	Trees will be planted to replace those submerged by the reservoir.
	Blasting and Excavation
16	Indicate the limits of a clearing land with highly visible markers.
8	Leave a layer of about 5 m of undisturbed softs above the top of the overburden blasts. This will act as a blanket to contain air blast, dust and fly rock.
8	Sprinkle water on the area where blasting is done to settle down the particulate matter emissions.

Exhibit 9.13: Powerhouse Site Construction Site Manager Additional EMP Responsibilities

Impact Reference	Mitigation Measure
	Blasting
8	Leave a layer of about 5 m of undisturbed softs above the top of the overburden blasts. This will act as a blanket to contain air blast, dust and fly rock.
8	Sprinkle water on the area where blasting is done to settle down the particulate matter emissions.

Exhibit 9.14: Headrace Tunnel Construction Site Manager Additional EMP Responsibilities

Impact Reference	*Mitigation Measure*
	Blasting and Excavation
16	Indicate the limits of a clearing land with highly visible markers.
8	Leave a layer of about 5 m of undisturbed softs above the top of the overburden blasts. This will act as a blanket to contain air blast, dust and fly rock.
8	Sprinkle water on the area where blasting is done to settle down the particulate matter emissions.
9	Blasting will be scheduled during the day only.
9	Local communities will be informed of blasting timetable in advance and will be provided adequate notice of when blasts are required outside of the planned schedule.
9	A Blasting Management Plan will be developed by the Construction Contractor. The Plan will be reviewed and approved by the Supervision Contractor before the initiation of the blasting work.
9	Throughout the blasting activity, vibration sensors will be installed at strategic location to monitor the impact of blasting and to ensure that the vibration levels are within the adopted criteria. The monitoring plan will be part of the Blasting Management Plan.
9	Unscheduled blasting will be strictly prohibited in any case.
10	A minimum buffer of 500 m should be provided between the settlements and point of blasting.
11, 12	Record location of the springs especially those in areas proximal to where the underground headrace tunnel will be closer to the ground level.
11, 12	Monitor flow for located springs and maintain records.

Exhibit 9.15: Workshop Manager EMP Responsibilities

Impact Reference	*Mitigation Measure*
	Pollution Control
5, 7, 13, 15	Solid waste should only be disposed of at designated sites.
6,7	Large flood lights should not be installed outside 50 m of the Project fence.
6,7	Lights should be directed towards Project facilities and not towards the natural habitats.
8	Water will be sprinkled on all exposed surfaces, particularly those close and up-wind of the settlements.
	Resource Use
6	Source goods/materials locally where possible.

Impact Reference	Mitigation Measure
13	Care will be taken while moving heavy machinery to avoid damage or blockage of natural waterways and channels.
12	Water conservation techniques will be developed and implemented
	Spill Control
13, 15	Spill prevention trays will be provided and used at refueling locations
13, 15	Regular inspections will be carried out to detect leakages in construction vehicles and equipment.
13, 15	Fuels and lubricants will be stored in covered and dyked areas, underlain with impervious lining.
13, 15	Spill control kit (shovels, plastic bags and absorbent materials) will be available near fuel and oil storage areas.
13, 15	Contaminated soil will be removed from the site and disposed in a manner to ensure protection of water sources
13, 15	Emergency plan for spill management will be prepared and inducted to the staff for any incident of spill.
13, 15	The bottom of any soak pit or septic tank will be constructed at least 100 meters away from springs and water bores
13, 15	Record of spills and volume of removed contaminated soil will be maintained.
13, 15	Record of remedial measures taken will be maintained.
	Maintenance
14	Equipment under use will be regularly maintained, tuned, and provided with mufflers to minimize noise levels.
13, 15	On-site maintenance of construction vehicles and equipment will be avoided, as far as possible.
	Noise Control
14	Equipment in poor state of maintenance, particularly without effective noise control will be checked to determine if it can be improved, and replaced with less noisy equipment as soon as practicable.
14	Equipment emitting excessive noise in comparison with other similar equipment will not be allowed to operate.
14	Schedule blasting outside of hours when people are most disturbed by noise (such as at night).
14	Unscheduled blasting will be strictly prohibited in any case.
	Closure and Completion
17	After closure, areas under use shall be covered with grass and shrubs.
17	Back fill to original levels.

Exhibit 9.16: Batching Plant Manager EMP Responsibilities

Impact Reference	*Mitigation Measure*
	Air Pollution
8	Suspend earthwork operation when wind speed exceeds 20 km/hr. in areas within 500 m of any settlement.
8	The whole process of weighing and mixing would be performed in a fully enclosed environment.
8	The mixers would all equipped with dust collectors, no dust emission would be expected.
8	Siting the concrete batching plant out of prevailing high winds minimizing dust emissions.
8	The prevailing wind direction should be considered to ensure that bunkers and conveyors are sited in the leeward direction to minimize the effects of the wind.
8	The provision of natural or artificial wind barriers – such as trees, fences and landforms – to help control the emission of dust from the plant should be considered.
8	Batching plants should be sited on land that is not flood prone.
8	Suspend operation when wind speed exceeds 20 km/hr. in areas within 500 m of any settlement.
8	The prevailing wind direction should be considered to ensure that aggregate handling systems located in the leeward direction to minimize the effects of the wind.
8	Sprinkle water on all exposed surfaces, particularly those close and up-wind of settlements.
	Noise Control
14	Locate noisy equipment away from potential sources of conflict.
14	Locate noisy equipment behind sound barriers or sound absorbers – for example, gravel stockpiles or constructed barriers.
14	Install silencing devices to all pressure operated equipment.
14	Schedule blasting outside of hours when people are most disturbed by noise (such as at night).
14	Unscheduled blasting will be strictly prohibited in any case.
	Closure and Completion
20	After closure, areas under use shall be covered with grass and shrubs.
20	Back fill to original levels.

Exhibit 9.17: Construction Camp Manager EMP Responsibilities

Impact Reference	*Mitigation Measure*
	Pollution Control
5. 6. 7, 13, 15	Develop and implement a Waste Management Plan
5. 6. 7, 13, 15	Solid waste should only be disposed of at designated sites.
6,7	Large flood lights should not be installed outside 50 m of the Project fence.
6,7	Lights should be directed towards Project facilities and not towards the natural habitats.
8	Water will be sprinkled on all exposed surfaces, particularly those close and up-wind of the settlements.
	Resource Use
6	Source goods/materials locally where possible.
12	Water conservation techniques will be developed and implemented
	Spill Control
13, 15	Spill control kit (shovels, plastic bags and absorbent materials) will be available near fuel and oil storage areas.
13, 15	The bottom of any soak pit or septic tank will be constructed at least 100 meters away from springs and water bores
13, 15	Record of spills and volume of removed contaminated soil will be maintained.
	Maintenance
14	Equipment under use will be regularly maintained, tuned, and provided with mufflers to minimize noise levels.
	Noise Control
14	Equipment in poor state of maintenance, particularly without effective noise control will be checked to determine if it can be improved, and replaced with less noisy equipment as soon as practicable.
14	Equipment emitting excessive noise in comparison with other similar equipment will not be allowed to operate.
	Closure and Completion
17	Construction camp after the closure shall be covered with grass and shrubs.

Exhibit 9.18: Spoil Disposal Site Manager EMP Responsibilities

Impact Reference	*Mitigation Measures*
17	Slope movements will be monitored around excavation work areas.
16, 17	Restore to the maximum extent possible the hydrological regime and reinstate natural drainage of the land (including provisions to maintain the water balance of the site and protect from flooding where appropriate)

Impact Reference	Mitigation Measures
16, 17	Reinstate topsoil (in case it was stripped before construction activities)
16, 17	Revegetate sites with suitable native plant species
16, 17	Drain spoil piles to prevent the concentration of flow and to prevent rill and gully erosion
16	Separate organic material (e.g., roots, stumps) from the dirt fill and store separately. Place this material in long-term, upland storage sites, as it cannot be used for fill.
16	Store “clean” material in a short-term disposal site (stockpile) if it will likely be re-used for fill or shoulder widening projects.
16	Where feasible, recycle asphalt material in embankments and shoulder backing. Place these materials where they will not enter the stream system. Asphalt that is 5 years old is considered “inert” (that is, all oils washed off).
16	Do not add excess unusable material to permanently closed sites.
16	Spread material not to be re-used in compacted layers, generally conforming to the local topography. Design the final disposal site reclamation topography to minimize the discharge of concentrated surface water and sediment off the site and into nearby watercourses.
16	Cover the compacted surfaces with a 6-inch layer of organic or fine-grained soil, if feasible.
16	After placement of the soil layer, track walk the slopes perpendicular to the contour to stabilize the soil until vegetation is established. Track walking creates indentations that trap seed and decrease erosion of the reclaimed surfaces. (See figure on next page.)
16	Revegetate the disposal site with a mix of native plant species. Cover the seeded and planted areas with straw compost, mulched with straw at a rate of 1 to 1 ½ tons per acre. Apply jute netting or similar erosion control fabric on slopes greater than 1:2 if site is erosive.
16	Locate stockpiles away from drainage lines, at least 10 meters away from natural waterways and where they will be least susceptible to wind erosion
16	Ensure that stockpiles and batters are designed with slopes no greater than 1:2 (vertical\ horizontal).
16	Besides these measures, erosion can also be minimized by regular rehabilitation of areas not in use for Project activities during construction. These will include: • Re-grading and immediate re-vegetation (using fast-growing species and different functional groups of plants for keeping soil in place) of slopes to minimize erosion,
16	Install erosion and sediment control measures, if possible before construction commences. · Identify drainage lines and install control measures to handle predicted storm-water and sediment loads generated in the mini-catchment.
16	Design and install appropriate erosion and sediment run-off control measures appropriate to site conditions to handle a one-in-two-year storm event (two-year ARI with intensity of six hours), for temporary structures, and a one-in-fifty year storm event, for permanent structures.

Impact Reference	Mitigation Measures
16	Establish an adequate inspection, maintenance and cleaning program for sediment run-off control structures. Ensure that contingency plans are in place for unusual storm events.
16	Continually assess the effectiveness of sediment control measures and make necessary improvements.
16	Keep temporary disposal sites out of wetlands, adjacent riparian corridors, and ordinary high water areas as well as high risk zones, such as 100-year floodplain and unstable slopes.
16	Anticipate sufficient storage area with no risk for sediment delivery for piles that may slump. Stress cracks indicate that the pile is at risk of slumping.

Exhibit 9.19: Transport Fleet Manager EMP Responsibilities

Impact Reference	Mitigation Measures
	Develop and implement a Traffic Management Plan.
	Community Safety
12	Access of community to water sources shall be kept clear so that the community's ability to meet its water requirements are not compromised.
14	Equipment emitting excessive noise in comparison with other similar equipment will not be allowed to operate.
14	Equipment in poor state of maintenance, particularly without effective noise control will be checked to determine if it can be improved, and replaced with less noisy equipment as soon as practicable.
14	Blowing of horn will be prohibited on all access road except under emergency conditions.
24	Prohibiting use of horns particularly pressure horns, in areas where the group is moving.
14	Equipment under use will be regularly maintained, tuned, and provided with mufflers to minimize noise levels.
24	Keep speeds slow where there is traffic exchange between roads.
24	Make roundabouts for the congestion points.
24	Construction traffic will not travel during school starting and ending hours on designated road segments in front of schools on the transport route
24	Designate traffic wardens at roads on the transport route to manage traffic during important hours
	Pollution Control
8	Cover all trucks hauling soil, sand, and other loose materials or require all trucks to maintain at least two feet of freeboard (i.e., the minimum required space between the top of the load and the top of the trailer).

Impact Reference	*Mitigation Measures*
8	Install and maintain all vehicles and machinery with appropriate emission control equipment.
8	Regularly maintain vehicles and equipment to keep emissions in check.
8	Smoke from internal combustion engines should not be visible for more than ten seconds.
8	To the extent possible, use new and low emission equipment and vehicles.
8	Purchase best quality fuel and lubes and where possible use lead free oil and lubes.
8	Sprinkle water on all unsealed roads used by Project vehicles that are within 200 m of any settlement.
8	Reduce traffic speeds on all unpaved surfaces to 15 miles per hour or less.
8	Paved roads shall be swept frequently if soil material has been carried onto adjacent paved, public thoroughfares from the Project site.
8	Install wheel washers where vehicle exit onto paved road from unpaved.
8	Wheel washing of vehicles leaving the site.
8	Wash vehicles/equipment prior to each trip.
8	Use catalytic converters on vehicles, an emission control device, used to convert harmful pollutants to less harmful pollutants e.g. it converts the nitrogen oxides back into nitrogen and oxygen.
8	Appropriate maintenance of vehicles and machinery.
12, 16	Exercise care while moving heavy machinery to avoid damage or blockage of natural waterways and channels.
14	Fit and maintain appropriate mufflers on earth-moving and other vehicles on the site.
14	Mobile plants such as excavators, front-end loaders and other diesel-engine equipment should be fitted with residential class mufflers and other silencing equipment, as applicable.
14	Haul roads within the site should have as low a gradient as possible, and paving should be considered if practicable where noise-sensitive receptors are likely to be affected;
14	Owners and operators of existing facilities should implement special noise reduction measures, such as erecting purpose-built acoustic barriers, restricting opening hours and maintaining transport vehicle
15	Carry cleanup kits in all fuel trucks.
15	Fueling should only take place over impermeable surfaces, other hazmats should be stored and used over impermeable surfaces.
22	Make roundabouts for the congestion points.
23	Retain as much natural vegetation as possible to reduce the impact of smoke due to vehicles.
24	The vehicles going on the spoil routes and passing through the communities must be completely covered to avoid dust emissions.

Impact Reference	*Mitigation Measures*
24	Strictly implement speed limits and defensive driving policies.
24	Keep speeds slow (30 km/hr) on unsealed roads.
24	Sprinkle water on unsealed roads that are used for construction traffic.
24	Retain as much natural vegetation as possible to reduce the impact of smoke due to vehicles.
24	The vehicles going on the spoil routes and passing through the communities must be completely covered to avoid dust emissions.
24	Road safety awareness education will also be included during community visits or information sessions, so that communities can be familiarized with common road signs and the types of vehicles and equipment that will be moving through the area.
24	Make roundabouts for the congestion points.
24	Construction traffic will not travel during school starting and ending hours on designated road segments in front of schools on the transport route.
24	Maintain vehicles especially brakes.
24	Promptly and properly repair and maintain roads that are subject to damage by Project activities.

Exhibit 9.20: Labor Manager EMP Responsibilities

Impact Reference	*Mitigation Measures*
	Health and Safety
14	Reduce workers' exposure to high noise levels by keeping moving workers away from the noise source; restricting access to areas; rotating workers performing noisy tasks; and shutting down noisy equipment when not needed.
14	Use earplugs to reduce workers' exposure to high noise levels.
	Community Employment
26, 27	Ensure preferential recruitment of local candidates provided they have the required skills and qualifications.
26, 27	Include an assessment of the contractor's demonstrated commitment to domestic and local procurement and local hiring in the tender evaluation process.
26, 27	Determine what is considered to be 'fair and transparent' in recruitment and in distribution of jobs between different community groups, in consultation with local communities and their leaders.
26, 27	Support a 'vocational training program' to assist local people to qualify for semi-skilled positions focusing on issues such as procurement, involvement of vulnerable groups in Project opportunities and continual professional development of staff.
26, 27	Assist local people having practical skills but lacking qualifications to obtain their certificates and thus increase their employment opportunities.

Exhibit 9.21: Community Liaison Officer EMP Responsibilities

Impact Reference	*Mitigation Measures*
	Community Water Supply
12	Water for construction will be sourced from authorized abstraction sources agreed between the local communities, local government and EPC contractor.
12	Access of community to water sources shall be kept clear so that the community's ability to meet its water requirements are not compromised.
12	Support the community in development of alternate water supply schemes through local NGOs
12	Ensure the availability of water to the communities and the access of the communities to the water resources being used by them is not adversely affected.
14	Close liaison with the community and regular monitoring of the noise levels in the community are key to successfully implementation of the above mitigation measures. Specifically: The communities will be informed of all major construction activities at three days in advance. Noise control measures will be discussed with the community through informal and formal meetings.
	Construction Noise
14	A complaint registering, tracking and redressal mechanism will be implemented.
14	Noise levels will be monitored regularly in the community in order to take timely corrective measures, if needed.
14	Inform local communities of blasting timetable in advance and provide adequate notice of when blasts are required outside of the planned schedule.
	Grievance Procedure
14, 24	Encourage local communities to use the grievance procedure for concerns related to deterioration of local services and environment (including noise)
14, 24	Provide support for implementation of the PEDO Stakeholder Engagement Plan by:
14, 24	a. maintaining regular communication with local communities and other stakeholders to minimize tensions arising from Project activities;
14, 24	b. maintaining a grievance procedure, and encourage and facilitate stakeholders to use the mechanism to express concerns; and
14, 24	c. providing sufficient resources to the community relations officers to enable them to monitor negative perceptions and associated tensions, and to address them in a timely fashion.
	Training and Recruitment
26	Coordinate recruitment efforts related to non-skilled labor, including for non-skilled labor positions required by contractors.
27	Support initiatives promoting a culture of learning in local communities.
27	Plan and implement training program for vulnerable groups to encourage their participation in economic opportunities created by the Project.
27	Assist employees and local communities to improve basic personal financial life skills through training and awareness campaigns, respectively.

Impact Reference	Mitigation Measures
27	Consider further training programs to prepare retrenched workers to seek employment in sectors not related to dam construction.
	Graveyard Land Acquisition
34	Plaster the graves with mud or cement.
34	If relocation of the graveyard cannot be avoided, it shall be managed through the local religious authorities.

Exhibit 9.22: Project Environmental Manager EMP Responsibilities

Impact Reference	Mitigation Measures
	Community Water Supply
12	Water for construction will be sourced from authorized abstraction sources agreed between the local communities, local government and EPC contractor.
	Poaching and Wildlife
5,6,7	Encourage personnel to report sightings of wildlife of conservation importance or incidents of poaching to PEDO.
6	Project staff and contractors to report kills of large mammals particularly designated species of conservation concern.
6,7	Regulations for Project staff and contractors to avoid illegal poaching to be incorporated in contract documents.
6,7	Provide adequate knowledge to the workers on relevant government regulations and punishments for illegal poaching.
	Awareness Trainings
5,6, 7	Train and raise awareness regarding AIS among Project staff and contractors.
6,7	Provide awareness training to staff and contractors on: prevention of injury of animals; identification of likely species found on site; identifications of animal hazards (such as venomous snakes); and what to do if dangerous animals are encountered.

Exhibit 9.23: PEDO's EMP Responsibilities

Impact Reference	Mitigation Measures
	Ecology
1, 2, 3,4,6,7	Implementation of the BAP (see **Volume 2C** of the **EIA**)
	Community
29, 30, 31, 32, 33, 34	Implement PEDO Stakeholder Engagement Plan, which includes the grievance procedure.

Impact Reference	Mitigation Measures
29	A Sediment Mining and Management Guidelines will be prepared and implemented as a part of BAP, which will identify possible sand and gravel mining spots along the Kunhar River to meet community needs without harming the river ecology.
24	Support local government in the implementation of infrastructure projects.
24	Support NGOs specializing in development of infrastructure to assist local government.

Exhibit 9.24: Owner's Engineer EMP Responsibilities

Impact Reference	Mitigation Measures
7	Solid waste should only be disposed of at designated sites.
11	Monitoring records of local springs within 1 km downstream of Dam Site
11, 12	Maintain records of water release to downstream of river at Dam Site
3, 4	Ensure release of environmental flow of the river in dry seasons.
17	Develop and implement an emergency response plan.

9.4.2 Specific Environment Management Plans

Nineteen specific management plans that are to be developed to facilitate the implementation of the mitigation measures are detailed in **Exhibit 9.25**. Additional plans may be developed on discretion to further facilitate other areas of mitigation.

It should be noted that these plans (and other required mitigation measures not included within these plans) will be operationalized via Site Specific Environmental Management Plans (SSEMP) that are discussed in detail in **Section 9.5.3**. All construction sites must have a SSEMP prepared by the EPC Contractor and approved by PEDO before any major construction activity is started on the site.

Some of the required plans that have been developed as part of the EIA are described in the following sections.

Exhibit 9.25: Supporting Plans

No.	Title	Description and Requirements	Responsibility
1	Air Pollution Control Plan	The plan will incorporate mitigation measures described under IR 8 in **Exhibit 9.8.**	EPC Contractor
2	Biodiversity Action Plan	The Study Area for the Project falls in Critical Habitat as defined in the IFC PS6 due to the presence of the endemic and restricted range species the Nalbant's Loach and Kashmir Hillstream Loach. The Project is required to	As given in BAP

No.	Title	Description and Requirements	Responsibility
		achieve a 'Net Gain' in the population of both species to comply with PS6. There is an increasing threat to river ecology and fish fauna due to increasing levels of illegal fishing and unregulated sand mining in the Project area. The EFlow assessment of the Project (see **Volume 2C** of the **EIA**) recommended an environmental flow of 1.5 m^3/s downstream of the dam, and implementation of strict protection measures and management measures to control illegal fishing and regulate sand mining. A Biodiversity Action Plan (BAP) has been prepared as a part of the EIA to ensure that the protection measures as assumed in the EFlow assessment are implemented to protect fish fauna in general and Nalbant's Loach and Kashmir Hillstream Loach, in particular, such that achievement of Net Gain in the populations of these two species is achieved. In addition, management measures triggered by the CIA of the Project and included in the BAP are establishment of an Institute for Research on River Ecology and a Watershed Management Program (WMP). Together, these are aimed at improving conditions for both aquatic and terrestrial ecology derived from research and development in areas such as captive breeding and restocking, genetic studies, improvements in water quality, afforestation, land use management, amongst others. The complete plan is presented in the **BAP** in **Volume 2C**.	
3	Blasting and Explosives Control Plan	The plan will be developed using mitigation measures described under IR 9 and 10 in **Exhibit 9.8**.	EPC Contractor Headrace Tunnel Construction Manager Quarry Area Manager
4	Construction Site Environmental Management Plan	The plan will incorporate mitigation measures for the site.	EPC Contractor All managers for construction sites
5	Emergency Preparedness and Response Plan	This plan will identify emergency situations such as fires, landslides, earthquakes, coffer dam failure etc. that could realistically occur and detail the response that is required.	PEDO

No.	Title	Description and Requirements	Responsibility
6	Environmental Training Plan	This plan will sensitize Project employees on environmental aspects and will incorporate mitigation measures described under IR 5 and, 6 in **Exhibit 9.8.**	Labor Manager Project Environmental Manager
7	Surface Run Off and Erosion Control Plan	The plan will contain mitigation measures listed under IR 16 in **Exhibit 9.8.**	EPC Contractor
8	Spoil Disposal Plan	Major measures for safe spoil disposal are included in the Project design. The plan will contain these Project design features and additional mitigation measures as listed under IR 17 in **Exhibit 9.8.**	EPC Contractor Disposal Site Manager
9	Noise and Vibration Control Plan	An important feature of effective noise control is regular monitoring in effected communities and a complaint registering and redressal mechanism. Key measures presented in IR 14 in **Exhibit 9.8** should be incorporated in the plan.	Community Liaison Officer
10	Occupational Health and Safety	This plan should seek to meet guidelines followed by ADB, specifically those laid down in the IFC's General EHS Guidelines on Occupational Health and Safety.	Labor Manager
11	Reservoir Clearing Plan	This plan should ensure maximum utilization of cleared material by local communities and limit clearing to where required.	Community Liaison Officer EPC Contractor
12	Sediment Mining and Management Plan	This plan will be based on the guidelines presented in the BAP in **Volume 2C**.	PEDO
13	Site Rehabilitation and Landscaping Plan	The plan will contain measures listed under IR 18 and 20 in **Exhibit 9.8.**	EPC Contractor
14	Spill Prevention and Response Plan	The plan will contain measures listed under IR 13 and 15 in **Exhibit 9.8.**	EPC Contractor
15	Traffic Management Plan	The plan will contain measures listed under IR 22, 23, 24 in **Exhibit 9.8.**	Transport Fleet Manager
16	Vocational Training Plan	The plan will outline the 'vocational training program' to assist local people to qualify for semi-skilled positions focusing on issues such as procurement, involvement of vulnerable groups in Project opportunities and continual professional development of staff.	PEDO

No.	Title	Description and Requirements	Responsibility
17	Waste Management Plan	A waste management plan is the written record of what must be done to achieve the goals you have set for managing construction waste. Where subcontractors have sole responsibility for their waste, they should complete their own waste management plan. Each site should have its own waste management plan.	All construction site managers especially Construction Camp Manager
18	Water Sourcing and Abstraction Plan	The plan will contain measures listed under IR 12 in both **Exhibit 9.7** and **Exhibit 9.8**.	EPC Contractor
19	Worker Accommodation Management Plan	This plan can draw upon the IFC publication *Workers' accommodation: processes and standards, A guidance note by IFC and the EBRD.p*	Labor Manager Construction Camp Managers

9.4.3 Frameworks for Spoil and Quarry Management Plans

The exact location of quarry and spoil disposal areas will require technical and engineering studies which will be conducted at the detailed engineering stage. Proposed locations for spoil diposal areas are shown in **Section 3.4.4** and a comparison of the impacts of these locations is provided in **Section 7.8.3**. This section provides frameworks for preparation of the Spoil and Quarry Management Plans. These plans will be prepared for each of the spoil disposal and quarry areas prior to commencement of quarrying and spoil disposal operations in the construction phase.

Spoil Management Plans

This section provides the framework for development of the Spoil Management Plan (SMP) including purpose of the plan, mitigation hierarchy, and guidelines for on-site management.

A SMP will be prepared prior to commencement of any tunnelling works and other works that may generate spoil. The SMP will incorporate detailed information on the handling of spoil generated during construction. It should be consistent with the Traffic Management Plan to allow for ready access to spoil and spoil disposal areas and to avoid disturbance to the non-Project related traffic.

Purpose

The purpose of the SMP is to:

- identify environmental management issues associated with sourcing, handling, transportation, stockpiling, disposal and reuse of spoil material; and
- document and describe the systems and procedures developed to mitigate environmental impacts specifically to:
  - Minimise spoil removal and associated impacts on stakeholders, community and the environment;
  - Maximise the beneficial reuse of spoil material from the Project; and

- ▷ Address the Project wide objective to provide certainty of delivery by managing spoil in a manner that avoids impacts on construction activities and timing

Mitigation Heirarchy

Where feasible and reasonable, spoil should be managed according to the following hierarchy:

- Minimisation of spoil generation through design and management
- Reuse of spoil within the Project
- Beneficial reuse of spoil outside the Project for environmental and community works
- Beneficial reuse of spoil outside the Project for site levelling, development or rehabilitation
- Disposal of spoil outside the Project for non-beneficial uses (landfilling)

On-site Management

On-site management includes management of stockpiling sites, spoil transport, spoil tracking and spoil testing for re-use.

Stockpiles

On site management of spoil material stockpiling sites involves planning for stockpiling including selection of stockpiling sites, their accessibility to the road network, management of stockpiles to minimize wind and water erosion, management of stockpiles to minimize dust from exposed surfaces and management of noise and dust during loading and unloading.

The stockpile sites need to:

- Have ready access to the road network
- Be located on levelled land where possible
- Not affect land use of adjacent properties
- Be located in areas so that the erosion control measures can be implemented
- Be located in areas so that flooding does not result in runoff
- Be located in areas such that they do not result in the disturbance of species of conservation importance
- Be positioned in areas where there is minimal visual, noise and vibration impacts anticipated on nearby residents
- Be located within the Project approved boundary
- Be located in areas such that they do not affect cultural heritage
- Ensure land care and avoid loss of habitat and spread of invasive plant species

- Avoid flooding of trees and waterlogging of soils
- Have contaminated materials stockpiled separately
- Have erosion and sedimentation controls in place
- Be subjected to regular inspection

Spoil transport

The following need to considered for spoil transport:

- Spoil transport/haulage routes should be identified, assessed and if necessary upgraded
- Haulage routes should be assessed and if necessary upgraded
- The routes should be selected to minimize impacts on sensitive receptors including people, ecology and the landscape
- Transport should be undertaken with minimization of noise and dust

Spoil tracking

A spoil tracking system should be developed which should include fields such as:

- Date
- Docket Number
- Haulage Company (if other than EPC Contractor)
- Material Classification
- Quantity in Tonnes to be Transported
- Truck Identification Number
- Location of Spoil Generation Site
- Location of Spoil Receival Site

Spoil Testing

It is necessary to determine if the waste material is hazardous or non-hazardous and whether or not it requires any special treatment before disposal or re-use. Spoil testing before re-use is important to answer questions such as the following:

- Are manufactured chemicals or process residues present?
- Are sulfidic ores or soil present?
- Are naturally occurring asbestos soils present?
- Is there any other waste present?

Quarry Management Plans

Quarrying involves the removal, haulage, processing, stockpiling, and distribution of rock products. Planning a site for quarrying must take account of geological, environmental, and engineering parameters. Rehabilitation and post quarry land use options must also be considered in planning and developing a quarry.

The framework for the Quarry Management Plan (QMP) includes its environmental objectives, major activities, key management areas, rehabilitation and site selection guidelines.

Environmental Objectives

Environmental objectives of the QMP are to:

- Protect water quality
- Reduce potential for erosion and sedimentation
- Protect the general amenity of the site and surrounding area
- Protect the acoustic environment and surrounding residences to minimize disturbance to people
- Protect air quality
- Ensure land care and avoid loss of habitat and spread of invasive plant species
- Minimize waste and control waste disposal
- Avoid complaints from the community

Major Activities

The major activities of the QMP include:

- demarcation of the area to be quarried;
- an indication of final contours and floor levels including the proposals for the coordination of final levels of adjoining land;
- proposed ultimate drainage of quarried lands and include any water consents that it may be necessary to obtain;
- an indication of the period over which quarrying will continue, and of staged development
- provision for the disposal and/or stockpiling of overburden, waste and quarried material, including the area to be used for stockpiling;
- areas for stockpiling topsoil (where applicable);
- provision for screening unsightly features from public view and fencing dangerous or potentially dangerous features;
- description of methods to be employed to prevent contamination of air or natural water and to comply with the noise and vibration provisions of these rules;
- description of methods to be employed to maintain impact of sensitive ecological resources as identified in the EIA within acceptable limits:
- an indication of the route by which quarried material is to be removed from the lot;

- provision for the progressive restoration of the lot such that the land will be left in such condition that is suitable for the establishment of those uses to which that land may subsequently be put; and
- description of methods to be employed to avoid, remediate or mitigate any adverse effects of quarrying operations on identified significant places and areas

Key Management Areas

The following are key management areas:

- Noise Management
- Stormwater Management
- Air Quality Management
- Traffic Management
- Blasting Management
- Landcare Management
- Oil, Grease, Fuel and Chemical Management
- Ecological Management (if resources of concern exist as identified in ecological baseline in the EIA or Biodiversity Management Plan)
- Community Relations Management
- Waste Management
- Rehabilitation Management

Rehabilitation

Rehabilitation is an essential component of quarry planning and development. Good planning prior to the commencement of quarrying greatly assists in the management of environmental impacts and provides for efficient operations.

The principal objectives of rehabilitation and landscaping at the proposed quarry will be:

- To reduce the potential for erosion
- To protect and enhance visual screening
- To protect the general amenity of the area both during and subsequent to extractive operations
- To ensure a safe and stable landform
- To ensure self-sustaining vegetation
- To protect and enhance the wildlife habitat of the site
- To improve and maintain habitats in buffer areas surrounding the quarry
- To ensure a sustainable post extraction land use

Site Selection Guidelines

The location of the quarry and processing plant needs to be done to maximize noise and dust attenuation as well as visual impact. Careful site selection will:

- reduce the potential environmental impacts and consequently, the need for impact mitigation and ongoing management measures
- reduce levels of public controversy
- avoid potential delays in the approval process.

Principles of site selection for quarry proposals consideration must be given to whether:

- the land use is permissible
- environmentally sensitive areas are avoided
- the use is compatible with nearby land uses
- initial site investigations indicate the site is fundamentally suitable for a quarry or not

The following steps are recommended for site selection:

- Describing the socio-environmental conditions of each site and identifying potential impacts;
- Constructing a comparative matrix to evaluate relative site characteristics with respect to physical, ecological, socioeconomic factors; and
- Selecting the most suitable site based on the above factors and with the stakeholder participation.

Details of the factors that need to be considered for the physical, ecological and socioeconomic environment are as follows:

Physical Environment

- accessibility by heavy transport vehicles
- being, or having the potential to be, well drained;
- resulting in minimal soil loss and erosion;
- not degrading water quality in waterways and aquifers;
- stable enough to attenuate noise and vibration levels;
- screened to minimize dust pollution;
- being restorable to a suitable condition.

Key questions include the following:

- Are the rainfall patterns or prevailing wind directions likely to cause management difficulties?

- Are the local climatic conditions (e.g. air movement, rainfall) in combination with the topography likely to result in microclimatic conditions which will adversely increase impacts on the community?
- Are there any site constraints which make on-site water management difficult (including both process water and stormwater)?
- Are there risks of surface water pollution because of the proximity or pathways to waterbodies?
- Can any required separation distances from waterbodies under any existing legislation or guidelines be complied with?
- Are there risks of groundwater pollution because of shallow or rising groundwater tables, or proximity to groundwater recharge areas, or areas with a high vulnerability to pollution?
- Is the site susceptible to flooding?
- Are there any topographic or geological characteristics which will cause difficulties in managing impacts (subsidence, slippage, seismic)?
- Are the soils highly erodible? Identify any potential sediment management problems?
- Are there existing soils problems e.g. contaminated soils, acid sulfate or saline soils?
- Can the standard and capacity of the road network accommodate traffic likely to be generated by the proposal?
- Can truck traffic avoid residential areas, hospitals, schools and commercial areas?
- If inadequacies exist, can the road network or traffic management be changed to minimise any impacts particularly on residential areas?

Ecology

- maintenance of the quality, structure and functioning of important natural and sensitive ecosystems;
- minimizing impacts on species populations and biodiversity

Key questions include the following:

- Is there sufficient separation from environmentally sensitive areas such as national parks, nature reserves, wetlands, protection zones?
- Can clearing of natural vegetation be avoided?
- Can clearing of vegetation of high significance be avoided e.g. vegetation used for visual screening, riparian vegetation, vegetation used as corridors for the movement of fauna?
- Are threatened flora or fauna species, populations and ecological communities or their habitats liked to be affected?

Socioeconomic Environment

- Community infrastructure
- public goods and services
- aquifers used by local communities
- recreation
- community activities
- aesthetics
- quality of life
- open space and community amenity

Key questions include the following:

- Is the proposal likely to be compatible with surrounding existing or proposed land uses, particularly any residential, special uses (such as schools, hospitals, community buildings) and any sites of outstanding natural or environmental value?
- Is there likely to be a problem in meeting sustained compliance with dust, noise or water quality requirements due to the proximity and nature of nearby land uses?
- Is the proposal likely to pose health risks?
- Is the proposal likely to affect the heritage of significance?
- Is the site highly visible?
- Will there be significant visual impacts?

9.5 Implementation Plan

Effective implementation and functioning of the EMP depends on adequate human and financial resources, clearly defined responsibilities for environmental management, appropriate training and good communication. An outline of how these features will be managed for the Project is presented below.

9.5.1 Contractual Requirements

PEDO will ensure that:

1. EMP is included in the bidding package for the EPC Contractor;
2. During the bid evaluation the environmental performance of the bidders are taken into consideration;
3. Environmental costs are included in the financial bid of the bidders;
4. The environmental requirements are included in the contract of the selected EPC Contractor. Any conditions of the environmental clearance from the KP EPA and any subsequent licenses and approvals from KP EPA are also included in the environmental requirements for the contractors.

5. The contract of the of the selected EPC Contractor provides for withholding payment for completion of specific works until E&S requirements for those works have been implemented satisfactorily, and penalties for unsatisfactory performance

9.5.2 Design

The approving authority for the detailed design will:

- Ensure that all environmental aspects are communicated to the EPC;
- The detailed design includes the environmental design;

9.5.3 Site Specific Environmental Management Plans

EPC's Contractor's managers during the construction phase will operationalize their responsibilities described in **Section 9.4** (*Mitigation and Management Plan*) by developing Site Specific Environmental Management Plans (SSEMP). These will be applied to the actual site where construction activities will occur. Ideally, the preparation of the SSEMP must occur before the contractor is given access to the project site. However, it can be prepared after the access is given but certainly *before* the initiation of site clearance and any major site construction or erection work. At a minimum the following sites should have an SSEMP prepared:

- Dam Site
- Powerhouse Site
- Headrace Tunnel site
- Tailrace Tunnel site
- Waste Dump Areas
- Quarry Areas
- Workshops
- Batching Plants
- Labour Camp

Some of these sites, such as the headrace tunnel may require multiple SSEMPs to cover the entire spatial extent of the development.

All contract documents must include the requirement that SSEMPs be prepared by the contractor and reviewed by PEDO and OE and approved by ADB prior to commencement of construction activities.

Preparing an SSEMP

This section explains the following steps that should be followed while developing an SSEMP:

- Definition of boundaries
- Identification of environmental values and sensitive receptors of the site and its surrounds

- Definition of construction activities
- Assignment of environmental management measures
- Preparation of site plans
- Preparation of environment work plans

Definition of Boundaries

For megaprojects with multiple construction sites, such as a hydropower scheme, there will be a number of SSEMPs for each site. A hydropower scheme would need to have SSEMPs covering works at the dam site, the powerhouse, the switchyard, the downstream channel, headrace and tailrace tunnels, the intake structures, quarries that supply aggregate, the waste disposal areas, contractor's camps, equipment yards, workers' accommodations, etc. Generally, areas falling under the jurisdiction of a construction manager should have a separate SEMP.

Identification of Sensitive Receptors

Once the boundaries of a site to be covered by a SSEMP have been defined, the sensitive receptors surrounding the site and the environmental values of the area need to be confirmed.

Areas that can be considered sensitive receptors include

- Forested area
- Water bodies
- Communities (including schools, hospitals, homes)
- Agricultural areas

The physical, ecological and socioeconomic baselines in the **Section 4**, *Description of the Environment* provide the necessary details. The information is best presented as an overlay on the detailed engineering drawings or maps for the project.

Construction and Associated Mitigation Activities

A schedule of works for the project will have been prepared during the detailed design phase. It is important to understand what the various phases of work are for each site, as different phases will include different activities and thus different environmental management requirements. In this simplified example, the construction of a bridge across a river could have the following schedule of works:

- Site surveying, vegetation clearance
- Site establishment
- Soil stripping and earth movement
- Bridge construction
- Grading approaches
- Surfacing
- Painting and finishing structures

- Landscaping and signage

The planning of the environmental management requirements for the bridge must ensure that the necessary environmental management activities take place at the right time. For example, the site survey should markup areas of vegetation to be removed, trees that must be saved, and the locations of any species of importance. Soil stripping will need to be accompanied by the introduction of erosion-control measures to prevent sediment from entering the river. The concrete pouring and filling of the bridge abutments will require a large number of vehicle movements, so it may be necessary to develop a traffic management plan to ensure that the vehicles don't disrupt traffic on existing roads. If there are sensitive receptors nearby, there may be a requirement to limit working hours that will require a change in the work schedule. These measures are easy to plan for, but very hard to introduce once the project has started. This, again, emphasizes the need for effective planning of the environmental management measures.

Section 9.4 (*Mitigation and Management Plan*) provides a list of required mitigation measures that must be incorporated into the relevant SSEMPs.

Site Plan

A site plan must cover the extent of the construction activity and should contain:

- Location and nature of planned work;
- Locations of sensitive receptors; and
- Locations of required mitigation activities.

Other important features may include:

- Indication of North, and scale;
- Existing and planned supporting infrastructure (e.g., access roads, water supplies, electricity supplies, etc.);
- Contours; and
- Drainage systems.

Work Plan

The completed SSEMP provides details of all the environmental management requirements for all stages of the construction process. For individual work teams responsible for only a small part of the overall construction work, it can be hard to understand what is required for their particular work components. For example, the work team responsible for stripping soil for the construction areas are not going to be interested in the requirements for pouring concrete for footings and foundations. However, it is essential that the soil stripping team know exactly what to clear, what to leave, and where to put stockpiles of soil for later use.

When different work activities are required at different times or at different locations, environmental work plans can be prepared. These are similar to the work method statements often produced for major construction projects.

9.5.4 Site Inspection

Site inspections will be undertaken regularly in relevant areas of the Project. The inspections will focus on compliance with the EMP. The inspections will play an important role in increasing awareness of EMP.

Minor non-conformances will be discussed during the inspection and recorded as a finding in the inspection report. Major non-conformances will be reported as incidents. Inspection results will be disclosed at management meetings.

9.5.5 Non-conformance and Incidents

Non-conformances include the following:

- exceedances of relevant thresholds as identified during routine monitoring;
- non-conformances with the requirements of the EMP or supporting documentation identified during an internal inspection;
- non-conformances identified during an audit or by regulatory authorities;
- events, such as spills, resulting in potential or actual environmental harm;
- events that did or could result in injury to staff, visitors to site or surrounding communities; and
- significant complaints or grievances received from any source.

Corrective and preventive actions will be identified and implemented in response to these non-conformances. These actions will address the root cause of the non-conformance and will reduce or prevent repeated non-conformances.

A process will be established for the identification, investigation and tracking of non-conformances, including:

- prioritizing and classifying non-conformances based on the type and severity of the non-conformance;
- recording of non-conformances and the results of corrective and/or preventive actions, including the actions necessary to mitigate or remedy any associated impacts;
- defining results expected from the corrective and/or preventative actions;
- confirming the corrective and/or preventive actions taken to eliminate the causes of the non-conformance are appropriate to the magnitude of problem and commensurate with the impacts encountered;
- reviewing the effectiveness of the corrective and/or preventive actions taken; and
- implementing and recording required changes in the EMP or monitoring programme resulting from corrective and preventive action.

Serious non-conformances will be classified as incidents. Incidents will be promptly reported to appropriate management. A guideline will be prepared on:

- the types of incidents reportable to internal management at the site, Project and corporate levels, as well as to regulatory authorities and other external stakeholders; and
- standards to be observed when reporting incidents.

During construction, environmental monitoring will ensure the protection of air and noise pollution, community relations, and safety provisions. During operation, emissions, air, noise, and waste water quality monitoring and greenbelt development around the plant will be important parameter of the monitoring program.

The monitoring requirement can only be fulfilled by maintaining the proper documentation records of the findings. Daily checklists, weekly reports and monthly audit will be taken in accordance with construction management plan. Based on the EIA approval a scheduled audit will be conducted by the PEDO and reports will be shared with the regulatory authority and funding agency if required.

9.5.6 Audits

Formal audits will be undertaken at planned intervals in accordance with the requirements of client and regulatory authorities. Procedures for audits will be established, implemented and maintained. These will cover the audit criteria, scope, frequency and methods, and will address the responsibilities and requirements for planning and conducting audits, reporting results and retaining associated records.

Any negative findings arising from an audit will be treated an incident and dealt with in accordance with the non-conformance and incident procedure. Results from audits and evaluations of compliance with legal requirements will be reported to site and senior management and subject to management reviews. Usually environmental regulatory authorities require a quarterly audit report for large scale projects.

The following audits will be carried out for:

- Labor
- Health and Safety
- Environment

9.6 Monitoring Plan

Monitoring of environmental components and mitigation measures during implementation and operation stages is a key component of the EMP to safeguard the protection of environment. The objectives of the monitoring are to:

- manage environmental issues arising from construction works through closely monitoring evidence for implementation of the mitigation measures and environmental compliance; and
- monitor changes in the environment during various stages of the Project life cycle with respect to baseline conditions.

A monitoring mechanism is developed for identified impact and includes:

- location of the monitoring (near the Project activity, sensitive receptors or within the Project influence area);
- means of monitoring, i.e. parameters of monitoring and methods of monitoring (visual inspection, consultations, interviews, surveys, field measurements, or sampling and analysis); and
- frequency of monitoring (daily, weekly, monthly, seasonally, annually or during implementation of a particular activity).

Monitoring program will include regular monitoring of construction and commissioning activities for their compliance with the environmental requirements as per relevant standards, specifications and EMP. The purpose of such monitoring is to assess the performance of the undertaken mitigation measures and to immediately formulate additional mitigation measures and/or modify the existing ones aimed at meeting the environmental compliance as appropriate during construction.

The monitoring program will be coupled with a series of supporting procedures, yet to be developed, covering:

- sample or data collection;
- sample handling, sample storage and preservation;
- sample or data documentation;
- quality control;
- data reliability (calibration of instruments, test equipment, and software and hardware sampling);
- data storage and backup, and data protection;
- interpretation and reporting of results; and
- verification of monitoring information by qualified and experienced external experts.

9.6.1 Specific Monitoring Plan

Environmental monitoring and reporting plan for the construction and operation phases are provided in **Exhibit 9.22**. Moreover, each supporting plan (as described in **Section 9.4**) includes monitoring and documentation requirements; the same is also true of the SSEMP (as described in **Section 9.5.3**). Therefore, the monitoring plan will also contain requirements of these additional plans once they have been developed.

Monitoring framework for biodiversity is presented in **Section 9** (*Monitoring and Evaluation Framework*) in the BAP in **Volume 2C**.

9.6.2 Documentation and Reporting

Monitoring elements of the EMP will be documented and controlled in accordance with a document control system by the OE and communicated to PEDO. Records demonstrating compliance with legal requirements and conformance with the EMP will also be maintained. PEDO through its OE will supervise, establish, implement and maintain procedures.

Documentation and record keeping controls will include:

- measures to enable relevant documents and records to be readily available and identifiable (labeled, dated and properly filed), legible and protected from damage;
- review, revision and approval of documents for adequacy by authorized personnel at least once a year;
- establishment of the electronic document control version as the 'authorized version';
- making current versions of relevant documents available at locations where operations essential to the effective functioning;
- suitably identifying obsolete documents retained for legal and knowledge preservation purposes; and
- identification and segregation of confidential and privileged information.

Monitoring data will be documented and analyzed to determine temporal and spatial trends and confirm compliance with relevant thresholds. Monitoring reports will be produced to meet internal and external reporting requirements. If monitoring results indicate non-conformance with stipulated thresholds or if a significant deteriorating trend is observed, it will be recorded as a non-conformance and handled by the non-conformance and incident procedure. The following reports will be produced:

- Based on reports provided by the Construction Contractor as listed in **Exhibit 9.26**, quarterly and annual reports will be reviewed by OE/PEDO for monitoring of the physical and social environment and shared with the KP-EPA.
- Reports for biological environment will be produced under the frameworks provided in the BAP.
- Monitoring of NTDC's implementation of mitigation measures as described in the EIA of transmission lines will be carried out as part of the monitoring activities of the EMP.

Exhibit 9.26: Environmental Monitoring Program for Construction and Operation

Aspect	*Type of monitoring*	*Frequency of Monitoring*	*Location/s*	*Reporting Frequency*	*Monitoring and implementation Responsibility*	*Report Preparation Responsibility*	*Report Receiving Authority*
Construction Phase							
Soil Quality	Visual inspection for any oil and lubricant spills and leakages in the construction area and presence of oil in the drains at the construction site	Daily	Construction area and drains at the construction site	Monthly report during construction	EPC Contractor, OE, PEDO	EPC Contractor	PEDO, OE and EPA, KP
Soil Erosion	Visual inspection of soil erosion and land sliding, especially in the wet season	Once a month in dry season. Once a week in wet season.	Construction sites, rehabilitated areas and water release points	Monthly report during construction	EPC Contractor, OE, PEDO	EPC Contractor	PEDO, OE and EPA, KP
Waste Disposal	Inspection of waste disposal areas and channels	Weekly	Waste disposal sites,	Quarterly report during construction	EPC Contractor, OE, PEDO	EPC Contractor	PEDO, OE and EPA, KP
Water Resource Depletion	Record of water used and source of water supply for construction, sprinkling and camp	Daily	Construction sites, truck filling points and water tanks at camp.	Quarterly report during construction	EPC Contractor, OE, PEDO	EPC Contractor	PEDO and EPA, KP
Community Water Supplies	Monitor flow for springs identified as at risk from tailrace construction.	Monthly	Identified springs in communities.	Quarterly report during construction	EPC Contractor, OE, PEDO	EPC Contractor	PEDO and EPA, KP
Fugitive Dust Emissions	Air quality sampling at social receptors in case any complaints regarding excessive particulate matter in ambient air are received.	As required, in case complaints are received	Social receptors	Report as required, in case complaints are received	EPC Contractor, OE, PEDO	EPC Contractor	PEDO and EPA, KP

Aspect	Type of monitoring	Frequency of Monitoring	Location/s	Reporting Frequency	Monitoring and implementation Responsibility	Report Preparation Responsibility	Report Receiving Authority
Vehicular and Machinery Exhaust Emissions	Visual checks of exhaust emissions from vehicles and batching plant machinery to ensure excess pollutants are not being released	Monthly	Construction sites and batching plant location	Quarterly	EPC Contractor, OE, PEDO	EPC Contractor	PEDO and EPA, KP
Noise Nuisance	Monitoring of the noise levels in the nearest communities against the baseline noise conditions	Once a month and when a complaint is received	Nearest settlements or area for which complaint is received	Quarterly	EPC Contractor, OE, PEDO	EPC Contractor	PEDO and EPA, KP
Traffic	Random speed checks and inspections and investigations in case of complaints by community	Once a month and in case complaints are received	Different location and different time	Quarterly	EPC Contractor, OE, PEDO	EPC Contractor	PEDO and EPA, KP
Distribution of Project Employment	When complaint is received or an issue observed	When a complaint is received	Construction site, camp and nearby villages	Monthly	EPC Contractor, OE, PEDO	EPC Contractor	PEDO and EPA, KP
Social Unrest due to Conflicting Social Norms	When complaint is received or an issue observed	When a complaint is received	Construction site, camp and nearby villages	Monthly	EPC Contractor, OE, PEDO	EPC Contractor	PEDO and EPA, KP
Operation Phase							
Waste Disposal	Inspection of waste disposal areas and channels	Weekly	Dam and Powerhouse sites	Quarterly report	O&M Contractor	O&M	PEDO, and EPA, KP
Environmental Flow	Continuous record of downstream release into river by dam	Continuous	Dam site	Quarterly report	O&M Contractor	O&M	PEDO, and EPA, KP
Biodiversity Action Plan	As described in BAP	As described in BAP	As described in BAP	As described in BAP	As described in BAP	As described in BAP	As described in BAP

Aspect	Type of monitoring	Frequency of Monitoring	Location/s	Reporting Frequency	Monitoring and implementation Responsibility	Report Preparation Responsibility	Report Receiving Authority
		Monitoring to start at least one year before start of construction the BAP is to be initiated before financial close					

9.7 Roles and Responsibilities of Key Staff

To be effective, this EMP must be viewed as a tool reflecting to the contractors and sub-contractors' overall commitment to environmental protection. This must start at the most senior levels in the organization. Contractor management must provide strong and visible leadership to promote a culture in which all employees share a commitment to environmental awareness and protection. The following are commitments to be achieved by the highest position in Pakistan from PEDO:

- Putting environmental matters high on the agenda of meetings;
- Highlighting the importance of environmental issues in relation to the HSE considerations in business decisions and communication with stakeholders;
- Evaluating environmental aspects, before final decisions are reached;
- Being fully aware of the main environmental hazards associated with the Contractor and Sub Contractor activities and the systems, procedures and field practices in place to manage these hazards;
- Immediately and visibly responding and being involved in investigating incidents or other abnormal events related to environmental and HS issues;
- Seeking internal and external views on environmental issues; and recognizing their achievement.

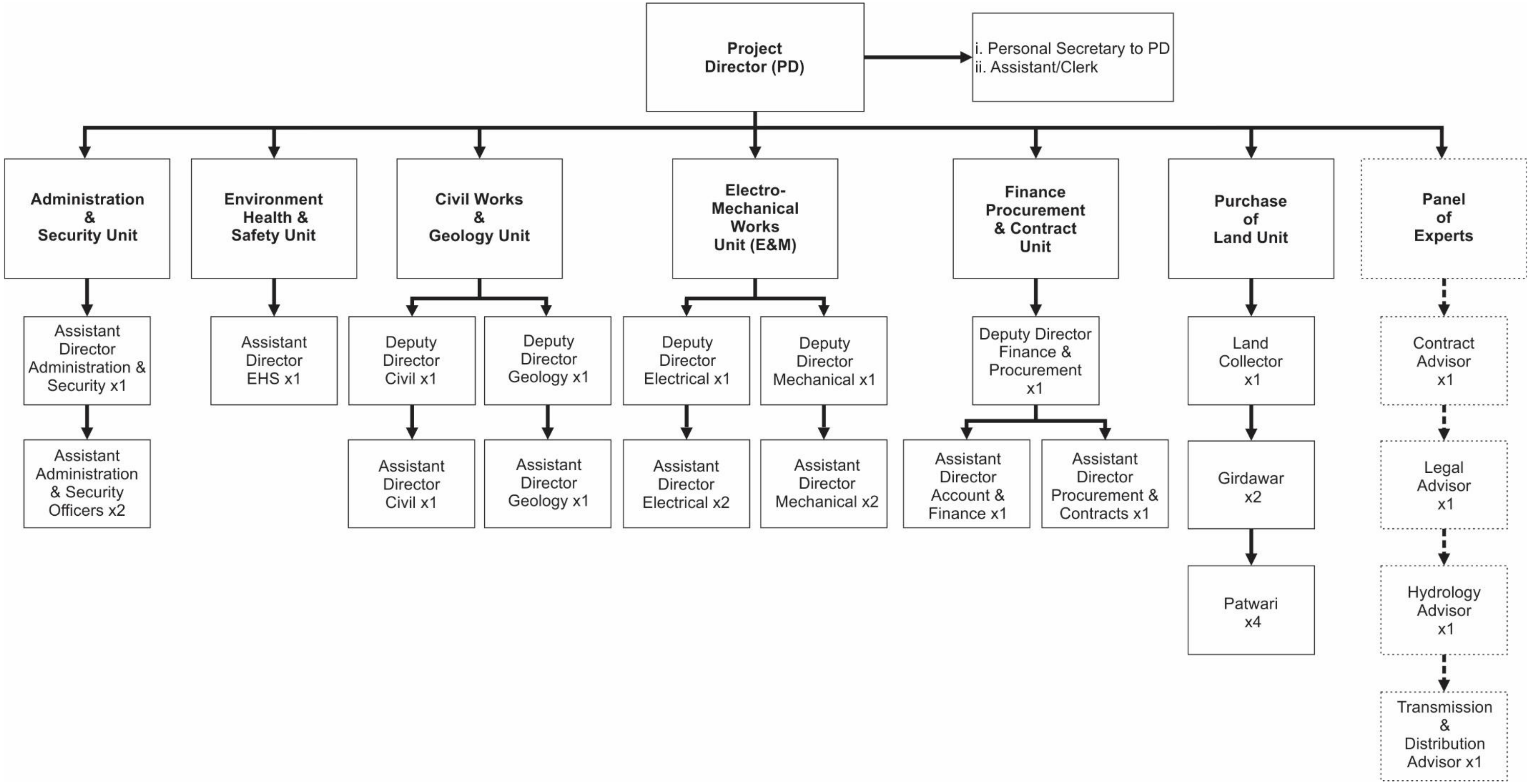
The organizational setup of PEDO for implementation of the EMP is provided in **Exhibit 9.27**. Key roles and responsibilities are described below.

9.7.1 PEDO

With overall responsibility for the Project, PEDO will:

- Prepare the ESMS and implement the ESMS and EMP.
- Minimize any impact the Project may have on the environment through preparation of this EIA (as being carried out in the design stage).
- Appoint responsible contractors who will comply with this EIA.
- Approve environmentally safe materials for use on site in accordance with the EIA.
- Ensure all relevant parties receive a copy of the approved EIA and that it is incorporated into all contractual documentation.
- Obtain the relevant environmental permits, consents and authorizations prior to commencing site works.
- Comply with all requirements of EPA, KP and obtain NOCs related to the Project.

Exhibit 9.27: Organizational Setup of PEDO for EMP Implementation



9.7.2 Owner's Engineer

Hiring an owner's engineer (OE) in the power industry is a practice which is considered a standard since the last two decades.[3] The OE is a person or, more appropriately, a team of experts that serves as an independent advocate for the owner. The OE plays a supporting but a very critical role as he is the technically trained eyes and ears of the project proponents in the field. It is expected that an OE will also be hired for the Project construction and commissioning phases. The specific roles and responsibilities of the OE will be defined in their contract. Typically, there are several important environmental roles that the OE can undertake on behalf of PEDO.

In general, following types of tasks can be assigned to the OE:

- Prepare technical specifications for design of environmental element
- Approval of technical design developed by the EPC Contractor of environmental elements of the Project
- Review and Approval of SSEMP
- Environmental Monitoring
- Review of the environmental monitoring reports and data produced by EPC

Some role for the OE is suggested in this document. However, prior to commencement of construction a formal agreement will be reached between PEDO and the OE on the latter's environmental role and responsibility.

9.7.3 Construction Contractor

The EPC or Construction Contractor will prepare a 'Construction Management Plan' (CMP) demonstrating the manner in which they will comply with the requirements of mitigation measures proposed in the EMP. After completion of the Construction Contractor's contract, PEDO will be in charge of the operation and maintenance of the Project and will be responsible for compliance with the monitoring plan during operations. The Construction Contractor's general responsibilities will be to:

- Ensure the implementation of the EIA/EMP throughout construction works by all contractor personnel and subcontractors.
- Ensure that adequate resources are available to implement the requirements of this EMP.
- Undertake quarterly environmental audits and report to PEDO on regular basis.
- To coordinate with PEDO for all correspondence to EPA, KP.
- Prepare a comprehensive legislation list and ensure compliance to these legislations.

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[3] http://www.powermag.com/who-needs-an-owners-engineer/

9.7.4 Sub-Contractors

Any Sub Contractor hired directly or indirectly by the Construction Contractor to carry out Project related tasks will be designated as a sub-contractor. It will be the responsibility of those sub-contractors, whose activities have at least one interface with identified key environmental aspects, to comply with the EIA at all times. They must also designate sufficient competent resources to ensure all Sub-Contractor personnel receive the required training. Sub-contractors directly in charge of activities shall be registered and approved. Registration documentation will be provided to PEDO prior to commencement of any activities. Sub-contractors will be expected to demonstrate a proactive behavior towards environmental concerns. It will be their responsibility to provide information requested by PEDO with regard to their scope of activities and to demonstrate compliance with the applicable environmental requirements.

9.7.5 PEDO Personnel

This section to be finalized following discussion with PEDO.

Project Director

The Project Director (PD) will manage and superintend all office and site activities for the implementation of the Project. In relation to the EIA and implementation of ESMS and EMP, the PD's responsibilities will include:

- Overall responsibility for ensuring implementation of the EMP in compliance of all legal matters regarding the Project.
- Development and establishment of adequate Environmental, Safety and Quality Management teams, who will ensure the development, communication and implementation of this EIA across the entire Project, including all activities being undertaken by subcontractors and suppliers working on the site, and all personnel visiting the site.
- Ensure that the sub-contractor has hired an environmental team to address environmental requirements in accordance with the EIA.
- Develop and establish an organization structure adequate to oversee the whole of the works, including overseeing the appointment of an appropriate qualified HSE Manager and Environmental Manager.
- Ensure that adequate resources are available to implement the requirements of this EIA.
- Ensure the EIA is reviewed regularly to correspond with on-going construction activities.
- Coordinate with government agencies and bodies regularly to discuss the Project's construction environmental issues and requirements.
- Attend regular meetings with Manager EHS and CSR in order to discuss the site's environmental issues and requirements.

Deputy Director – Civil

- Taking primary responsibility for all activities on site, including those undertaken by direct or indirectly employed personnel or agencies.
- Ensuring the issue of suitable procedures for the definition of working methods and site regulations that take into consideration the requirements within the EIA.
- Ensuring that construction and erection works are performed in respect of the EIA requirements.
- Attending regular meetings in order to discuss the site's environmental issues and requirements.

Assistant Director EHS

The Assistant Director EHS manages and supervises the Project activities relating to health, safety and environment. The Assistant Director EHS will be responsible for:

- The overall responsibility for the development and implementation of the Project HSE policy/philosophy.
- Coordinating weekly HSE meetings, during which any environmental issues will be discussed and minuted.
- Reviewing and ensuring the implementation of Contingency and Emergency Response Procedure.
- Providing specialized HSE input into engineering, construction and contracts, ensuring requirements are properly integrated into project planning, design criteria, construction plans and specifications and contracts
- Supporting/leading incident investigations as per project procedure and report to all concerned. Follow up and review the corrective and preventive action taken, and close-out the incidences.
- Conducting HSE inspections of project construction activities and monitoring compliance with requirements including contractual commitments, permits and projects HSE plan and other applicable HSE requirements and ensure that the Project HSE inspection plan is implemented.
- Ensuring that all internal as well as external incidents and complaints are appropriately resolved with all applicable forms and records duly filled and maintained.
- Coordinating and organizing regular meetings with the Project Director, Construction Manager and Environmental Manager in order to discuss the site's HSE issues and requirements.
- Coordinating the environmental activities with the higher management time to time.
- Coordinating with the EPA, KP, other regulatory authorities and stakeholders on environmental issues related to construction of the Project.

- Monitoring construction activities and performance to ensure compliance with the EIA and effectiveness of control measures adopted.
- Ensuring that no works are carried out outside the construction corridor as defined in the EIA, especially within the protected areas (e.g. forests).
- Ensuring the issue and updating of the Project's environmental plans.
- Coordinating Project document review activities from an environmental standpoint, assuring that the execution of these activities is compatible with development of the Project and reporting any discrepancies between the environmental requirements and other Project objectives to the Head Hydro Power and CEO.
- Supplying essential information for the preparation of the environmental control plan for construction.
- Updating EPA, KP regularly on construction information.
- Coordinate the development of environmental monitoring data relevant to construction activities.
- Performing environmental checks and monthly internal audits of onsite activities, in coordination with the HSE Manager.
- Supporting the higher management in relations with the governmental agencies and with the EPA, KP on environmental matters.
- Implementing the environmental requirements of the project management system including inspection and reporting.
- Monitoring construction activities and performance to ensure compliance with the Construction Management Plan and effectiveness of control measures adopted.
- Developing and implementing of the environmental training program.
- Conducting staff environmental training, inductions and Tool Box Talks (TBT).
- Communicate with internal and external parties as required.
- Coordinating daily and weekly site inspections and approving the associated environmental inspection report.
- Reviewing daily and weekly checklists to ensure that appropriate recording of site activities and observations.
- Preparing of the monthly environmental reports, quarterly performance reports and incident reports.
- Reporting of any environmental incidents to the higher management.
- Ensuring that major environmental incidents are reported to EPA, KP within a maximum of 3 days.
- Participating in environmental management reviews.
- Reviewing environmental monitoring data.

- Raise non-conformance and issue CAPs reports in coordination with the EHS Manager (PEDO).
- Ascertaining that effective measures and relevant actions are undertaken to avoid or minimize adverse environmental impacts.
- Attending regular meetings with the PD and staff that reports to the Assistant Director EHS in order to discuss the site's environmental issues and requirements.
- Ensuring that all internal as well as external environmental incidents, emergencies and complaints are appropriately resolved with all applicable forms and records duly filled and maintained.
- Regular reviewing of environmental plans and procedures to assess compliance and recommend revisions, where required.
- Review reports provided by the Construction Contractor and submit periodic reports to EPA, KP.
- Review BAP reports and submit to Management Committee for BAP and to EPA, KP.

9.8 Change Management and Document Control

It is possible that some changes in Project design will be required at the time of Project implementation. These can include changes to

- Operations and infrastructure,
- New developments (such as an expansion),
- Personnel and the Company,
- Legislation, and
- Project baseline environmental conditions (such as a new settlement established near Project infrastructure).

These changes could result in changes to the significance of environmental and social impacts and risks. This may necessitate updates to existing authorizations/ permits, changes to the ESMS, which may have to be approved by regulatory authorities, and general changes to the ESMS framework.

This section describes the mechanism that will be in place to manage changes that might affect the project's environmental impacts. The Change Management System recognizes three orders of changes:

First Order: A first order change is one that leads to a significant departure from the project and consequently requires a reassessment of the environmental impacts. A new environmental assessment will be conducted and a revised ESIA or IEE for updates will be submitted to the Punjab EPA for a first-order change in the project.

Second Order: A second order change is one that may result in different project impacts, although the overall magnitude of project impacts would be similar to those assessed in this report. The required action for such changes is to reassess the impact of the activity on the environment and report it to the Punjab EPA.

Third Order: A third-order change or uncertainty is one that is of little consequence to the ESIA and IEE findings. In case such a change is made, the only action necessary will be to make the required changes in the EMMP (Construction or Operations) to reflect how the change has been dealt with.

Changes will not be made without the required authorizations/ permits in place. The measures identified as necessary to mitigate impacts and risks will be implemented. The various elements of the ESMS will be modified as required in response to the change.

A procedure specifically for changes to the policy/s, ESMS, underlying management plans and supporting documentation will be established. This will detail:

- how the changes are to be recorded;
- who has responsibility for overseeing changes and checking that they do not conflict with any planning conditions or other obligations;
- the process of review and sign off in response to changes; and
- how changes to the ESMS and underlying and associated plans should be communicated internally and externally.

9.9 Cost Estimate

Cost estimate for EMP implementation is presented in **Exhibit 9.28**. It is separated into cost to be borne by PEDO and EPC Contractor. The EPC Contractor will provide the cost of other items.

The cost estimates for control measures and some of the mitigation measures that were already part of the design are not included in the EMP.

In addition to the cost estimate for EMP implementation estimated land acquisition and resettlement cost is USD 13,514,184. Breakdown of the land acquisition and resettlement cost cost is provided in the LARP[4] of the BHDP.

4 Hagler Bailly Pakistan, Balakot Hydropower Development Project Land Acquisition and Resettlement Plan, June 2019.

Exhibit 9.28: Summary of Cost Estimates for EMP (USD) to be borne by PEDO and EPC Contractor

No	*Item*	*Note*	*Construction Phase*			*Operation Phase (Annual)*
			Capital	*Recurring (Annual)*	*Total (years) 6.5*	
1	**Biodiversity Action Plan**		**388,343**	**340,761**	**2,603,290**	**340,761**
1.1	Protection		114,238	40,533	377,703	40,533
1.3	Monitoring and Evaluation of Protection		125,000	76,740	623,810	76,740
1.4	Implementation of the IRRE	Subject to approval by NEPRA	21,792	23,822	176,635	23,822
1.5	Implementation of the WMP	Subject to approval by NEPRA	127,313	169,666	1,230,142	169,666
1.6	Monitoring and Evaluation of the IRRE and WMP	Subject to approval by NEPRA	–	30,000	195,000	30,000
2	**Implementation of Stakeholders Engagement Plan**		–	**208,190**	**1,353,235**	**208,190**
3	**Environmental & Social Mitigation Measures**			**310,780**	**2,286,990**	**192,640**
3.1	Salaries and benefits		–	310,780	1,786,990	192,640
3.2	EHS Training, Laboratory Fees and out of pocket expenses				500,000	
4	**External monitoring**	For the construction phase this is lump sum cost for the services for 6.5 years, based on 18 visits. For the operation phase this is the annual cost based on 2 visits per year	–	–	284,460	31,610
5	**Instrumental monitoring and sampling**		**8,380**	**700**	**12,930**	**9,080**

No	Item	Note	Construction Phase			Operation Phase (Annual)
			Capital	Recurring (Annual)	Total (years) 6.5	
5.1	Monitoring of vehicles for emissions and noise*		–	700	4,550	700
5.2	Monitoring of ambient noise levels		2,190		2,190	2,190
5.3	Monitoring of ambient dust levels		6,190		6,190	6,190
6	**Mitigation Measures**		**2,185,265**	**–**	**2,185,265**	**–**
6.1	Compensation for trees	To be determined in consultation with Forest Department	1,223,965	–	1,223,965	–
6.2	Tree plantation cost	To be determined in consultation with Forest Department	822,420	–	822,420	–
6.3	Springs and water resources		138,880	–	138,880	–
	Total (1+2+3+4+5+6)		**2,581,988**	**860,431**	**8,726,170**	**782,281**

*Unit rate for monitoring of vehicles for emissions and noise is assumed as PKR 5,000.

The annual cost is calculated by multiplying unit rate with the number of trucks used for the Project. Calculation is as follows:

Monitoring of vehicles for emissions and noise = 50 USD

Number of truck trips for the Project = 70 (Section 7.10)

Number of trips per truck = 5 (assumed)

Number of trucks = 70 /5 = 14 trucks

10. Conclusion and Recommendation

PEDO has proposed the 300 MW Balakot Hydropower Development Project (BHDP) or Balakot Hydropower Project (BAHPP) on the Kunhar River about 18.6 kilometer (km) upstream of the town of Balakot in KP. This Project was evaluated in this report by HBP and its associated team experts for environmental and social impacts. The proposed design and construction activities were assessed against the laws of KP, the GoP policies and ADB Guidelines. Mitigation and management measures were recommended and made part of the Project design.

Environmentally, the most important aspect of the Project is the cumulative impact of the proposed Project and other hydropower projects in the Jhelum Basin on the aquatic biodiversity of the Basin, including the fish fauna, macro-invertebrates, periphyton biomass, and riparian vegetation. Two species of fish are of conservation importance, namely the Nalbant's Loach and Kashmir Hillstream Loach, both of which are endemic and restricted range species.

Cumulative impact assessment was carried out following the methodology adapted from the guidelines of the IFC. The study area for the assessment included the Kunhar River from Lulusar Lake downstream to the top of the confluence of the Kunhar River and Jhelum River. In addition to the existing Patrind HPP, the other four proposed projects on the Kunhar River, including the Project, were included in the assessment.

The Biodiversity Action Plan (BAP) for Balakot Hydropower Development Project[1] identified fish fauna as a priority biodiversity value. The Discrete Management Unit (DMU) for the Project falls in Critical Habitat as defined in the IFC PS6 mainly due to presence of the two endemic and restricted range species, the Nalbant's Loach and Kashmir Hillstream Loach. The Project is required to achieve a 'net gain' in the population of these two species to comply with PS6. River ecology and fish fauna in the Study Area was also determined to be a priority biodiversity value.

A Biodiversity Action Plan (BAP) has been prepared as a part of the EIA to ensure that the protection measures as described in the EFlow assessment are implemented to protect fish fauna in general and the Nalbant's Loach and Kashmir Hillstream Loach, in particular, such that achievement in net gain in the populations of these two species is achieved.

Socially, the most important aspect is resettlement. 165 household are likely to lose their land and residences. A resettlement action plan has been prepared separately to undertake the resettlement in a fair and open manner and to minimize social or economic impacts. The basic principles used for resettlement are derived from Pakistani laws and ADB's SPS 2009 so that the livelihoods and standards of living for all affected households are improved or at least restored.

1 Hagler Bailly Pakistan (HBP), July 2017. Draft Report of the Biodiversity Action Plan for the 300 megawatt (MW) Balakot Hydropower Development Project for the Asian Development Bank (ADB).

All the affected households losing any asset will be compensated according to the replacement cost. Every Project Affected Person (PAP) losing their livelihood resources or places of income generation as a result of Project interventions will be supported with income and livelihood restoration assistance. Moreover, eligible PAPs will also receive resettlement allowances like relocation allowance, vulnerability allowance, severe impact allowance etc. The Resettlement Action Plan also provides a grievance redress mechanism and a monitoring and evaluation system.