WATER AND POWER DEPARTMENT
GILGIT-BALTISTAN

CONSULTANCY SERVICES FOR 20 MW HANZEL HYDROPOWER PROJECT, GILGIT BALTISTAN

INITIAL ENVIRONMENTAL EXAMINATION (IEE) REPORT

MARCH 2019

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LIMITED
Geotechnical & Geoenvironmental Engineering Division
NESPAK House, 1-C, Block N, Model Town Extension, Lahore
Tel: +92-42-99231917, 99090310 Fax: +92-42-99231918, 99231950
Email: geotech@nespak.com.pk Web site: www.nespak.com.pk

Disclaimer

NESPAK has prepared this document in accordance with the TOR of Client (Water & Power Department, Gilgit Baltistan) for their sole and specific use. This document has been prepared in good faith on the basis of available data and information. NESPAK does not guarantee or warrant the accuracy and reliability of the information/data. NESPAK will not liable for any loss, damage, cost or expense incurred or arising by reason of any third party using or relying on information mentioned in this report. The company accepts no liability whatsoever for any direct or consequential loss arising from the unauthorized use of this report or its content.

20 MW HANZEL HYDROPOWER PROJECT, GILGIT BALTISTAN
INITIAL ENVIRONMENTAL EXAMINATION (IEE) REPORT

TABLE OF CONTENTS

LIST OF FIGURES

(This Space is Intentionally Left Blank)

LIST OF TABLES

(This Space is Intentionally Left Blank)

LIST OF ANNEXES

(This Space is Intentionally Left Blank)

LIST OF ABBREVIATIONS

AOI	Area of Influence
BCP	Building Code of Pakistan
BOD	Biochemical Oxygen Demand
CCHA	Community Controlled Hunting Area
dBA	Decibels (Equivalent to Scale A)
DFO	District Forest Officer
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EPC	Engineering Procurement Construction
GB	Gilgit Baltistan
GBDMA	Gilgit Baltistan Disaster Management Authority
GOP	Government of Pakistan
GHG	Green House Gases
HHP	Hanzel Hydropower Project
IEE	Initial Environmental Examination
KKH	Karakoram Highway
LAA	Land Acquisition Act
LPG	Liquefied Petroleum Gas
MASL	Meters Above Sea Level
MW	Megawatt
MSDS	Material Safety Data Sheets
NESPAK	National Engineering Services Pakistan (Pvt.) Limited
NCS	National Conservation Strategy
NEP	National Environmental Policy
NEQS	National Environmental Quality Standards
NGOs	Non-Governmental Organization
NPO	No Project Option
NWFP	North-West Frontier Province (Old Name of Khyber Pakhtunkhwa)
O&M	Operation and Maintenance
OBE	Operating Basis Earthquake
OSHA’s	Occupational Safety and Health Administration’s
PAPs	Project Affected Persons
PGA	Peak Ground Acceleration
PC	Public Consultation
PPEs	Personal Protective Equipment’s
PMU	Project Management Unit
RCC	Reinforced Cement Concrete
SPSS	Statistical Package for Social Sciences
TMP	Traffic Management Plan
WPDGB	Water and Power Department, Gilgit Baltistan
WAPDA	Water and Power Development Authority
WHO	World Health Organization

20 MW HANZEL HYDROPOWER PROJECT, GILGIT BALTISTAN
INITIAL ENVIRONMENTAL EXAMINATION (IEE) REPORT

EXECUTIVE SUMMARY

Hanzel Hydropower Project has been identified through various studies undertaken by different agencies of Government of Pakistan (GoP) and Government of Gilgit Baltistan (GB). The Government of GB with support from the Ministry of Kashmir Affair & Gilgit Baltistan (KA&GB) has initiated the 20 MW Hydropower Project at Hanzel, Gilgit to meet the current and future demands of the consumers and to facilitate the industrial development in the region to get maximum benefit keeping in view the future trends and opportunities.

Keeping in view of the above, Water and Power Department (WPD), GB hired National Engineering Services Pakistan (Pvt.) Limited (NESPAK) for the Review of the Feasibility Study, Preparation of the Tender Documents for Engineering Procurement Construction (EPC) Contractor, Design Review and Construction Supervision for early implementation of Hanzel Hydropower Project. As part of this contract, preparation of the Initial Environmental Examination (IEE) Study for the subject Project is an important task. The main objective of the IEE study is to assess the potentially significant environmental and social impacts associated with the pre-construction, construction and operation activities of the Hanzel Hydropower Project. The approach and methodology for conducting the IEE study for the proposed Project has been adopted keeping in view the GB Environmental Protection Act 2015, Review of IEE and EIA Regulations, 2000, and Pakistan Environmental Impact Assessment (EIA) Procedures. Gilgit Baltistan Environmental Protection Agency (GBEPA) is the concerned authority for the proposed Project. All the relevant provisions of the policy and legal frameworks have been duly considered in this IEE study.

The proposed project is essentially a 20 MW Hydropower Project which is located about 17 km from Gilgit Town on Gilgit River which is a right bank tributary of Indus River. The proposed project includes a weir with flushing section, sedimentation basin, headrace channel, forebay, penstock, spill channel, and a powerhouse. The proposed project will generate 163.672 GWh energy per annum to meet the power demand of Gilgit and its surrounding areas.

The Hanzel Hydro Electric Power Project will be interconnected to the new proposed 132 kV Gilgit grid station at Sakarkoi about 10 km from the switchyard. A 132 kV single circuit transmission line has been proposed for the transfer of energy to the proposed new grid station. The land to be acquired will be 142 acres (57 hectare) based on the project footprint, topographic and GIS surveys for the project execution, which will be further verified upon the mobilization of the EPC Contractor. The total estimated construction period of the proposed project will be 34 calendar months followed by 01 year of joint operation/ maintenance period and 02 years for defect liability period. The overall project cost (Approved PC-I Cost) is about Pkr. 6,273.569 million.

In order to optimize the location of the Project in terms of benefits and potential impacts on the environment, following project location alternatives were discussed:

- Alternative 1: Weir near Tholdas village with tunnel
- Alternative 2: Weir on rock at upstream of Hanzel Bala
- Alternative 3: Dam at 7 Km (7,000 m) upstream of Gilgit River from Gilgit.

Alternative 2: Weir on Rock at Upstream of Hanzel Bala has been considered for detail studies.

A consultant's team of experts was constituted to establish the baseline conditions of the Study Area. The team comprised Environmental Engineers, Environmentalist, Sociologist and Ecologist. The experts conducted a detailed desk study of the available data before mobilization to the site. For the collection of baseline information checklists, proformas, Satellite Imagery

(Google Earth) and General Topographic (GT) sheets were used. Study Area was delineated based on the field reconnaissance, study of available maps and data collected through the secondary sources. Checklist/proformas were prepared for the collection of baseline data. Scoping sessions with all the concerned Project stakeholders were carried out for the collection of primary information and disclosure of Project interventions. The relevant collected data was analyzed using software such as Microsoft Office (Word, Excel and Access), Statistical Package for Social Sciences (SPSS), Computer Aided Design (CAD), and Coral Draw 12 etc.

Based on the consultant experience in the field of environment, the Study Area has been demarcated using the Google Earth Imagery and reconnaissance visit. The Study Area mainly includes the weir site, headrace channel, forebay, penstock, power house (Project Area) nearby settlements/villages in the area downstream of weir up to power house and the areas where adverse or positive impacts may be foreseen due to the implementation of the Project. The Study Area is selected on basis of the Project's potential environmental and social impacts on the local resources viz., river water, irrigation channels, water supply systems and the natural resources (if any) currently under use of community in the vicinity of the Project Area.

This physical environment elaborate the settings of physical parameters including topography, land use, soils, geology, seismicity, climate, water resources, and other parameters. The Project Area is located in the "Gilgita City" and mostly shows E-W trending folds and faults. The Project Area as per Building Code of Pakistan (BCP), 2007 (Seismic Provisions) falls entirely in the Zone 3, which is the moderate to severe damage zone. The dominant weather of the city is winter, which lasts eight to nine months a year. Gilgit District is surrounded by glaciers. Gilgit is the nearest weather station and the climatic data has been obtained from EPA, GB. The climate of the district is characterized by cold winter and warm and dry summer. The summer season in low lying valleys is hot but at high altitudes it is very pleasant. The data for the various climatic parameters of Gilgit is presented in the relevant section of this IEE report.

Ambient Air quality in the Project Area appears to be good based on observation during the field visit. Domestic sources of air pollution, such as emissions from wood and kerosene burning stoves as well as small diesel standby generators in some households, are well dissipated. No other industrial pollution sources are present in the vicinity. To record the ambient air quality, and noise levels instrumental monitoring was carried out at five (05) different locations inside the Study Area. Ambient Air Monitoring was carried out for SO_2, NO_2, CO, CO_2, VOC and Particulate Matter (PM_{10} & $PM_{2.5}$) parameters. All the above parameters were found within the applicable NEQS limiting values.

Ecological study of the AOI has been carried out during the site visits, standard ecological assessment technique based on primary and secondary information, discussion with Government departments and meeting with groups of communities/public living in and around the Project area coupled with expert visual observations was used for the assessment. The indigenous species of flora are xerophytic in nature including mainly willow Ilenthus and poplar, whereas eucalyptus, frash ber, etc. are found in the Study Area. Many bird species have been reported in and around the Study Area. No Endangered or Critically Endangered bird has been reported from the area. In Study Area, the trout species are socio-economically important since they not only provide food for the local communities but are also used for commercial fishing and attract tourists for recreational fishing. GB holds several protected areas, which plays very important role in ecological balances including our Study Area, which needs effective management systems. The Kargah Area has been declared as the community controlled hunting area, which is more than 5 km away from the Project Area under conservancy name "Kargah Gilgit" in May, 2013 under GB Wildlife Preservation Act, 1975.

The socioeconomic baseline covers the demography, administrative and political settings, religious and cultural, economic aspects, infrastructure and facilities, security situation, gender, and NGOs. The basic objective of the socio-economic survey was to identify the living standard and socio-economic characteristics of the people of the Project Area and to assess the possible impacts of the proposed project on the population. In the Project Area one archeological site Hanzel Stupa exist. There is no direct impact foreseen on these archeological features, however, during construction and operation stage special measure for its safety may be required.

Considering the importance of the project, consultations were carried out at all possible levels i.e. departmental and local level. The process of consultation is an on-going process which continues during the project life cycle and even after the submission of this report and so on. Stakeholders were identified, categorized and consulted at departmental level i.e. with GB-EPA, Forest Department, Wildlife Department and Fisheries Department of GB and at village level (Direct and Indirect Affectees and Locals). Consultation were carried out through meetings with locals, village people, directly affected people, local NGOs etc. during the baseline survey of the Study Area. The major concern of the local people is about free electricity, jobs, market based compensation and improved infrastructure facilities.

The project impacts have been assessed for the design/pre-construction, construction and operation phases. Various IEE/EIA methodologies are available for identification of impacts including the checklist and project impact matrix. Among these methods, project impact matrix was used as impact identification methodology. In order to identify spatial based impacts, overlays were used. The major adverse impact of the proposed Project will be the land acquisition, about 142 acres (57 hectare) of land will be required based on the project footprint and topographic survey for the project execution, which will be further verified upon the mobilization of the EPC Contractor. The land that will be required for the weir, spillway, headrace channel, forebay, penstock, powerhouse, contractor’s camps, access roads, bridges and operator’s colony is about 15 acres (6 hectare). The other anticipated impacts would be construction phase mostly of a temporary nature and their magnitudes are subject to the engineering management practices adopted during construction. Such impacts are related to soil (erosion and slope stability), water quality, noise, air quality and disruption to the biological environment, public health, interruption of communications, at-risk population/safety, community stability, and cultural and religious values/properties.

An EMP is developed for managing and monitoring the potentially significant environmental and social impacts of the proposed Project and to describe the institutional framework and reporting mechanism to implement the EMP. This EMP is structured as Institutional Setup: Mitigation Management Matrix (MMM); Instrumental Monitoring; Training and Awareness; Site Specific Plans; Tree Plantation and Environmental Cost. EMP cost is estimated as; environmental monitoring Pkr. 600,000 at pre-construction stage, Pkr. 2,900,000/annum during construction and Pkr. 1,600,000/annum for operation. The plantation cost is calculated to be about Pkr. 13,238,400 (13.2 Million).

Based on the IEE study conducted, with the implementation of the proposed mitigation measures, it can safely be concluded that Hanzel Hydropower Project would bring improvement in civic and social services for locals, increase in business and tourism industry. The provision of electricity in the area will bring prosperity and improve the living standards of the local people. It is recommended that EMP will become part of all bidding/tender documents. EPC Contractor will be bound to completely implement relevant mitigation measures as set out in the EMP and IEE for environmental sustainability. EPC Contractor shall prepare the Health, Safety and Environment (HSE) Plan and other site specific plans as specified in IEE based on the frameworks provided in the EMP of this IEE report.

CHAPTER 1- INTRODUCTION

1.1 GENERAL

The proposed 20 MW Hanzel Hydropower Project (HHP) is located at about 17 km from Gilgit Town on Gilgit River which is right bank tributary of Mighty Indus. Gilgit Town is the head quarter of the Gilgit Baltistan (GB) entity commonly known as Gilgit Baltistan Agency. The administrative location of the Project is shown in **Figure 1-1**.

The GB became a separate administrative unit in 1970 under the name of "Northern Areas". It was formed by the amalgamation of the former Gilgit Agency, the Baltistan district and several small former princely states, the larger of which being Hunza and Nagar. In 2009, it was granted limited autonomy and renamed to GB via the Self-Governance Order signed by the President of Pakistan, which also aimed to empower the people of GB[1].

The concept of the proposed project was perceived back in 1980 by Planning and Investigation (P&I) Department of Water and Power Development Authority (WAPDA). P&I initial studies, suggested a 30 m high rockfill dam. Later in 1990s, Hanzel Project was also studied as a part of Comprehensive Planning of Hydropower on Tributaries of Indus River carried out by HEPO-WAPDA and GTZ[2]. Later in 2012, JV of Associate Consulting Engineers (ACE) (Pvt.) Limited and Technical Engineering and Management (TEAM) Consultant carried out the feasibility study and PC-1 Proforma was also prepared.

Based on the information made available on GB official website, the current generation of the GB is about 90 MW due to about 92 small Power Generation Projects. This electricity is only supplied to about 75% of the potential consumers. The current conservative demand in the GB is on the order of about 200 MW. Considering the above, in-line with Government of Pakistan (GoP) policy to overcome the energy crisis and to improve the power availability for current and future demand, Government of GB through its Water and Power Department (WPD) is pressing hard for the early implementation of this highly feasible and much needed Hydropower Project.

Keeping in view the above, Water and Power Department (WPD), GB hired NESPAK for the Review of the Feasibility Study, Preparation of the EPC Level Tender Documents for Engineering Procurement Construction (EPC) Contractor, Design Review and Construction Supervision for early implementation of Hanzel Hydropower Project. As part of this contract, preparation of the Initial Environmental Examination (IEE) Study for the proposed Project is an important task of the study.

1.2 PROJECT BACKGROUND

Hanzel Hydropower Project has been identified through various studies undertaken by different agencies of GoP and Government of GB. In 1982 Feasibility Study for the scheme was prepared by P&I Division of WAPDA, wherein construction of 30 m high rock fill dam was proposed by WAPDA and it was not constructed due to some environmental and submergence issue of Hanzel Town.

During the study on Comprehensive Planning of Hydropower Resources of Tributaries of Indus River in Northern Areas of Pakistan conducted by HEPO-WAPDA and GTZ during 1994 to 1998 this site was also studied.

Later, due to the increase in the demand of the electricity, the need for the development of the small hydropower Projects below 50 MW was over emphasized for the subject region.

[1] Wikipedia, Shahid Burki, 2009
[2] Feasibility Study of Hanzel Hydropower Project

Meanwhile, with the ever-increasing gap in the demand and supply in the national grid the short fall reached to an extent that an electricity crisis arises in the country which resulted in long hours of load shedding even in the main cities of the Pakistan.

This situation necessitates the revamping and development of the Power Sector of Pakistan, on emergency grounds though injection of more power to the system, upgrading of the existing generation sources, rehabilitation, revamping and development of new transmission and dispatch lines, sub stations and grid stations etc.

To avoid the similar situation in the GB, taking a proactive approach in line with the GOP, the Government of GB with support from the GOP concerned ministries, Energy Department is looking of the early development of Hydropower Potential of the GB to not only meet the current demand of the consumers but to facilitate the industrial development in the region to get maximum benefit considering the future trends and opportunities.

Based on the above, the Feasibility Study of the Hanzel Hydropower Project was awarded to the joint venture of M/s ACE and M/s TEAM by the Power Department, Northern Area in 2009. The Feasibility Report has proposed a diversion weir located at a distance of 17 km (17,000 m) from Gilgit city, a power channel, forebay and a power house.

1.3 OBJECTIVES OF THE PROJECT

Following are the main objectives of the Project:

- The prime objective of the implementation of the Project is to develop the Power Potential, available in GB on sustainable basis by providing cheaper, renewable, environmental friendly and most needed power, keeping in view the present and future requirements of Pakistan especially rural and remote areas for the development of the country.
- Transmit energy to Gilgit Town and adjoining areas through a 132 KV transmission line for meeting Power and Energy requirements of the Gilgit district. Ensured availability of Power will reduce reliance and consumption of diesel, timber and other fuels. This will overall reduce the Greenhouse Gases (GHGs).

1.4 PROJECT LOCATION, SIZE AND MAGNITUDE

The proposed Project is essentially a Hydropower Project. The proposed site is located near Hanzel village on Gilgit River about 17 km (17,000 m) from Gilgit Town, GB. The location map of the proposed Project is attached as **Figure 1-2**. Based on the geographical location the concerned Environmental Protection Agency (EPA) for the subject Project is the GB, EPA.

GB Environmental Protection Act, 2015 is the core legislation which deals with the protection of the environment in GB Agency. Subsection 16 Initial Environmental Examination and Environmental Impact of Part VI Environmental Examinations and Assessments of this act deals with the Environmental Assessments and Approvals. As per Part VI “no proponent shall commence construction or operation unless proponent has acquired approval from the Agency”. This act and other relevant applicable laws, regulations and guidelines have been considered for the subject study.

Proposed installed capacity of the Power house is 20 MW. The proposed Project comprises a weir (including flushing section, sedimentation basin), headrace channel to carry water for power intake, forebay, penstock, powerhouse, switchyard, spill channel, 132 kV transmission line and grid station at Sakarkoi. Weir is divided into three sections. Segment one is designed as a flushing section, second segment is a broad crested weir (85 m wide and 8.5 m high) to divert the required discharge from the river to the lateral intake section. Third segment is being proposed for the placement of the fish ladder. Water through weir will be diverted to a lateral intake open channel. The headrace is 4.983 km (4,983 m) long upto forebay. A surface Powerhouse is proposed to generate power and the water will be again released to the main River after passing though the Power house.

Based on the Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 the only criterion provided for the environmental screening of a hydropower Project is the Hydroelectric Generation. There is no environmental screening criterion related to the weir length and height or discharge capacity as well as the carrying capacity of the channel or the length. Hence the Hydroelectric Power Generation Criteria was applied. As per the Criteria provided in the Schedule-I Category A: Energy, 1. Hydroelectric Power Generation less than 50 MW, an IEE study is required to be filed to concerned EPA for the initiation of Environmental approval Process.

(This Space is Intentionally Left Blank)

Figure 1-1: Administrative Location of the Project

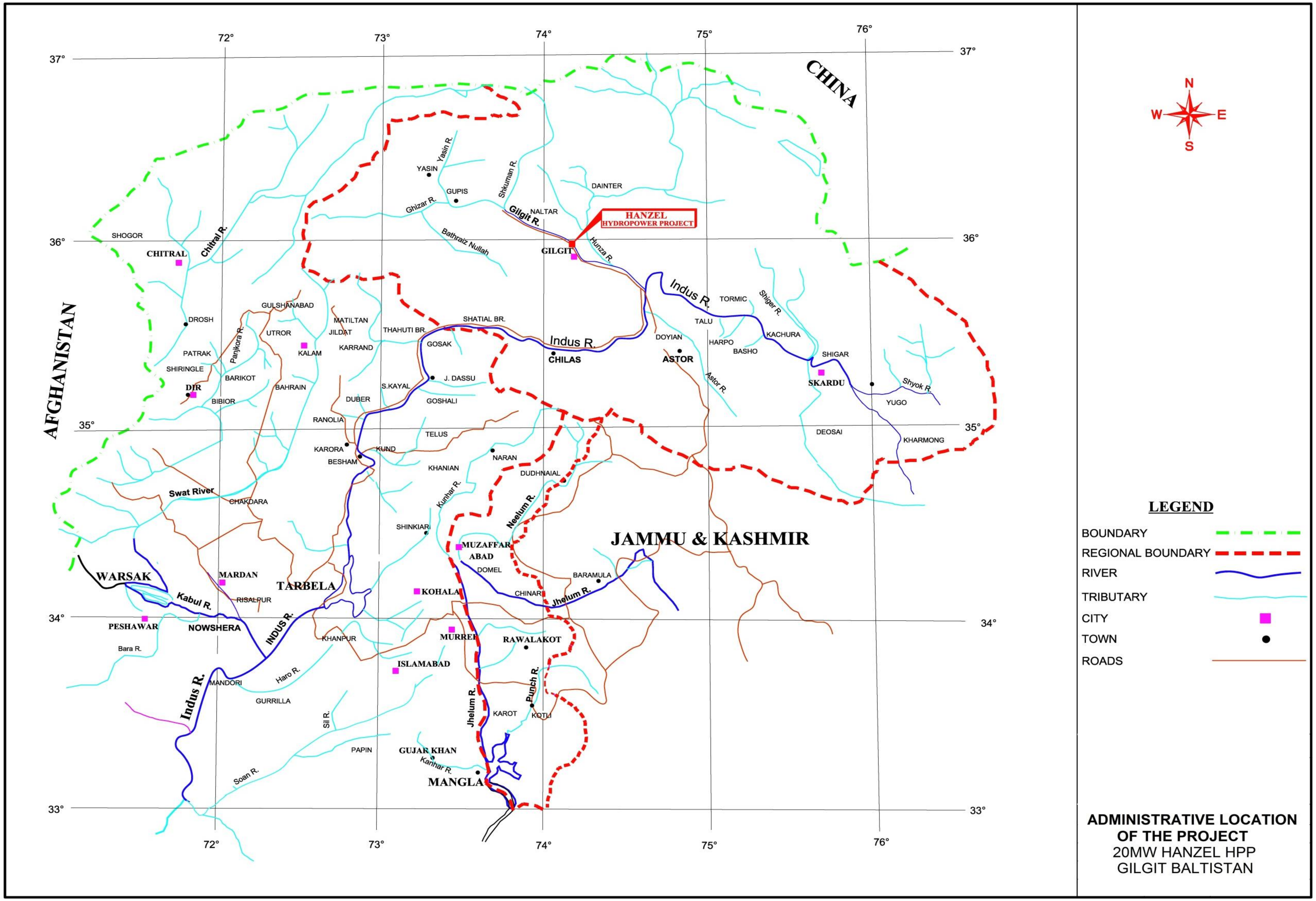
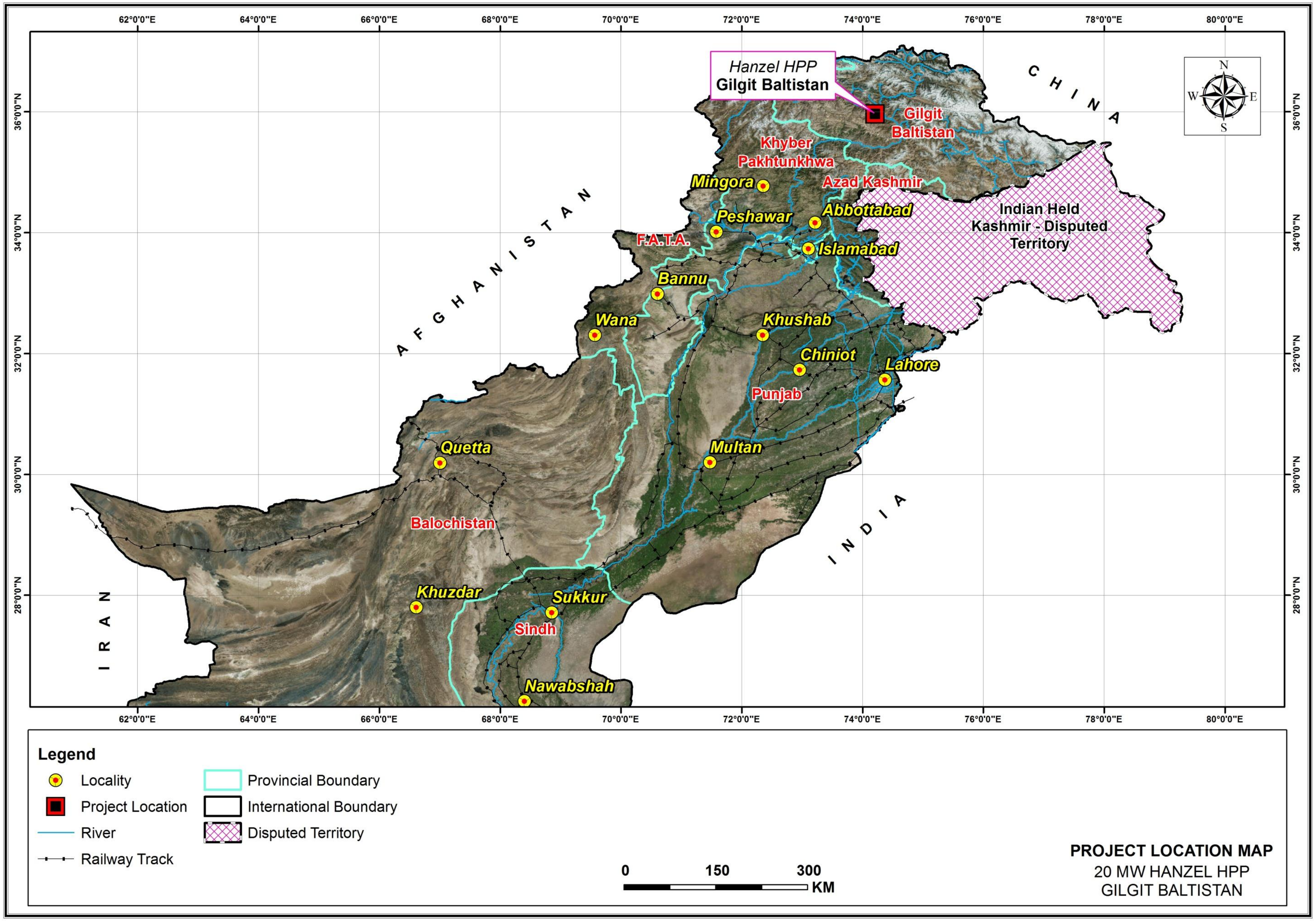


Figure 1-2: Project Location Map



1.5 PURPOSE OF REPORT

The main objective of the IEE study is to assess the potentially significant environmental and social impacts associated with the pre-construction, construction and operation activities of the Hanzel Hydropower Project.

The main objectives of this IEE are to:

- Assess the existing environmental conditions (physical, ecological and socio-economic) in the Project Area;
- Assess the proposed project activities to identify and evaluate the impacts, and determine their significance;
- Propose appropriate mitigation and monitoring measures that can be incorporated into the design of the proposed activities to minimize any damaging effects or any lasting negative consequences identified by the assessment; and
- Prepare an IEE report for submittal to the GB EPA and technically assist the Client to initiate the No Objection Certificate (NOC) process.

1.6 DELINEATION OF THE STUDY AREA/AREA OF INFLUENCE (AOI)

For an IEE Study, a clear delineation of the Study Area/ Area of Influence (AOI) is required. Study Area/AOI is the area within which the potentially significant impacts of the proposed Project activities (direct or indirect) are envisaged. In this report, the Study Area/AOI is the area where the Project impacts on the environment due to the proposed Project activities are assessed. The proposed Project comprises various components of linear and non-linear nature.

Based on the available Google Earth Imagery and ARC GIS software, Project components were overlaid on the existing Project Area Imagery. Utilizing the information collected through the study of previous documents including the Feasibility Study, reconnaissance visit, consultations with the locals and concerned departments and foreseen impacts of the hydropower, a tentative AOI was delineated which was firmed up during the detailed design stage. Map of the Study Area/AOI is shown as **Figure 1-3.**

Based on the proposed Project components, geographical location and nature of the Project following is the description of the Study Area/AOI of the Project:

1.6.1 Catchment Area

Gilgit River originates from Ghizer River at an elevation of about 4,300 Meters Above Sea Level (MASL) at Shundur pass and flows westward joining Yasin and Ishkuman River and ultimately falls into Indus River at Alam Bridge. The catchment area of Gilgit River at Gilgit gauging station (1,430 m.a.s.l) is 12,095 km^2 while upto proposed weir site is about 11,491 km^2. Based on the hydrology, proposed Project activities have no potentially significant impacts on whole catchment area. Below is the description of the Study Area/AOI component wise.

1.6.2 Weir Area (A-1)

The Weir is proposed at rock exposed on left bank of Gilgit River upstream of Harpoon village. The Weir area also includes the flushing section and sedimentation basin as shown in **Figure 1-3.**

1.6.3 Headrace Channel (A-2)

Proposed headrace channel length on right bank of Gilgit River is about 4.983 km (4,983 m) which is starting from sedimentation basin, traverses the alluvial deposits, moraine deposits, amphibolite rock outcrop and terminates at forebay in moraine deposits.

1.6.4 Forebay (A-3)

The forebay structure shall be founded on rock foundation. The Forebay will be constructed near the existing nullah and it will be used as spill channel to carry surplus/spill water as a result of reduction of load or sudden shutdown of turbine back to Gilgit River.

1.6.5 Penstock (A-3)

Embedded penstock was considered as an alternative of underground penstock. There will be one (01) penstock. The entire penstock shall be buried at least one meter deep.

1.6.6 Power House (A-3)

The powerhouse is located in Hanzel Paine on the right bank of the Gilgit River. The Power house site is flat and lies above of river flood water level. Powerhouse shall be protected from floods and its foundation shall be placed above high flood level. The tailrace structure will directly discharge water in the Gilgit River.

1.6.7 Contractor Camp Area (A-3)

The contractor’s camps shall be constructed by the EPC Contractor in accordance with project construction requirement and other improvements that may be directed by the Supervision Consultant. The EPC Contractor shall submit for review a plan to Supervision Consultant /Client showing the proposed layout for field cabins, field office and accommodation in close proximity of forebay area for approval. The exact location and area of contractor’s camps shall be finalized by the Employer/Engineer after mobilization of Contractor at Project site.

1.6.8 Quarry Area (A-3)

The EPC Contractor shall submit proposals for the Employer/Engineer’s approval giving the location of borrow pits and stockpiles and proposals for their management to ensure acceptability of the materials.

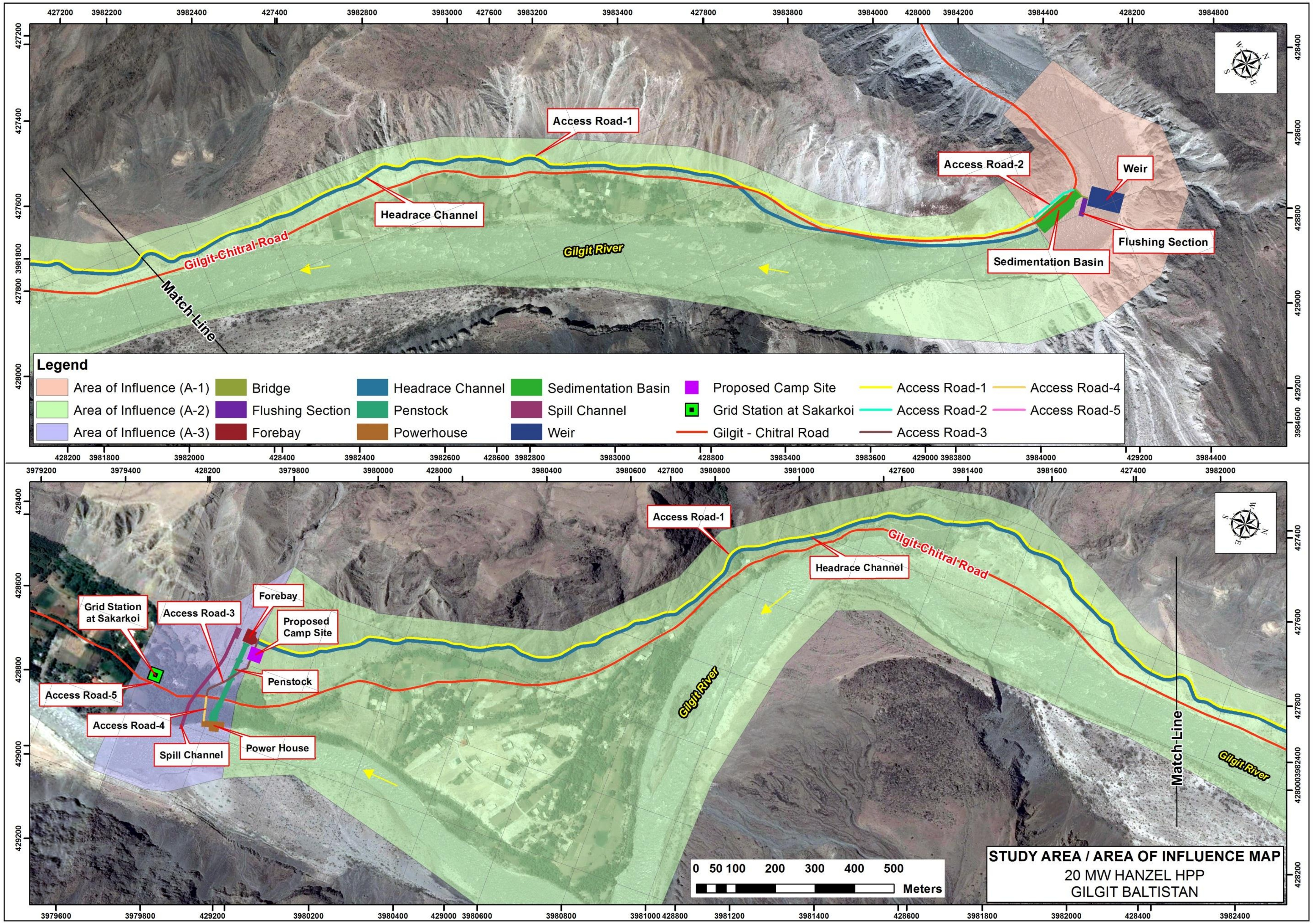
1.6.9 Access Roads

The details of the permanent access roads (not more than 10 Km) which comprises of:

- 4m wide Access road along the headrace channel with connection from existing public road (Shingle type) (Access Road-1).
- 4m wide access roads which connect existing public road to access road of headrace channel at three points (DST Type). (Access Road-2).
- 7m wide Truck able access road from Existing public road to Forebay area by using existing track (DST Type) (Access Road-3).
- 7m wide Truck able access road from Existing Forebay area to Powerhouse and Switchyard (DST Type) using existing track and existing public road (Access Road-4).
- 7m wide Truck able access road for Grid Station at Sakarkoi to connect with nearest public road (DST Type) (Access Road-5).
- Others Access road (truck able/ jeep able) in the project area as per project requirement (DST Type).

(This Space is Intentionally Left Blank)

Figure 1-3: Study Area/Area of Influence Map



1.7 PROJECT PROPONENT

The contact details are as follows:

Proponent Department: Water and Power Department, GB

Designation: Project Director

Address: Office of the Project Director, 20 MW Hydropower Project, Near K.I.U Gilgit, Water & Power Department Gilgit Baltistan

Telephone: +92-5811-922609

Fax: +92-5811-922619

E-mail: hanzelpd14@gmail.com

1.8 APPROACH AND METHODOLOGY ADOPTED

Following approach was adopted for the IEE study.

1.8.1 Desktop Studies

After the award of the contract, the consultants acquired various Project specific studies, relevant studies to the regions, available maps such as GT sheets, Google Earth Imagery of the Area, published reports, relevant legislations etc. List of Reports and data acquired and consulted for the subject Project is listed below:

- Feasibility Study Report, 2009;
- 20 MW HPP PC-1 Proforma, 2014;
- GB Environmental Protection Act, 2015;
- Feasibility Review Report, 2017; and
- Other relevant laws and regulations;

After the acquisition of data, reports, maps and relevant information, Consultant relevant experts started the desktop studies. The main objective of the desktop study was to conceptualize the Project, familiarize with the project layout, design, status of the Project, identification of the issues related to the Project. Based on the desktop studies it was find out that at Feasibility stage of the Project, a minor level IEE study was carried out. The IEE study chapter as a part of the Feasibility Report was made available. This chapter helped to assess the quantum and planning for the execution of the works. Following are the major output from the desktop studies:

- Identification of the gaps in the previous studies;
- Need and extent to update the IEE Study;
- Tentative delineation of the Study Area/AOI; and
- Development of the tentative work plan for IEE.

1.8.2 Review of Previous IEE report

The Feasibility Study (IEE Chapter No. 9) has been reviewed comprehensively with the objective to identify the deficiencies and assess the issues/gaps in the previously IEE study related to physical, ecological, social and cultural resources.

1.8.3 Reconnaissance Visit

Based on the desktop studies, a field reconnaissance was carried out from September 15, 2017 to September 22, 2017 to accomplish the following tasks;

- Preliminary level consultation with the major stakeholders;

- Collect preliminary baseline information in the Study Area/AOI;
- Delineation of the Study Area/AOI;
- Preparation of the detailed work plan for the study; and
- Field visit report of the reconnaissance **(Annex-1).**

1.8.4 Scoping

Based on the findings of the desktop studies, reconnaissance and consultations with the regulatory authorities and government departments, scoping was carried out to pin point the risks and impacts associated with the proposed project. Output of the scoping was the scope of work for the Environment team. The scoping provides an overview of the project areas of the proposed project.

Reconnaissance of the project was conducted for the areas including weir site, power channel route, forebay, penstock, power house site and the adjacent villages such as Hanzel Bala, Hanzel Paine, Harpoon and Saeeda Abad Villages. Preliminary consultation with the local communities and concerned Government Departments such as Environmental Protection Agency (EPA), GB, Wildlife Department, Fisheries Department and Forest Department were also carried out as part of the visit. However the detailed consultations with departments, locals and concerned agencies are presented in **Chapter 5**.

1.8.5 Environmental Baseline Survey

A team of NESPAK experts comprising Civil Engineer, Environment Scientist, Ecologist, Sociologist visited the Hanzel Hydropower Study Area site including the upstream, command and lower riparian areas to collect the data regarding the baseline conditions of the existing environment. Environmental baseline survey includes weir, headrace channel, forebay, penstock, and powerhouse location. The site visit was made from September 15 to September 22, 2017. For the collection of data, formal meetings were held and data collected is based on instrumental reading, visual observations and interviews with the local residents and officials. Information about the geology, soils, water resources, climate, existing flora and fauna, and other natural resources, local communities and socio-economic conditions were collected. In order to collect the relevant published information, government offices located in Gilgit city were also visited.

1.8.6 Analysis of Data

Primary and secondary data has been compiled and analyzed to develop baseline conditions in the Study Area/AOI. For the data analysis state of the art software such as Microsoft office, Statistical Package for Social Sciences (SPSS) and AutoCAD was utilized.

1.8.7 Screening of Potential Environmental Impacts and Mitigation Measures

Based on the generally established baseline conditions in the adjacent as well as in the Project Area, potential physical, ecological and social impacts of the proposed Project were identified, evaluated and quantified, wherever possible, by using a combination of the satellite imagery, secondary data and field visit and discussion with the local residents of the Study Area/AOI and by using the check-lists. To mitigate the significant identified adverse impacts, economic and practically implementable mitigation measures were suggested.

1.8.8 Environmental Monitoring Plan, Management and Implementation

To implement the suggested mitigation measures, a framework for institutional requirements, together with the development of Mitigation Management Matrix (MMM) and the proposed environmental monitoring program and environmental cost was prepared.

1.9 IEE TEAM

The IEE team comprised of the following main experts:

- Mr. Irfan-ul-Haq — GM/Head Environment and Resettlement (E&R)
- Mr. Muhammad Moeen — Design Team Leader/Geotechnical Engineer
- Mr. Muhammad Shariq Ahmad — Principal Engineer (E&R & HSE)
- Mr. Saqib Rehman — Senior Environmental Scientist
- Mr. Waqar Saleem — Senior Sociologist
- Mr. Ibadullah Khan — Ecologist
- Mr. Shoaib Aziz — Chemical Engineer

1.10 Report Structure

The IEE report is divided into eight (08) chapters;

Chapter-1 Covers Introduction to the proposed Project;

Chapter-2 Provides the country's environmental regulatory requirements and framework applicable to the proposed Project together with the international standards and guidelines;

Chapter-3 Presents the description of the Project including project components and activities, design parameters, detail of infrastructure facilities and project alternatives;

Chapter-4 Describes in detail the existing environmental baseline conditions of the Study Area related to the physical, ecological and social domains of environment;

Chapter-5 Explains the public consultation and disclosure**;**

Chapter-6 Exhibits the impacts assessment at construction and operational phases of the proposed Project along with their mitigation measures;

Chapter-7 Outlines environmental mitigation plan, management and implementation along with proposed institutional framework required for effective implementation and monitoring; and

Chapter-8 Gives the conclusions and recommendations.

(This Space is Intentionally Left Blank)

CHAPTER 2 – ENVIRONMENTAL REGULATORY REQUIREMENTS AND FRAMEWORK

2.1 GENERAL

This section deals with the relevant environmental policy, legal and administrative framework instituted by the Government of GB for the protection of environment. All the relevant provisions of the policy and legal frameworks have been duly considered in this IEE study. Pakistan is signatory to various international conventions for pollution control and biodiversity, which are also discussed.

2.2 NATIONAL/PROVINCIAL POLICIES, LAWS, REGULATIONS AND GUIDELINES

In 1983 Pakistan Environmental Protection Ordinance (PEPO) was notified. Subsequently, Pakistan Environmental Protection Act (PEPA), 1997 was passed by the act of parliament. Based on the law EPAs were formed at Federal as well as Provincial level. In 2012 after the 18th Amendment protection of the environment became a provincial subject. As per the amendment, all provincial EPAs was made completely independent and has to formulate their own legislations, laws and guidelines related to the protection of environment. Role of Federal EPA was limited to the jurisdiction of Capital Islamabad.

A separate EPA for the GB at Gilgit has also been established. The IEE and EIA reports pertaining to projects falling within the different provincial boundaries and the GB are submitted to the relevant EPA for approval. The proposed Hanzel Hydropower Project is located in Hanzel, Gilgit and falls under the jurisdiction of the EPA GB.

2.2.1 The National Environmental Policy, 2005

The National Environmental Policy (NEP) describes integration of the environment into development planning through the implementation of the IEE and EIA process at the scheme level. The NEP is the overarching framework which aims to protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development. The policy includes guidelines to Federal, Provincial and Local Governments under the following headings:

- Water Supply and Management;
- Air Quality and Noise;
- Waste Management;
- Forestry;
- Biodiversity and Protected Areas;
- Climate Change and Ozone Depletion;
- Energy Efficiency and Renewable Energy; and
- Multilateral Environmental Agreements.

2.2.2 National Conservation Strategy (NCS), 1992

The Pakistan National Conservation Strategy (NCS) is the principal policy document for environmental issues in the country which was developed and approved by the Government of Pakistan in March, 1992. The NCS works on a ten-year planning and implementation cycle. It deals with fourteen core areas as follows:

- Maintaining soils in cropland;
- Increasing irrigation efficiency;
- Protecting watersheds;
- Supporting forestry and plantations;
- Restoring rangelands and improving livestock;

- Protecting water bodies and sustaining fisheries;
- Conserving biodiversity;
- Increasing energy efficiency;
- Developing and deploying material and energy renewable;
- Preventing and abating pollution;
- Managing urban wastes;
- Supporting institutions for common resources;
- Integrating population and environmental programmes; and
- Preserving the cultural heritages;

2.2.3 The Gilgit Baltistan Environmental Protection Act, 2015

The GB Environmental Protection Act 2015 was enacted by Govt. of GB on May 06, 2016. The act has Eleven (11) Parts out of which part VI is related to environmental examination and assessments. This act is applicable to almost all environmental parameters such as air, water, soil, and noise pollution, as well as to the handling of hazardous wastes. The Act provides the framework for protection and conservation of species, wildlife habitats and biodiversity, conservation of renewable resources, establishment of standards for the quality of the ambient air, water and land, establishment of Environmental Tribunals, appointment of Environmental Magistrates, IEE and EIA approval. Penalties have been prescribed for those contravene the Act. The key features of the Act have a direct bearing on the requirement for an Initial Environmental Examination and Environmental Impact Assessment for development projects.

Following are the key features of the Act that have a direct bearing on the Proposed Project:

- Section 11 (Prohibition of Certain Discharges or Emissions) 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 GB Environmental Quality Standards” or where applicable , the standards established under sub-clause (i) of clause (g) of sub-section (1) of section 6;
- Section 16 (Initial Environmental Examination and Environmental Impact Assessment) requires that “No proponent of a project shall commence construction or operation unless he has filed with the Agency an IEE or, where the project is likely to cause an adverse environmental effect, an EIA, and has obtained from the Agency approval in respect thereof.”;
- Section 16-2a The Agency shall review the initial environmental examination and accord its approval, subject to such terms and conditions as it may prescribe, or require submission of an environmental impact assessment by the proponent;
- Section 16-2b (Review of IEE and EIA): The Agency shall review the Environmental Impact Assessment report and accord its approval subject to such conditions as it may deem fit to impose, or require that the Environmental Impact Assessment be re-submitted after such modifications as may be stipulated or rejected, the project as being contrary to environmental objectives;
- Section 13 (Handling of Hazardous Substances) requires that “Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose off, store, handle, or otherwise use or deal with 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, rule, regulation or notification for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement, or other Instrument to which Pakistan is a party.”;

- Section 15 (Regulation of Motor Vehicles): Subject to provision of this act and its rules and regulations 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 GB Environmental Quality Standards" or where applicable, the standards established under sub-clause (i) of clause (g) of sub-section (1) of section 6.;
- Section 21 (Penalties): Whoever contravenes or fails to comply with the provisions of section 11, 14, 16, and section 20 or any order passed issued there under shall be punishable with fine which may extend to one million rupees, and in the case of a continuing contravention or failure, with an additional fine which may extend to one thousand rupees for every day during which such contravention or failure continues: Provided that if contravention of the provisions of section 11 also constitutes contravention of the provisions of section 15, such contravention shall be punishable under sub-section (2) only; and
- Section 22 (Offences by Bodies Corporate): Where any contravention of this Act has been committed by a body corporate, and it is proved that such offence has been committed with the consent or connivance or, is attributed to any negligence on the part of, any director, partner, manager, secretary or other officer of the body corporate, such director, partner, manager, secretary or other officer of the body corporate, shall be deemed guilty of such contravention along with the body corporate and shall be punished accordingly.

2.2.4 Land Acquisition Act, 1894

This Act is the primary law for acquisition of land and built-up properties for public interest in Pakistan and also sets out the procedure and rules for acquisition and compensating the owners, as well as for compensating owners for damage caused to their properties, crops and trees by a project but it lacks the mechanism to address the complex issues of resettlement. It comprises 55 sections dealing with area notifications, surveys, acquisition, compensation, appointment awards, disputes resolution, penalties and exemptions. The latest revisions and amendments including Land Acquisition Rules were made in 1983. Presently, the Land Acquisition Act 1894 is applicable throughout Pakistan including GB. The valuation of land for compensation is governed by sections 23 and 24 of the Act, which include the following provisions:

- Market value of the land at the time of notification of Section 6;
- Damage sustained by the person interested by taking of any standing crops or trees;
- Damage sustained by the person at the time of Collector's taking possession of land; and
- Damage sustained by the person at the time of acquisition of land injuriously affecting his other property, movable or immovable.

For the Hanzel Hydropower Project compensation for acquisition of 17 hectares land for project structures (connecting channel, headrace channel, penstock, and powerhouse complex), colonies, labor camp, stores, workshops will be carried out primarily in the light of this Act, supported by other measures (to be decided in the particular circumstances to suit the requirements). However, in case a need arises, this Act will be used for this purpose, supported by other measures as warranted, to fulfil requirements of the World Bank Guidelines. In the Project Area land is privately owned which is mostly barren and not being used for agriculture. Local people use a part of that land for pastures.

2.2.5 Antiquities Act 1975

The Antiquities Act of 1975 ensures the protection of the cultural resources of Pakistan. All the archaeological features e.g. archaeological sites, arte facts, historical carvings, historical monuments, temples, shrines and old graveyards come under the cultural property. The Act is designed to protect "antiquities" from destruction, theft, negligence, unlawful excavation, trade and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area which is of archaeological significance. Under this Act, it is understood that all project proponents are obliged to:

- Ensure that no activity is undertaken in the proximity of a protected areas without permission of the competent authority; and
- In case any antiquities have been found or reported in any Project Area it will be the responsibility of the proponent to report to the department of Archaeology, Government of Pakistan.

2.2.6 Factories Act, 1934

The clauses relevant to the project are those which concern health, safety and welfare of workers, disposal of solid wastes and effluents, and damage to private and public property. The Factories Act also provides regulations for handling and disposal of toxic and hazardous materials. As construction activity is classified as ‘industry’, these regulations will be applicable to the project construction contractor.

2.2.7 Gilgit Baltistan (Northern Areas) Wildlife Preservation Act, 1975

This Act provides for the establishment of national parks, wildlife reserves and wildlife sanctuaries and the issuing of hunting licenses and certificates of lawful possession. It regulates hunting, prohibits the use of in humane methods and imposes certain other limitations, such as time of day, season and area in which hunting is permitted. The First Schedule to the Act contains a list of animals divided according to the categories of “small game” and “big game”. All activities at the project site will have to be carried out keeping in view the provisions of this act.

2.2.8 Gilgit Baltistan (Northern Areas) Fisheries Act, 1975

This act is related to the fisheries in the Gilgit Baltistan. The act mainly describes the prohibition of destruction of fish by explosive and destruction of fish by poisoning water. The act also describes the fish size not to be kill and capture specified in the second column of the First Schedule. Moreover, the act also describes the separate penalties for the violation of section 4, 5 or 9 and section 6, 7, 8 or 10.

2.2.9 Explosives Act, 1884

Under the Explosives Act, the project contractors are bound by the regulations on handling, transportation and using explosives during the quarrying, blasting, and other purposes.

2.2.10 Gilgit Baltistan (Northen Areas) Forest Rules, 1983

The Gilgit Baltistan (Northern Areas) Forest Rules protected forests which are either the property of the government or have property rights to the whole or part of the forest produce. However local people may have some concessions and user rights. They may be able to use these forests for grazing and collection of fuel wood and other non-timber products.

2.2.11 National Disaster Management Act, 2010

National Disaster Management Act, 2010, is the core legislation which defines the roles and responsibilities of the concerned authorities related to the natural disaster management plan etc. Section 9, 16, 20, 22 and 25 of the Act, 2010 explicitly mentioned that who will prepare and implement the disaster management plans at National, Provincial and District Level in case of disaster.

Under the section 9 of above referred act, NDMA has laid down the guidelines for preparation of disaster management plans by different Ministries or Departments and the Provincial Authorities. NDMA give directions to the concerned Ministries or Provincial Governments and the Provincial Authorities regarding measures to be taken by the, in response to any threatening disaster situation or disaster. These plans are updated on seasonal basis according to the forecast.

For the proposed Project, Gilgit Baltistan Disaster Management Authority (GBDMA) is responsible for the preparation and updation of Disaster Management Plan. The detailed Disaster Risk Management Plan will be prepared by the EPC contractor based on these guidelines.

2.2.12 Motor Vehicle Ordinance 1965

The Motor Vehicles Ordinance of 1965 of Punjab was extended to the whole of Pakistan in 1978. The ordinance deals with the powers of the Motor Vehicle Licensing Authorities and empowers other related agencies to regulate traffic rules, vehicle speed and weight limits, and vehicle use, to erect traffic signs, and to prescribe special duties of drivers in case of accidents. It also prescribes powers of police officers to check and penalise traffic offenders. At the same time, the ordinance also empowers the regional transport authority to operate as a quasi-judicial body at district level to monitor road transport, licensing requirements, and compensations for deaths or injuries to passengers on public carriers.

2.2.13 EPA, IEE and EIA Regulations, 2000

The EPA prepared the regulations during 2000 for “Review of IEE and EIA” under the powers conferred upon it by the PEPA. These regulations categories development projects for IEE and EIA into three schedules: Schedules I, II and III. Projects are classified on the basis of expected degree and magnitude of environmental impacts and are included in different schedules. The projects listed in Schedule-I include those where the range of environmental issues is comparatively narrow and the issues can be understood and managed through less extensive analysis. Schedule-I projects require an IEE to be conducted, rather than a full-fledged EIA, provided that the project is not located in an environmentally sensitive area.

The projects listed in Schedule-II are generally major projects and have the potential to affect a large number of people in addition to significant adverse environmental impacts. The impacts of projects included in Schedule-II may be irreversible and could lead to significant changes in land use and the social, physical and biological environment. Dams and reservoirs with a maximum storage volume greater than 50 million cubic meters or a surface area greater than 8 km^2 fall under Schedule-II of the IEE-EIA Regulations, 2000. Schedule-III is for the proponent to pay non-refundable review fee at the time of submission of IEE or EIA.

It’s already mentioned in the chapter 1 that IEE is obligatory for the proposed project.

2.2.14 National Environmental Quality Standards (NEQS)

The National Environmental Quality Standards (NEQS) were first promulgated in 1993 and have been amended in 1995 and 2000. The following standards are specified therein:

- Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment facilities, and the sea (three separate sets of numbers);

- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources; and
- Maximum allowable concentration of pollutants (2 parameters) in gaseous emissions from vehicle exhaust and noise emission from vehicles.

The standards apply to liquid effluents from the construction sites, dam area, powerhouse site and residential areas and to wastewater discharges from workers and other construction camps, and to project vehicles, especially heavy construction vehicles. The prevailing NEQS for liquid effluents discharged to inland surface waters and gaseous emission from industrial sources are provided in **Annex- 2**. These standards will be applicable to the gaseous emissions and liquid effluents discharged to the environment from the project.

2.2.15 Guidelines for Public Consultations

These guidelines deal 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 legitimate concerns in any impact assessment study. These guidelines cover

- Consultation, involvement and participation of Stakeholders;
- Techniques for public consultation (principles, levels of involvements, tools, building trust);
- Effective public consultation (planning, stages of EIA where consultation is appropriate);
- Consensus building and dispute resolution; and
- Facilitation involvement (including the poor, women, building community and NGO capacity).

2.2.16 Guidelines for Sensitive and Critical Areas

The Guidelines for Sensitive and Critical Areas, 1997, identify officially notified protected areas in Pakistan, including critical ecosystems, archaeological sites etc., and provides checklists for environmental assessment procedures to be carried out inside or near such sites. Environmentally sensitive areas include, among others, archaeological sites, biosphere reserves and natural parks, and wildlife sanctuaries and preserves.

2.3 INTERNATIONAL TREATIES AND CONVENTIONS

Pakistan is a member of several international organizations such as United Nations Organization (UNO), Organization of the Islamic Conference (OIC), South Asian Association for Regional Cooperation (SAARC), and the Economic Cooperation Organization (ECO). The conventions, ratification dates and obligations related to the proposed Project are given in **Table 2-1.**

Table 2-1: International Agreements/Conventions relevant to the Project

Sr. No	Agreement/Convention	Ratification	Description/Relevance
1	Convention on Biological Diversity, 1994 **Web Link:** https://www.cbd.int/	Signed in 1992 and ratified in 1994.	The Convention on Biological Diversity (CBD) has three main goals: conservation of biological diversity (or biodiversity); sustainable use of its components; and fair and equitable sharing of benefits arising from genetic resources. This is applicable to the Project for

Sr. No	Agreement/Convention	Ratification	Description/Relevance
			conservation of biological diversity and restoring habitats during the Project life.
2	The Rio Declaration, 1992 **Web Link:** http://www.unep.org/documents.multilingual/default.asp? documented =78 &articled = 1163	Signed on 13th June 1992, and ratified on 1st June 1994	The Rio Declaration comprises 27 principles which address important issues such as; sustainable development to integrate environmental protection into the development process; common but differentiated responsibilities to conserve, protect and restore the earth's ecosystems; public participation and information access at the national level, reduce and eliminate unsustainable patterns of production and consumption. The provision of the declaration is applicable for environmental protection during the Project life.
3	Kyoto Protocol, 1992 **Web Link:** http://unfccc.int/kyoto_protocol/items/ 2830.php	Ratified in 2005	The Kyoto Protocol is a protocol to reduce greenhouse gasses that cause climate change. It was agreed on 11th December, 1997 at the 3rd Conference of the countries to the treaty when they met in Kyoto, and entered into force on 16th February, 2005. As of November 2007, 175 countries have ratified the protocol. One hundred and thirty seven (137) developing countries have ratified the protocol, including Brazil, China, India and Pakistan but have no obligation beyond monitoring and reporting emissions. The protocol is applicable to reduce the emissions from Project construction activities.
4	The Basel Convention, 1989 **Web Link**: http://www.basel.int/theconvention / overview/tabid/1271/default.aspx	Ratified 26th July 1994	Basel Convention on the control of trans-boundary movements of hazardous wastes and their disposal is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to Less Developed Countries (LDCs). It does not, however, address the movement of radioactive waste. The Convention is also intended to minimize the amount and toxicity of wastes generated, for environmentally sound management as closely as possible to the source of generation,

Sr. No	Agreement/Convention	Ratification	Description/Relevance
			and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate. The provisions of this convention implies to minimize the amount of waste generated and its management during construction and O&M phases.
5	Convention on the International Trade of Endangered Species (CITES), 1975 **Web Link:** https://www.cites.org/	Pakistan signed the Convention in 1973 and ratified it in April 1976.	The convention entered in to force on 1st July 1975. The principal obligations of contracting parties to the CITES are to safeguard the trade in rare or endangered species and it established a permit system to control imports and exports of wild fauna and flora. According to this convention species threatened with extinction whose movement between countries is prohibited except for conservation purposes such as captive breeding, species whose commercial trade is permitted but export permits are needed. The National Council for Conservation of Wildlife (NCCW) is the CITES Scientific and Management Authority in Pakistan. This convention is applicable during the construction and operation phase of the Project in terms of safeguarding the flora and endangered fauna such as migratory birds.
6	UNESCO Convention on the Protection of the World's Cultural and Natural Heritage, 1972 **Web Link:** http://whc.unesco.org/en/ convention text/	Pakistan ratified this convention on 23rd July 1976.	Convention concerning the Protection of the World Cultural and Natural Heritage - requires parties to adopt 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. The convention is applicable for protection and conservation of cultural and heritage site (Hanzel Stupa) during the construction phase of the project.
7	The Rotterdam Convention on Chemicals, 1998 **Web Link:** http://www.pic.int/	Pakistan signed this convention on 9th September, 1999 and ratified on 14th July, 2005	The convention promotes shared responsibilities in relation to importation of hazardous chemicals. The convention promotes open exchange of information and calls on exporters of hazardous chemicals to use proper labeling, include directions on safe handling, and inform

Sr. No	Agreement/Convention	Ratification	Description/Relevance
			purchasers of any unknown restrictions or bans. Signatory nations can decide whether to allow or ban the importation of chemicals listed in the treaty, and exporting countries are obliged to make sure that procedures within their jurisdiction are complied. The convention is applicable with reference to proper labeling and safe handling of hazardous chemical if used during the Project implementation.

(This Space is Intentionally Left Blank)

CHAPTER 3 – DESCRIPTION OF THE PROJECT

3.1 GENERAL

This Chapter presents the location and access facilities to proposed Project Area. Moreover, detailed description of each component of project scheme along with alternatives analysis is also the part of this Chapter.

3.2 PROJECT LOCATION

The Hanzel Hydropower Project is proposed on Gilgit River in Mauza Hanzel, Hanzel Bala and Hanzel Paine, Tehsil and District Gilgit. The project Site is located about 17 km from Gilgit Town on Gilgit River which is a right bank tributary of Indus River. Gilgit Town is headquarter of the GB and the biggest city in the whole area respectively. Project Location Map is shown in **Figure 1-2**.

3.3 ACCESSIBILITY

3.3.1 Railway

The main railway line from Karachi ends in Havelian about 450 km (450,000 m) from Gilgit. The railway is designed for about 22 tones axle load, with a free width of 4.1 m and a free height of about 5.8 m which is sufficient to carry the project equipments. From Havelian onward, site is accessible through N-35 commonly known as Karakoram Highway (KKH). The accessibility through railway is shown in **Figure 3-1**.

3.3.2 Roads

a) Existing Access to the Project Area

Gilgit is located at the main KKH which starts from Havelian in Abbotabad District. Gilgit is some 570 km (570,000 m) from Islamabad, the Capital of Pakistan. Havelian is connected to other parts of the country through good roads. Gilgit is about 450 km (450,000 m) from Havelian. KKH crosses Indus River at Thakot, Dasu and Raikot where concrete bridges are constructed. Concrete and temporary steel bridges are constructed over Nullah falling into Indus River. In general KKH is suitable for two axle truck at present; however, it will be upgraded for long vehicles very soon for trade activities with China and Central Asian States. The project site (Hanzel) is accessible through Gilgit Gupis good quality newly constructed road.

b) Existing Access to Weir Area

The weir is proposed along the Gilgit Gupis road, therefore there is no need of new road. The accessibility through main highways is shown in **Figure 3-1**.

3.3.3 Airport and Air Link

Gilgit Airport is the nearest facility to the Project Area. The city of Gilgit is about 17 km from the project site. By air lines it is linked to all Pakistan. The accessibility through airport and air link is shown in **Figure 3-2**.

3.3.4 Proposed Access Roads and Bridges

The proposed roads and bridges with respect to their location is described below and shown in **Figure 3-3**.

Permanent Access Roads

Permanent access roads (not more than 10 Km) which comprises of:

- 4m wide Access road along the headrace channel with connection from existing public road (Shingle type) (Access Road-1).
- 4m wide access roads which connect existing public road to access road of headrace channel at three points (DST Type). (Access Road-2).
- 7m wide Truck able access road from Existing public road to Forebay area by using existing track (DST Type) (Access Road-3).
- 7m wide Truck able access road from Existing Forebay area to Powerhouse and Switchyard (DST Type) using existing track and existing public road (Access Road-4).
- 7m wide Truck able access road for Grid Station at Sakarkoi to connect with nearest public road (DST Type) (Access Road-5).
- Others Access road (truck able/ jeep able) in the project area as per project requirement (DST Type).

Permanent Bridges/Culverts

Permanent Bridges includes the following:

- Bridge or Culvert along the route of headrace channel (Bridge or Culvert-1).
- Bridge or Culvert along route of Emergency Drainage Structure at Barbuch (Bridge or Culvert-2).
- Bridge along route of old road crossing spill channel (Bridge-3).
- Bridge or Culvert along the route of penstock (Bridge or Culvert-4).
- Bridge or Culvert along the route of spill channel (Bridge or Culvert-5).
- Bridge or Culvert along the route of access road of powerhouse (Bridge or Culvert-6).

(This Space is Intentionally Left Blank)

Figure: 3-1: Accessibility Map Showing Road and Railway Network

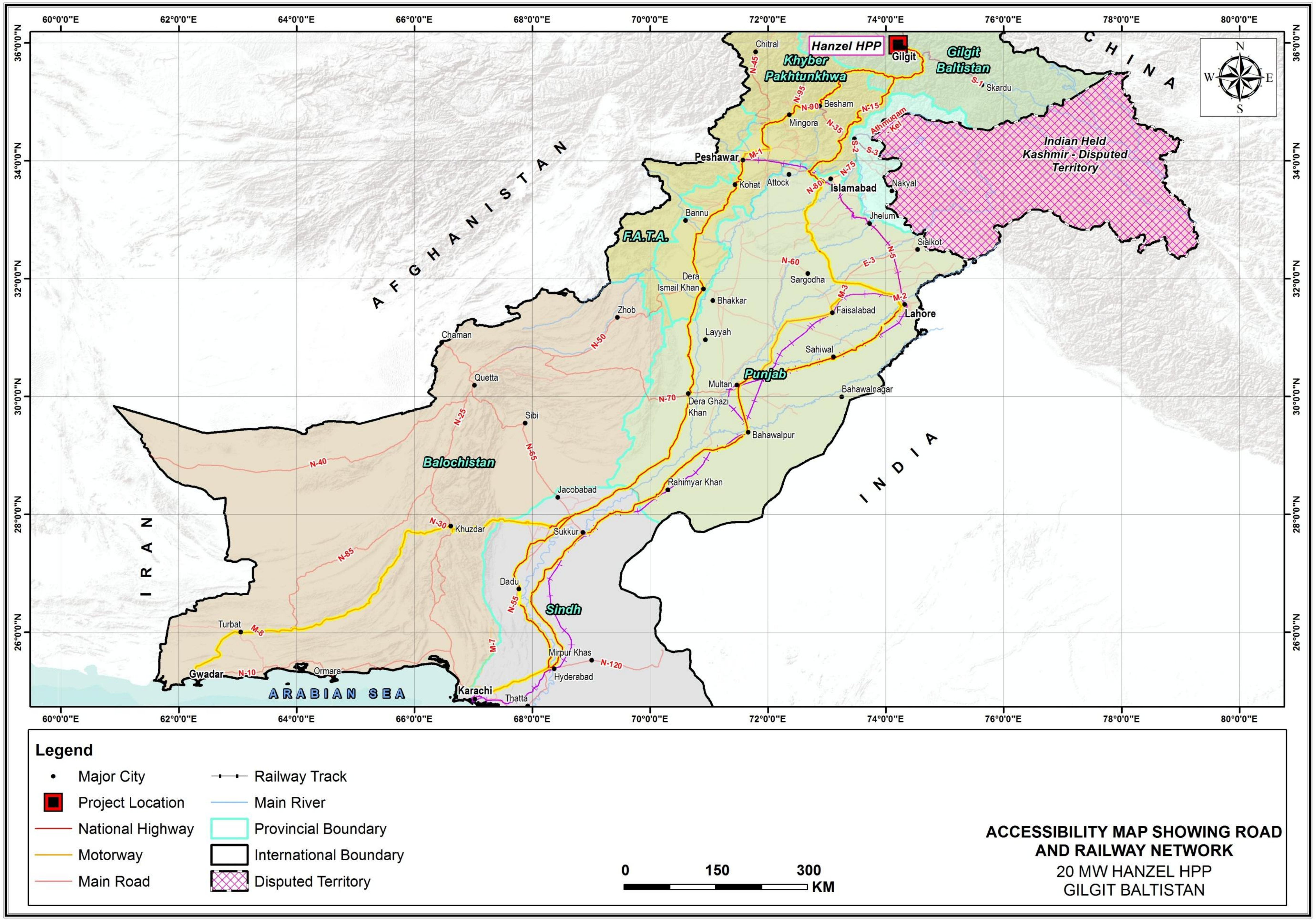


Figure: 3-2: Accessibility Map Showing Airline Network

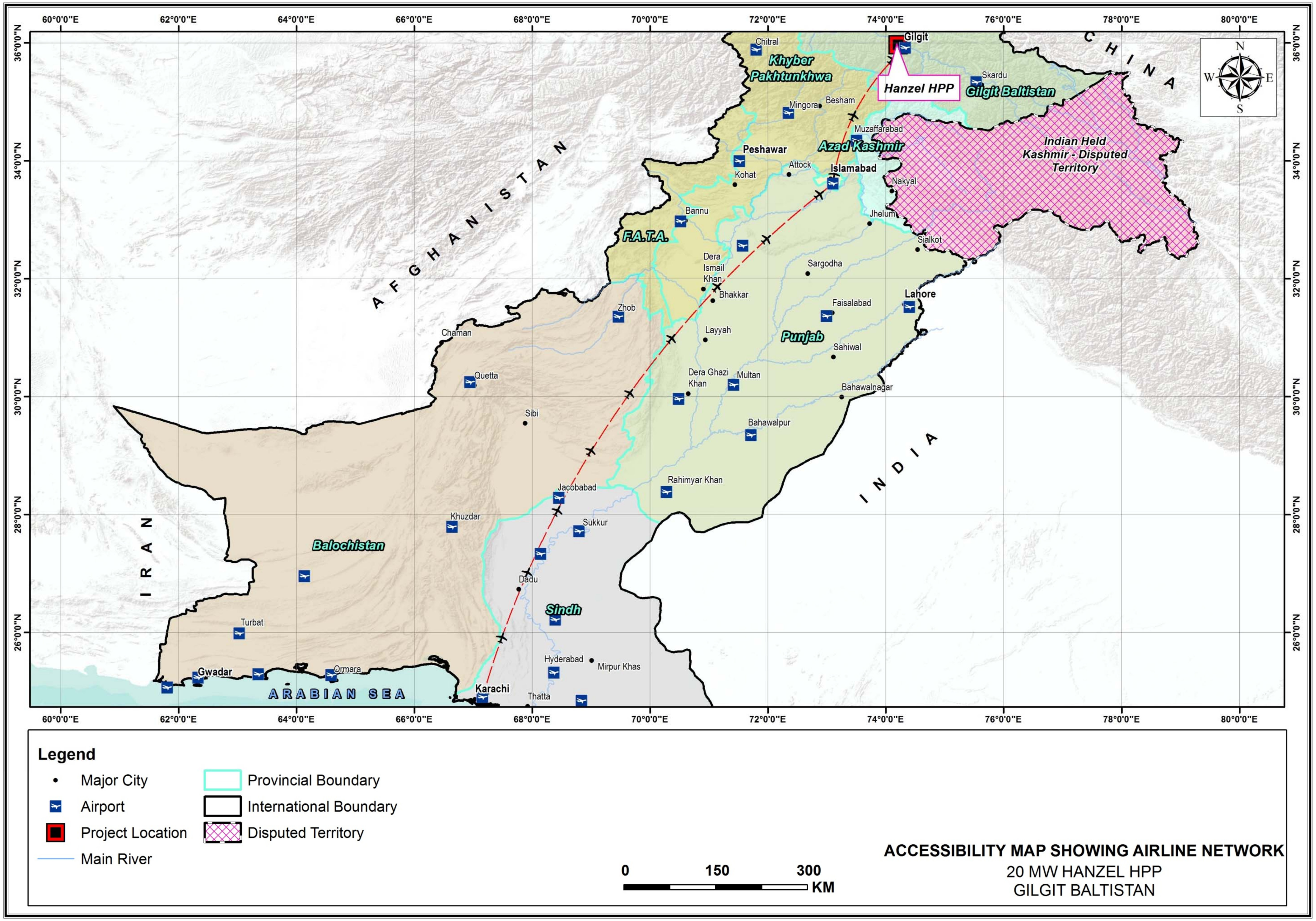
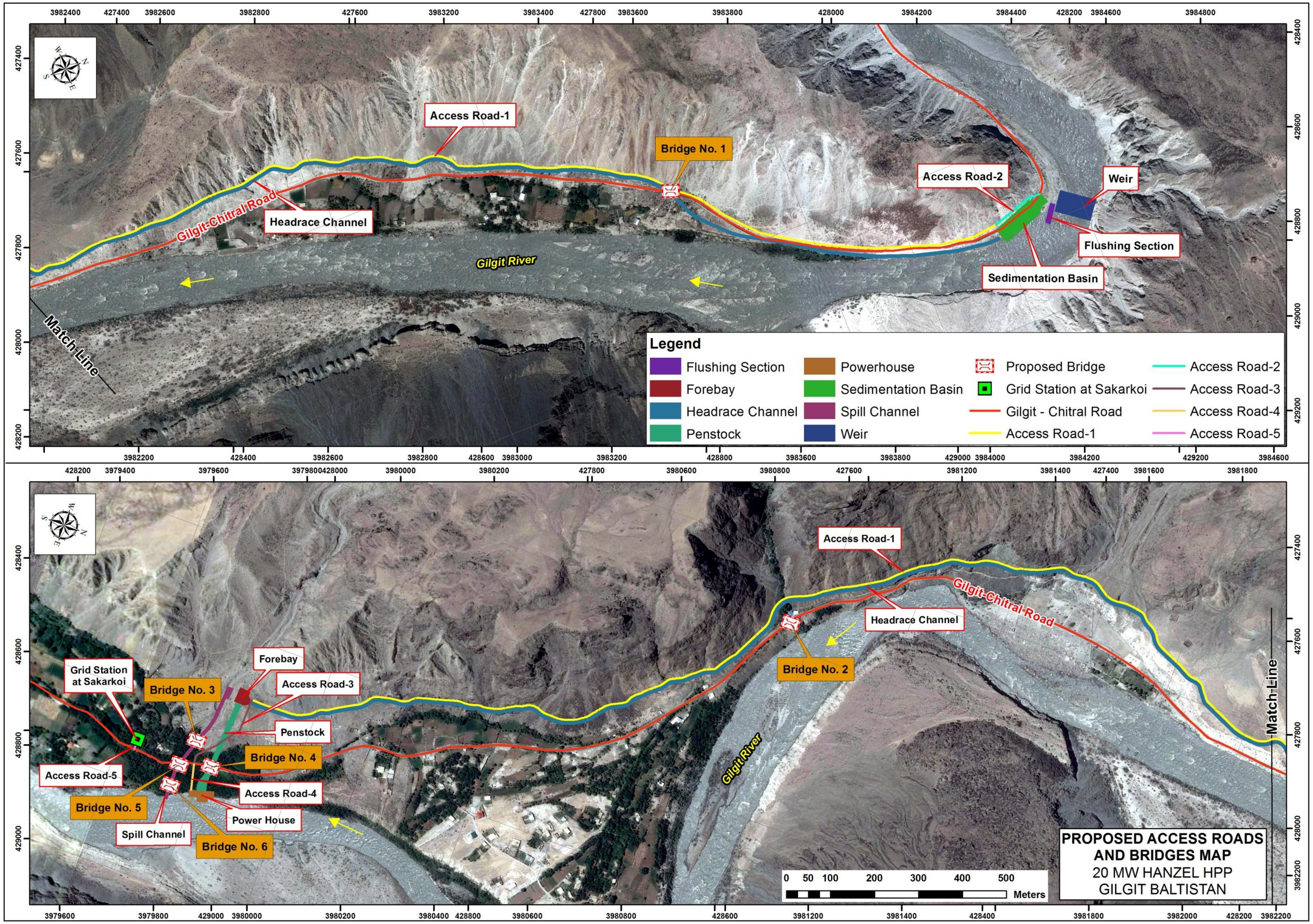


Figure 3-3: Proposed Access Roads and Bridges Map



3.4 PROJECT LAYOUT

The selected project layout consists of diversion weir placed at distance of about 17 km (17,000 m) from Gilgit with Easting 428588.96 m and Northing 3984382.78 m. Diversion weir consists of fixed weir having height of 8.5 m and flushing section. The lateral intake is placed in the right abutment of the diversion weir just next to flushing section. The proposed project will generate 163.672 GWh energy per annum to meet the power demand of Gilgit and its surrounding. The intake is lateral type which delivers water to the connecting channel which joins the sedimentation basin. Three chambers sediment basin is equipped with flushing pipes and ducts which ultimately discharge sediment and water back into Gilgit River.

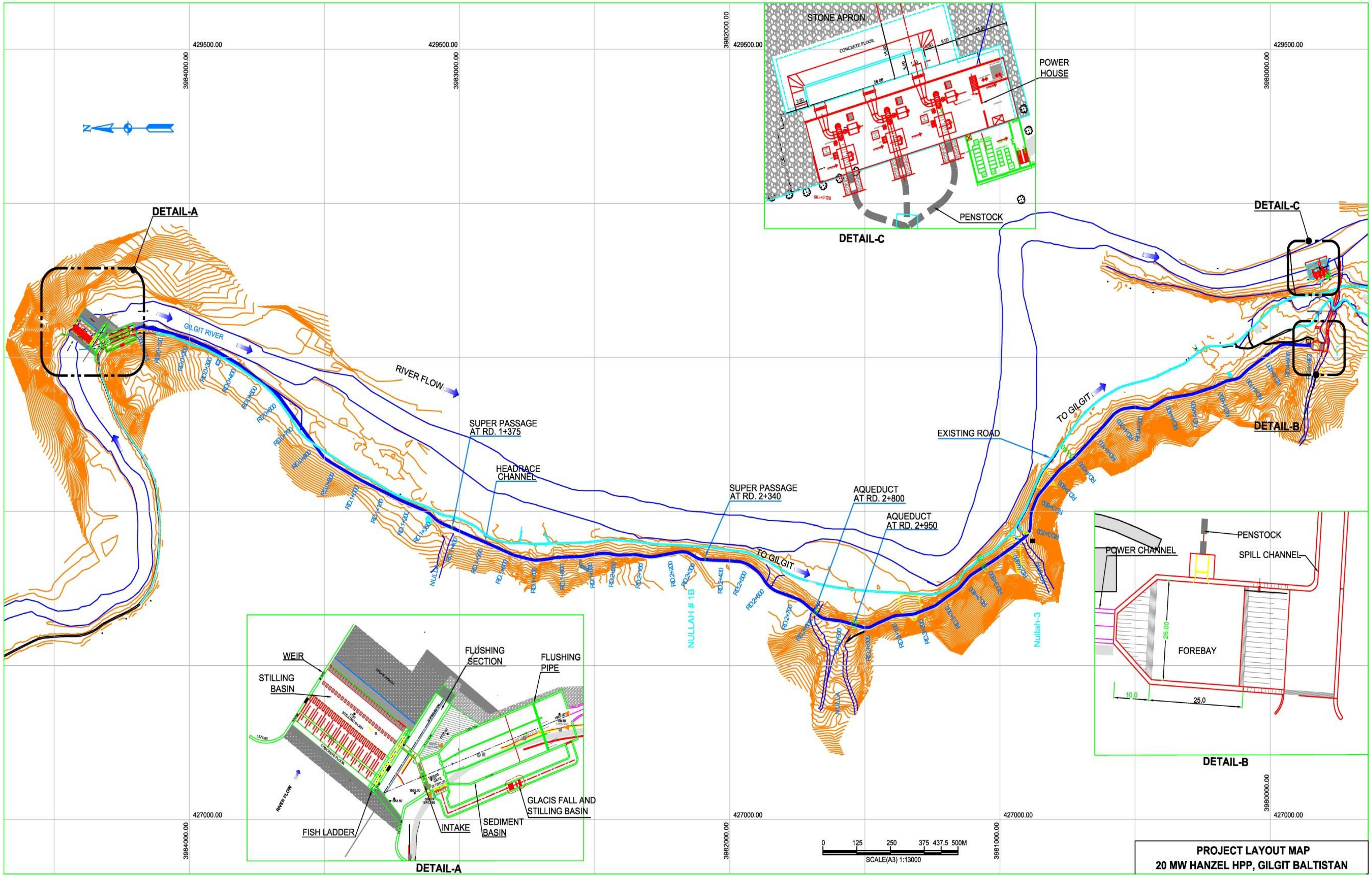
Headrace channel collect flows coming from sedimentation basin and carries them to forebay. Headrace channel runs along right bank of Gilgit River till it ends at forebay. Headrace channel is concrete lined rectangular cross-section and having a length of 4.983 km (4,983 m). Approximately, 60% of headrace channel is slab covered for crossings of animals and human beings and remaining portion of headrace channel has guard railing for safety purpose.

Headrace channel terminates at forebay structure which is a pond type structure from where penstock off-takes. One (01) penstock off-take from left wall and join the powerhouse structure which is placed at a distance of 11.5 km (11,500 m) from Gilgit. The powerhouse is located at Easting 428065.52 and Northing 3982003.11.

A spill channel is proposed which passes the flows back into Gilgit River in case of load rejection or turbine shut down. Spill channel is concrete lined equipped with three baffle blocks chutes for energy dissipation. The selected layout is presented in **Figure 3-4**.

(This Space is Intentionally Left Blank)

Figure 3-4: Project Layout Map



3.5 PROJECT COMPONENTS

The salient features of the proposed Project are described in detail in **Table 3-1** and the main components of the proposed project are:

- Weir with flushing section;
- Lateral Intake;
- Sedimentation Basin;
- Headrace Channel;
- Emergency drainage structure
- Forebay;
- Penstock;
- Spill channel;
- Powerhouse;
- Tailrace;
- Switchyard;
- 132 kV Transmission line;
- Grid station;
- Bridges/Culverts (06 Nos.);
- Access roads; and
- Project building.

Table 3-1: Salient Features of the Proposed Project

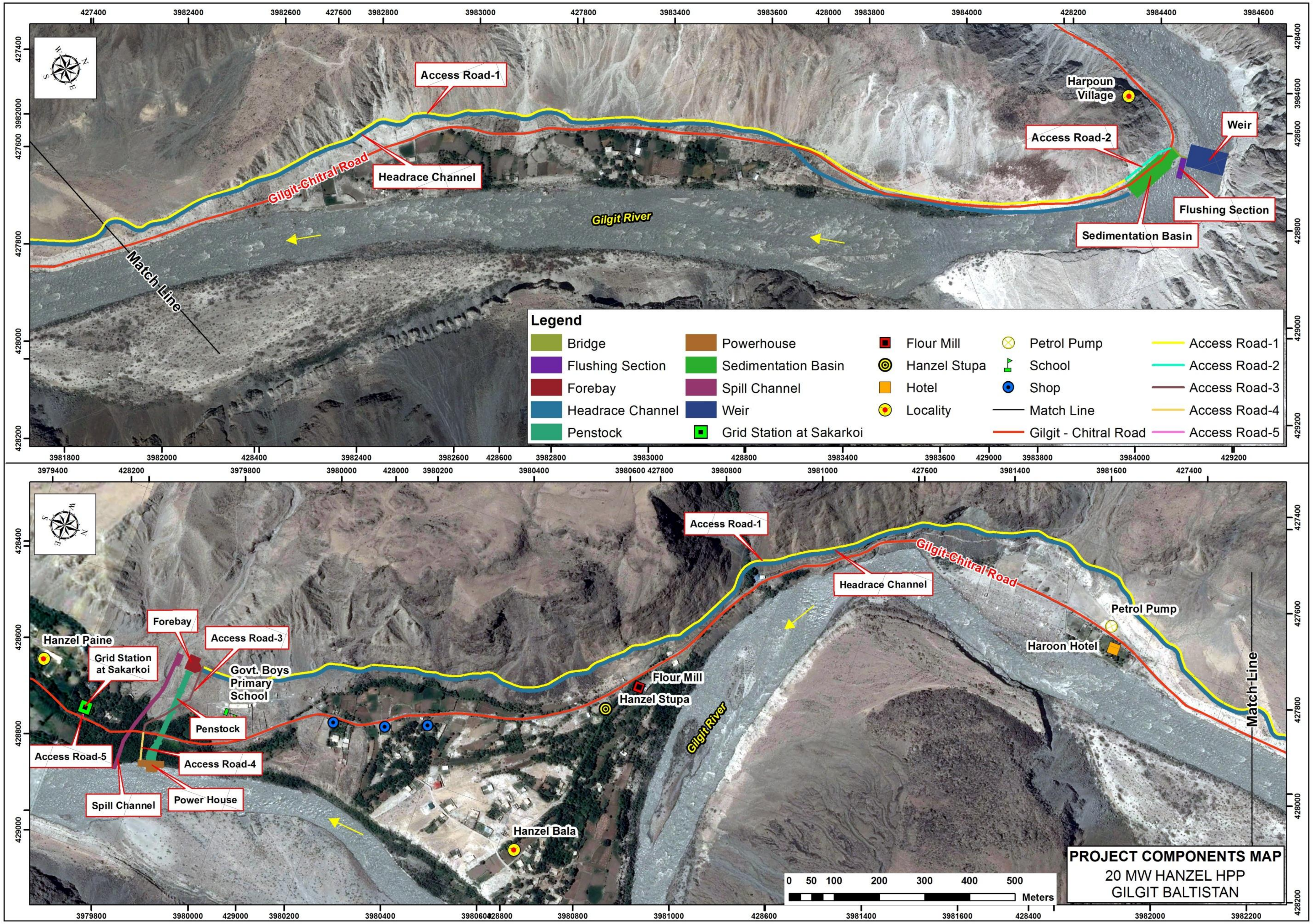
Component		Detail
General	Location (Weir)	17 km from Gilgit City
	River	Gilgit River
	Purpose	Power
Weir	Type	Fixed Sill Type
	Height from u/s floor	3.30 m
	Length including u/s & d/s slopes	55.3 m
	Design flood (1000 year)	3393 m^3/s
Fish Ladder	Length	52.8 m
	Width	3.4 m
Flushing Section	Width of Opening	11m (5.5m each)
	Depth of Opening	4m
Intake	Type	Lateral Intake (3 Gates)
	Width of opening	18 m (6m each)
	Depth of opening	2 m
Connecting Canal	Height	5 m
	Width at the start of channel	24 m
	Width at the end of channel	24 m
	Length	16.55 m
Sedimentation Basin	No of chambers	3
	Effective depth	8 m
	Effective width	45 m
	Effective length	87.5 m

Component		**Detail**
	Total length	113.8 m
Headrace Channel	Height, internal	5.5 m
	Depth	5 m
	Width	6.5 m
	Length	4.983 km
	Design discharge	37.25 m^3/s
Forebay	Length	25 m
	Width	25 m
	Height at the start	8.9 m
	Height at the end	9.64 m
Power Facility	Rated Gross Head	63.6 m
	Discharge per unit	12.33 m^3/s
	Power output	20 MW
	Penstock diameter	3.5 m
	Penstock length	231 m
	Number of turbines	3

The location of the major project components is shown in **Figure 3-5**.

(This Space is Intentionally Left Blank)

Figure 3-5: Project Components Map



3.5.1 Weir

The proposed weir is divided into three sections. One segment is designed as a flushing channel and placed on right bank through which the sediments deposited in channel and in front of power intake will be flushed out downstream of the river. The second segment is a broad crest weir 85 m wide and 8.50 m high which has been chosen to collect and divert the required discharge for power generation through power intake which is placed on right next to flushing channel. A small fish ladder for fish movement (upstream or downstream) is proposed along divide wall which is placed between fixed weir and flushing channel.

Flushing channel is equipped with two radial gates which will be operated from concrete bridge just downstream of the gates. Flushing section 13 m wide and is equipped with concrete breast wall in order to reduce the size of the gates.

The approximate available head is 63.6 meters in 4.983 km (4,983 m) long headrace channel. Water diverted for power generation is 37 m^3/s. Surplus water will be released from the weir crest that fulfil discharge requirements of existing irrigation canal and domestic use of inhabitants.

No gates are required because the structure will act as a sill with a height of 8.50 m from foundation. The height of the weir above the riverbed is 4.0 m, giving a sill elevation of 1,567.00 m.a.s.l. The shape of the weir crest is parabolic in order to avoid negative pressure.

Its exact depth depends on the permeability of the river sediments, but will be at least 10 m upstream and 5 m downstream. The final depth has to be decided during detailed engineering design stage by the EPC Contractor as per Client requirements. The layout plan of the weir is shown in **Figure 3-6**.

3.5.2 Intake Structures

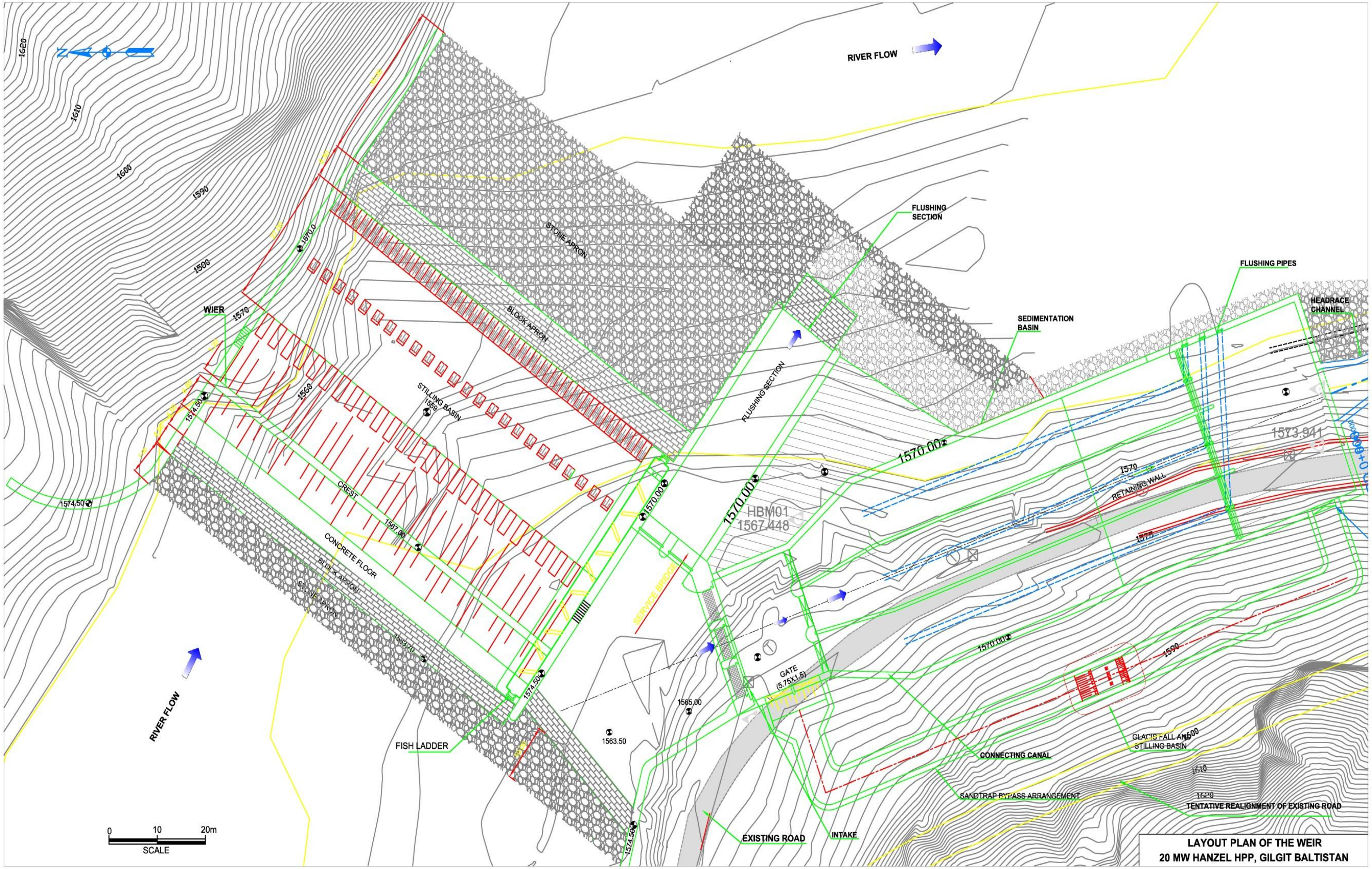
a) Lateral Intake

The lateral intake is proposed in the right abutment of the weir and is equipped with three gates which would be operated from a concrete bridge resting on bridge piers. The sill level of intake is provided about 1.5 m above the flushing channel bed. The gates have the size of 6.0 m length, and 6.0 wide. Coarse trash rack is proposed at intake with 80° inclination with horizontal to facilitate mechanical cleaning.

The intake is designed to be closed in times of extremely high floods in order to avoid excessive sediment inflow and damages to the conduit system and hydro-mechanical equipment.

(This Space is Intentionally Left Blank)

Figure 3-6: Layout Plan of the Weir



b) Connecting Channel

Connecting canal links the intake with sedimentation basin and has a length of 6 m. It is designed as an open channel having discharge of 37.25 m^3/s. The section of the channel is 21.35 m wide and 5.5 m deep.

The channel runs in parallel with existing irrigation channel on river bed deposits. Excavation is not a problem and can be down with mechanical means. During construction, measures will be adopted not to disturb the Existing Irrigation Canal. After construction, supplies to irrigation channel will be maintained from headrace channel. For proper regulation a vertical lift gate is proposed at the head of Irrigation channel along headrace.

c) Sedimentation Basin

An open and three chamber sedimentation basin has an effective length of 87.5 m, a total length of 104.05 m including the transition. The structure is designed to remove all sediments than 0.2 mm. The sand trap founded on moronic material consists of angular to sub-angular boulder and gravels with appreciable amount of fines up to 20 % (ABGM). It is anticipated that bedrock would not be encountered at shallow depth. Excavation is easy and will be done with normal method.

3.5.3 Headrace Channel

The headrace starts from sedimentation basin and ends after distance of 4.983 km (4,983 m) at forebay. Headrace runs along right bank slope of Gilgit River which is composed of moronic deposit and rock of Amphibolites.

The design of the headrace channel is based on the following considerations:

- Height of canal is 5.50 m;
- Optimization of cost of excavation which increase with width; and
- Design discharge of 37.25 m^3/s.

The final chosen dimensions are:

- Width: 6.50 m
- Water Depth: 5.00 m
- Height: 5.50 m.

3.5.4 Forebay

Forebay will be pond type and having 25.0 m length and 25.0 m width. A transition of 10.0 m length is provided between the headrace and forebay pond.

One penstock of 3.5 m diameter off-take from the left hand abutment wall from the centre of the forebay. At the intake of penstock fine trash rack and gates along with stoplogs groves will be provided. Penstock intakes are placed 0.57 m above the bed of the forebay (1,555.75 m.a.s.l) so that bed load could not enter. A spill channel is proposed at the downstream end of the forebay for collection of bed load and ultimately discharging in to river.

Spill weir is provided in the downstream wall which leads the water in to spill channel constructed of concrete. In the forebay the full supply level is 1,565.10 m.a.s.l while the minimum level is 1,562.28 m.a.s.l. A stoplog closer is provided for temporary closure in case of ice or cleaning of forebay between the headrace and forebay.

The assumptions of plant operation guidelines for the hydraulic design of the forebay are:

- Start-up time for all turbines: 30 seconds (full discharge: 37.0 m^3/s); and
- Closing time for all turbines: 10 seconds (full discharge: 37.0 m^3/s).

It is not unusual for relative small discharge plants to start up all units at the same time, whilst simultaneous breakdown of all units is unlikely but has to be considered in the hydraulic dimensioning. In the hydraulic calculations the most unfavourable frequency of turbine-operation as a basis for determination of the maximum and minimum possible surge levels in the forebay is considered.

The safety factor according to Thoma for the system stability is sufficient. The final dimensioning of the forebay structure will need basic detail specifications of the manufacture of the hydro-mechanical equipment.

3.5.5 Penstock

The penstocks have been designed to support 40% overpressure which may produce by the speed governing system. The 3.5 m diameter penstock start at the forebay runs towards west to powerhouse where penstock trifurcates to three (03) units having discharge of 12.33 m^3/sec each. The three units of penstock are covered by heavy anchor blocks which again are integrated into the substructure of the powerhouse. The radius of penstock should be minimum to avoid losses and possible uplift forces in the pipe.

The wall thickness of the 3.5 m diameter penstock will be 15 – 25 mm, for steel quality of ASTM A516-70. Final thickness of Penstock will be calculated by EPC Contractor at detail design stage. All welded joints should be X-rayed. The thickness and steel quality may further be optimized during final design. The penstock has been proposed to be buried in ground with atleast 2.0 m cover. The proper measures are proposed for protection against corrosion. External protection is done by using PE foil tapes or corrosion resistance paint.

The penstock at the start will be laid along the mild slope of moronic material consisting of angular boulder gravels with appreciable amount of fines (ABGM) and then will rest on terraces composed of clayey, sandy silt at surface with angular boulder gravels with steep slopes. Anchor blocks at change of slope/direction are foreseen while concrete supports are provided at regular interval.

3.5.6 Spill Channel

A spill weir is provided in the downstream wall of the forebay and designed for a discharge of 37.25 m^3/s. After the concrete weir, a concrete lined spill channel equipped with three baffle block chutes for energy dissipation is proposed. At end, the channel is a contour channel which directly discharges in to Gilgit River just downstream of Powerhouse tailrace.

3.5.7 Powerhouse

The powerhouse is located on the right bank of the Gilgit River. The power station comprises the following parts:

- A substructure housing the pump sumps, turbine pit and tailrace canals;
- A super structure above ground comprising the machine hall and service bay or loading and unloading bay; and
- A control building housing control room, stores, workshops and administrative rooms.
- Switchyard area.

The mean water level of Gilgit River is assumed to be at level of 1,500 m.a.s.l. The highest flood level according to a 1000 year flood is at a level of 1,506.82 m.a.s.l. Thus, the power house building is enclosed with retaining wall having top elevation of 1,508 m.a.s.l. The penstocks at the upstream side of the building are embedded in anchor blocks which are to be integrated into the powerhouse substructure. An approximate length of 150 m access road between powerhouse and existing road is proposed for construction which crosses the spill channel via concrete bridge constructed for this purpose.

3.5.8 Switchyard and Transmission Line

A flat 12 m by 16 m area is provided for the switchyard. The yard is located south west of the powerhouse building and can be accessed directly from the powerhouse access road. The main transformer is located here together with the oil separator. The auxiliary transformer is also located in the switchyard area.

The Hanzel Hydro Electric Power Project is interconnected with Grid Station at Sakarkoi by the 132 kV single circuit 10 Km (10,000 m) long transmission. Steel reinforced (ACSR) Linex conductor with steel lactic towers are foreseen which are according to the national standard. About 31 towers are required. Synchronizing with Gilgit grid system is done in the powerhouse control room.

The proposed 132 kV transmission line is equipped with directional distance protection system with relays in the 132 kV Gilgit grid station and in the powerhouse. A back-up protection at both stations with directional over current relays is included. Additional lightning arrestors are installed at the outgoing section of the Hanzel Hydropower Plant.

3.5.9 Hydro Mechanical Equipment

a) Turbines

For the Hanzel hydropower project three (03) no. of units will be required. The main design parameters of the selected turbines is given below:

- Type of turbine: Horizontal Francis
- No. of Units 03
- Design Discharge 12.33 m^3/sec (each unit)
- Rated Gross Head 63.6 m
- Horizontal Shaft Speed 428.6 rpm
- Turbine Rated Efficiency 94%
- Turbine Rated Output 6.64 kW
- Generator Efficiency 97.0%
- Total Installed Capacity 20 MW
- Turbine Setting 1498.50 m

The Turbine Components shall comprise of spiral case, runner, turbine shaft, guide vanes, stay vanes, draft tube bend, links and levers for guide vanes operations, servomotor etc.

3.5.10 Auxiliary Equipment

a) Cooling Water System

The main cooling system is required for cooling of generator coolers, thrust and guide bearings, and power transformers etc. The total cooling water demand has been estimated at approx. 70 l/s. Water will be taken from main tail-water channel collected in a pit and then pumped to a common header after passing through a twin strainer / filter before connecting to common header.

b) Oil Handling Equipment

A centralized oil handling system is not foreseen. Spare oil, as well as used oil, will be stored in ordinary oil drums.

c) Dewatering and Drainage System

Penstock pipe will be dewatered through turbine inlet bypass valve to the draft tube and by using submersible dewatering pumps installed in turbine dewatering pit. Leakage from shaft seal and other drains will be collected in a pit and pumped to tailrace channel by using drainage pumps.

3.6 CONSTRUCTION PLANNING

After the land acquisition by the Client, the following preparatory works are foreseen;

- Contractor's camp, installations and yards at the forebay site;
- Construction of access roads at weir, headrace channel, forebay and powerhouse site;
- Diversion and care of water for construction of weir and sedimentation basin;
- Dewatering of powerhouse area, if required; and
- Diversion arrangements for existing water course and public traffic.

Construction of access roads is independent activities and can be executed in parallel. Access road for headrace channel will be constructed within period of almost 18 months simultaneously with the headrace channel whereas the access road at weir, forebay and powerhouse site shall be constructed within period of almost 07 months before construction of these project components.

It will be the responsibility of the EPC Contractor to make proper arrangements to sustain traffic flow to Ghizer Valley during construction and ensure this by constructing suitable bypass arrangement. Similarly, the EPC Contractor shall be responsible for providing alternate irrigation water supply arrangement to the users of existing water course.

All the civil works of weir and allied structures shall be constructed within the period of almost 12 months while mechanical works (Hydraulic Steel Structures) within the period of 06 months thereafter. Whereas the conduit system (Connection Channel, Sedimentation basin and headrace Channel) shall be constructed within the period of 25 months in parallel while mechanical works (Hydraulic Steel Structures) within the period of 06 months thereafter.

The powerhouse civil works shall be completed within the period of 25 months whereas the civil works of forebay and penstock shall be completed within the period of 12 months in parallel including all mechanical and electrical works.

In parallel to the civil works, the turbines, generators, transformers, auxiliary equipment, and switchyard shall require the period of almost 26 months to fabricate, deliver and assemble. The transmission interconnection system, joining Hanzel powerhouse with the proposed 132/11 kV grid station at Sakarkoi (about 10 km) will take about 08 months.

Considering limited construction activities during winter, for each of the above works, about two summer seasons with full swing activities have been foreseen. The above mentioned construction planning is tentative and shall be provided by the EPC Contactor after mobilization at site. However, the total construction period shall remain the same i.e. 34 months.

3.7 WATER REQUIREMENT

Water requirement during construction operations is to be meet with the domestic demand and requirement of project construction activities like concrete preparation and wet drilling during excavation for water carrying channel. The water can be uplifted from the Gilgit River/existing irrigation channel through pumps. Water treatment plant will be necessary to maintain water supply to the standard of NEQS and World Health Organization (WHO).

3.8 MANPOWER REQUIREMENTS

The construction of Hanzel Hydropower shall be carried out by Water and Power Department (WPD) Gilgit Baltistan through EPC Contractor. Manpower requirement during construction, operation and maintenance is shown in **Table 3-2**.

Table 3-2: Manpower Requirement during Construction, Operation and Maintenance

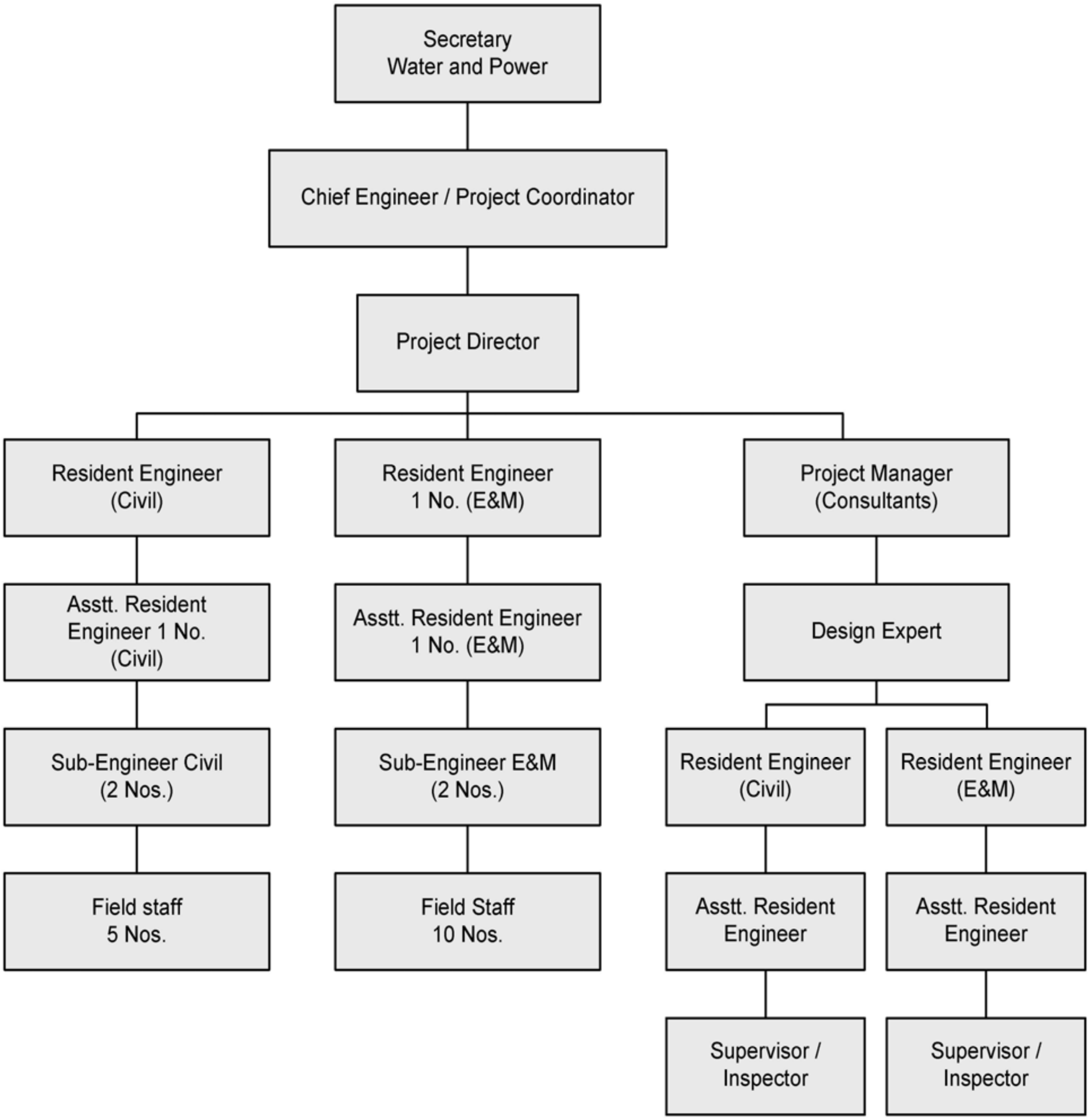
Sr. No	Category	BPS	Number For	
			Construction	Operation
1	Executive Engineer	18	1	1
2	Assistant Executive Engineer E&M	17	1	1
3	Assistant Executive Engineer Civil	17	1	1
4	Sub Engineer E&M	11	2	4
5	Sub Engineer Civil	11	2	1
6	Accounts Officer	16	1	1
7	Clerk/Computer Operator	7	4	4
8	Supervisor/Line Superintendent/Surveyor	9	8	9
9	Forman	7	6	6
10	Turbine Mechanic	7	0	3
11	Turbine Operator	7	0	9
12	Electrician	5	6	6
13	Line man/Head Regular Man	3	0	18
14	Panel Attendant	5	0	9
15	Road Inspector	9	0	2
16	Channel Inspector	7	0	2
17	Mason	5	0	2
18	Carpenter	4	0	2
19	Pipe Fitter	3	0	1
20	Road Mate	3	0	2
21	Drivers	4	6	2
23	Meter Readers/Billing Clerk/Work Munish	3	0	9
23	Peon/Chowkiddar/Helper/Coolies/Sweeper	1	2	10
		Total	**40**	**105**

Source: 20MW Hanzel HPP PC-1 Proforma

Administrative arrangements by the WPD-GB for the implementation of the construction and operation phases of the proposed project are shown in **Figure 3-7** and **Figure 3-8** respectively.

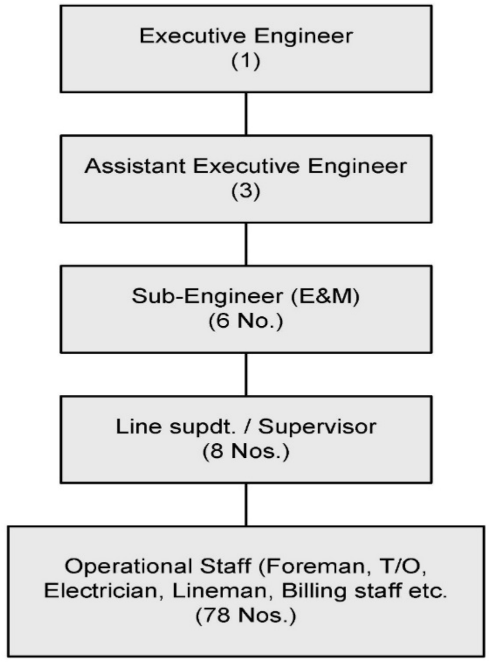
(This Space is Intentionally Left Blank)

Figure 3-7: Administrative Arrangements for 20 MW Hanzel Hydropower Project, Gilgit Baltistan (Construction Phase)



Source: 20 MW Hydropower Project, Hanzel Gilgit (PC-1 Proforma (Modified), December 2014)

Figure 3-8: Administrative Arrangements for 20 MW Hanzel Hydropower Project, Gilgit Baltistan (Operational Phase)



Source: 20 MW Hanzel Hydropower Project, Hanzel Gilgit (PC-1 Proforma (Modified), December 2014)

An Engineering division headed by Executive Engineer will be required for supervision during implementation of the project.

About 90% male and 10% female distributions are foreseen. No shortage of manpower by occupation is likely to be experienced.

Training of all level staff through seminars/workshops and higher education in local institutions is foreseen. However, training of higher level staff through foreign institutions is also anticipated.

3.9 CONSTRUCTION MACHINERY

The construction activities of the proposed project shall use the following types of construction machinery:[3]

- Chain excavator;
- Wheel loader;
- Tractor with blade; and
- Project vehicles etc.

3.10 CONSTRUCTION MATERIAL

The EPC Contractor before and during the construction will specify all the necessary materials requirements to meet the minimum quality of the work as per proposed design. Nowithstanding that the EPC Contractor shall follow the minimum quality requirements for material and workmanship in accordance with the Project requirements and shall satisfy that all materials used and that all its standards for workmanship are adequate to achieve the requirements of the Contract. Local materials may be procured for installation in the Project provided that the quality

[3] 20MW Hanzel HPP PC-1 Proforma

is in accordance with the agreed specifications and is fit in all respects for inclusion in the Project; the EPC Contractor shall be responsible for the cost, including transportation and all other incidental costs of such procurement.

3.11 CONSTRUCTION SCHEDULE

The total estimated construction period of the proposed project will be 34 calendar months followed by 01 year of joint operation/ maintenance period and 02 years for defect liability period. The implementation schedule will be finalized on the mobilization of EPC Contractor at the detailed design stage of the proposed Project. The tentative implementation schedule is attached as **Figure 3-9**.

(This Space is Intentionally Left Blank)

Figure 3-9: Construction Schedule

NOTE:
Construction schedule is tentative and based on the information available in Feasibility Review Report (NESPAK) June 2017 and shall be provided by the EPC Contractor after mobilization at Site. However, the total construction period shall remain the same i-e 34 months.

3.12 SAFETY CONSIDERATIONS DURING OPERATION

In general, six 6 kg handheld CO_2 fire extinguishers and one 25 kg trolley mounted CO_2 fire extinguisher shall be placed near generators, transformers and control panels. In addition, the power station will be provided with taps for fire hoses. The water for the firefighting system shall be taken from tail water channel through a pumping station specifically installed for this purpose. As an alternate the fire water during operation can also be taken from cooling water common header.

3.12.1 Fire Protection System

The fire protection system consists of the equipment to detect and extinguish fire in the most endangered zones of the project.

- Machine hall
- Control building
- Service bay floor and workshop
- Intake control building

Three systems of equipment for extinguishing fire will be used;

- CO_2 for the generators;
- Water spraying system (sprinkler); and
- Portable firefighting units.

The detection will be realized by use of heat, flame or smoke detectors initializing the fire alarm system of the power station including the general fire siren and will trigger in-place fire extinguishing equipment. The protection will be provided through the installation of wall mounted portable extinguishers with suitable capacity and locations within the buildings.

3.12.2 Fire Protection for the Generators

Generators are to be protected against the outbreak of fire as they use to be the most endangered parts within the powerhouse. Trolley mounted CO_2 cylinders will be arranged near the generator. Operation will be initiated by hand.

A system of taps for fire hoses could be installed on every floor, which would be filled directly from tailrace water channel by using pumps. The decision will be taken during final design stage and be subject to the approval by the Supervisory Consultant.

3.12.3 Fire Protection for the Transformers

The unit step-up transformers, which are placed alongside the powerhouse, will be separated by firewalls from each other. The firefighting equipment will consist of a water spray system (Sprinkler System), which will be initiated automatically by heat detectors. The auxiliary transformers will be protected by detectors for alarms and trolley mounted dry powder extinguishers with sufficient capacity to be placed nearby the transformers; together with sets of heat and fire resistant clothing including helmets, gloves and boots.

3.13 PROJECT COST (PC-I)

According to PC-I (August 2016) the total overall project cost is about PKR. 6,273.569 million, which includes civil works as well as electro-mechanical equipment, transportation, erection, testing and commissioning, cost of camps and temporary facilities, their running and maintenance, and land acquisition & resettlement. However, since the project will be awarded on EPC basis, therefore actual construction cost will be firmed up after the bidding process.

3.14 ANALYSIS OF ALTERNATIVES

The main purpose of the Analysis of Alternatives is to compare feasible alternatives to the proposed project and its components such as site/location, technology including a without project scenario as detailed below:

3.14.1 No Project Option (NPO)

Electricity has become a basic need of human beings and is one of the most important ingredients of economic development. There exists a strong correlation between energy utilization and rate of economic expansion of any country. In Pakistan per capita energy consumption is very low.

GB is the water bank for Pakistan due to large area of glaciers and snow deposits in its mountains. Hydropower potential on Main Tributaries of Indus River is 40,000 MW and Hydropower potential on sub tributaries is 1,200 MW but unfortunately only approximately 7,000 MW has been exploited so far. Further presently the power generation in GB is 92 MW with Population Connected with suppressed load is 75%. The Current demand of power generation in GB is 200 MW. Thermal power generation is more expensive, being dependent on the imported oil, and is less environmental friendly due to high emission rate of Green House Gases (GHGs). The power shortfall situation is being tackled through load management by shedding and supplying the power to various areas and sectors alternatively.

The biggest potential source of electricity generation in Gilgit Baltistan is hydel power. The proposed project will generate 163.672 GWh energy to meet the power demands of Gilgit and its surrounding areas. Hydropower generation is very attractive for sustainable development of the country as it reduces the need for imports and can abate substantial amount of GHG emission by substituting for largely gas and oil based power generation. The No Project Option (NPO) would therefore require the installation of more thermal units which will further aggravate the economy and will become a major source of environmental degradation. Therefore, NPO is not a feasible option.

3.14.2 Project Location Alternative

In order to optimize the location of the Project in terms of benefits and potential impacts on the environment, following project location alternatives were discussed:

- Alternative 1: Weir near Tholdas village with tunnel;
- Alternative 2: Weir on rock at upstream of Hanzel Bala; and
- Alternative 3: Dam at 7 Km (7,000 m) upstream of Gilgit River from Gilgit.

a) Alternative 1: Weir near Tholdas Village with Tunnel

In this case, weir will divert the flow to tunnel, surge tank and then powerhouse. This site is about 17 km (17,000 m) from the town of Gilgit. The rock is available on both banks of Gilgit River but distance apart is quite large, about 300 meters. Moreover the Gilgit River flows in a very mild slope, considerable head will not be available and length of headrace tunnel will be 4 km (4,000 m). The geologic formation for tunnel crossing is moranic deposits and is not very suitable for tunnel structure. Therefore, it is not considered for detail studies.

b) Alternative 2: Weir on Rock at Upstream of Hanzel Bala

In this case weir is proposed at rock exposed on left bank of Gilgit River upstream of Harpoon village. The right bank is moranic deposit. The weir will divert the flow to right bank through 4.983 km (4,983 m) headrace channel upto forebay at Kindadar, Hanzel and then to powerhouse. Width of River is about 112 m at the weir location. The approximate available head is 63.6 meters in 4.983 km (4,983 m) long headrace channel.

c) Alternative 3: Dam Site Proposed by P&I WAPDA

In 1982 Planning and Investigation Division of WAPDA prepared the feasibility study, about 8 km (8,000 m) upstream of Gilgit River from Gilgit.

The normal pond level is 1,510 m.a.s.l which shows that the reservoir area will be upto Hanzel village. Acquisition of land and inundation of population will be the major issues as well as environmental mitigation cost will be higher besides the technical issues. Construction of tunnel will be difficult because in Pakistan very few tunnel projects have been taken up so far by the local contractors and consultants.

Therefore Alternative 2: Weir on Rock at Upstream of Hanzel Bala has been considered for detail studies.

3.14.3 Weir Location Alternatives

Concrete weir will be constructed for the diversion of water to headrace channel. Two alternatives for the location of weir have been analyzed:

- Alternative 1: Weir just at rock upstream of Hanzel Bala; and
- Alternative 2: Weir location about 200 m upstream of Alternative 1.

a) Alternative-1

At the alternative-1 location, rock is exposed at the left bank of Gilgit River upstream of Hanzel Bala. Width of weir at this location is about 112 meters. At least one abutment will be on rock. The foundations of weir shall have to be laid on river deposits. Bearing in mind the nature of strata it is conceived that permeability values of river bed material will be high. In order to control seepage through foundation some seepage treatment measures shall have to be adopted.

b) Alternative-2

In this alternative weir shall be located at about location 200 m upstream of alternative-1. This option was not considered because bed width is wider and there is no rock available for anchoring the foundation of weir.

As such the Alternative-1 has more merit than Alternative-2 due to abutment placement and anchoring of weir with rock. However, foundation of weir will be on river deposits in both cases. Hence weir location of Alternative 1 is selected for further studies.

3.14.4 Weir Type Alternative

Existing topographic and geological environment of site provide the following weir alternatives;

- Gated weir with lateral intake;
- Tyrolean weir; and
- Fixed crest weir and lateral intake.

a) Gated Weir with Lateral Intake

Gates are expensive component and might cause safety problems in case of high floods because opening of the gates not only need round the clock energy but also mechanized regulated operational system. In areas where mud floods are common, the use of gated weir may have operational problem and hence not recommended.

b) Tyrolean Weir

The Tyrolean weir is effective on relatively lower discharges upto 10 m^3/s where as for Hanzel Hydropower Project discharge requirement could be more than 30 m^3/s if a 20 MW powerhouse is to be designed. Therefore despite having many favourable features, Tyrolean weir cannot be used for this discharge.

c) Fixed Crest Weir with Lateral Intake

High concentration of sediments during summer time flows of Gilgit River requires the necessity of low level flushing outlets. The fixed weir, low level flushing and intake system could be simple in Operation and Maintenance (O&M) and economical in cost. After considering the site topography, geology, hydrologic and sediment conditions broad crest type of weir with low level flushing arrangements and lateral intake is selected. Hence the broad crest weir type with flushing and lateral intake is recommended for detailed study and design.[4]

3.14.5 Headrace Alternatives

The placing of headrace channel has been studied with regard to suitability in the existing topographic, geological construction and management. The shortest possible route of headrace has been selected that will cut through the right bank of Gilgit River. The following options have been considered:

a) Utilization of Existing Irrigation Channel

The existing irrigation canal constructed with stone masonry is in good condition. The use of irrigation canal or its remodeling was not considered due to its low carrying capacity as limitation on the head available.

b) Cut and Cover Headrace Conduit

Cut and cover headrace conduit is also one of the options considering the risk of landslides and debris from hill torrent crossing the headrace alignment. However, its cost and maintenance will not be competitive with open channel.

c) Headrace on Upper Side of Irrigation Canal

A concrete lined headrace on hill side on higher contour of the existing irrigation canal is selected because it offers more head than other alternatives. However, some special measures have to be taken in order to avoid blocking of existing irrigation canal and road during construction.

3.14.6 Sedimentation Basin

A sedimentation basin will be required for the project for separation of suspended sediments before entering into headrace tunnel. The following options are considered:

---

[4] Feasibility Study of Hanzel Hydropower Project, 2009

- Sedimentation Basin near to Weir; and
- Sedimentation Basin at 650 m from Weir.

A sedimentation basin comprising three chambers (each 87.5 m x 8 m) is required to remove 0.2 mm of suspended sediments. Placing of sediment basin in open area near the weir axis and at distance of 650 m was studied. An area for sedimentation is available about 650 m downstream of weir axis which is relatively flat and suitable for sand trap however, not selected due other arrangement such as long flushing pipes and spilling channel required. Sediment basin will be placed very near to the power intake in order to save cost required for long flushing pipes and spill channel in case of high discharge Penstock.

Two alternatives for penstock were considered as under:

- Surface; and
- Underground.

Surface Penstock was considered due to moderate slope and topography (slopes varying 15º-30º). The installation of surface penstock is recommended.

3.14.7 Powerhouse

Two alternatives of powerhouse were considered which were:

- Slope Type Powerhouse; and
- Surface Powerhouse.

On the basis of probabilistic hazard analysis, the PGA (Peak Ground Acceleration) of 0.30 g associated with Operating Basis Earthquake (OBE) is recommended for the structures of the project.

a) Slope Type Powerhouse

Slope type powerhouse was not considered because rock is not available nearby the proposed location.

b) Surface Powerhouse

Generally surface powerhouse is less costly and has many other advantages e.g. construction and access etc. compared to slope type/underground powerhouse. Structural analysis for the surface powerhouse will be carried out to check its stability and preliminary thickness/sizes of the walls, slabs, columns and beams, etc. Therefore, surface powerhouse is proposed near Hanzel at right bank of Gilgit River about 17 km (17,000 m) from Gilgit town for further studies.

3.14.8 Tailrace

Two alternatives for placing the tailrace have been studied;

- Separate tailrace for each turbine; and
- Combined tailrace for multi-turbines.

For initial studies separate tailrace has been selected due to ease in construction and flexibility in operation. However, this option shall further be reviewed when detailed layout is available on accurate topographic maps.

3.14.9 Turbine Selection

The consultants studied, a number of alternative turbines including Francis horizontal and vertical such as:

- Horizontal Francis turbines were stated as the most suitable for the given head and discharge and were selected; and
- Vertical Francis turbines were stated also suitable but were not selected because of setting issues and civil works of complex in nature.

The use of three Francis units is suggested for this study. Main reasons are:

- The Francis horizontal are slightly cheaper compared with Francis vertical;
- The Francis was chosen with a speed of 428.6 rpm which is not too low and requires generator dimensions of manageable sizes; and
- The powerhouse design becomes much simpler and easier to construct and thus is also cheaper.

Francis turbines are used to optimize the operation during the period of low flow to add the flexibility of the system.

(This Space is Intentionally Left Blank)

CHAPTER 4 – DESCRIPTION OF ENVIRONMENT

4.1 GENERAL

This section describes the baseline conditions covering the existing physical, ecological, and socio-economic domains of the environment of the Study Area for the Project. Information on these aspects has been derived from the desk studies of available data and collection of primary data through field visits to the Study Area and visiting the concerned offices.

4.2 APPROACH ADOPTED

A consultant's team of experts was constituted to establish the baseline conditions of the Study Area. The team comprised Environmental Engineers, Environmentalist, Sociologist and Ecologist. The experts conducted a detailed desk study of the available data before mobilization to the site.

For the collection of baseline information checklists, proformas, Satellite Imagery (Google Earth), and General Topographic (GT) sheets were used. Study Area was delineated based on the field visit, study of available maps and data collected through the secondary sources.

Checklist/proformas were prepared for the collection of baseline data. Scoping sessions with all the concerned Project stakeholders were carried out for the collection of primary information and disclosure of Project interventions. The relevant collected data was computerized and analyzed using software such as Microsoft Office (Word, Excel and Access), SPSS, Computer Aided Design (CAD), and Coral Draw 12 etc. Following is the description of baseline conditions of the Study Area.

4.3 STUDY AREA

The Study Area is the area within which the potentially significant adverse environmental and social impacts of the proposed intervention are envisaged. Study Area includes the actual proposed Project boundary or the area which is considered to be acquired for the Project, as well as the area in the surroundings in which potential adverse impacts of the Project may be foreseen due to the implementation of the proposed Project.

Based on the consultant experience in the field of environment, the Study Area has been demarcated (**Refer Figure 1-3**) using the Google Earth Imagery and field visit. The Study Area mainly includes the weir site, headrace channel, forebay, penstock, power house (Project Area) nearby settlements/villages in the area, downstream of Gilgit River up to power house and the areas where adverse or positive impacts may be foreseen due to the implementation of the Project. The Study Area is selected on basis of the Project's potential environmental and social impacts on the local resources viz., river water, irrigation channels, water supply systems and the natural resources (if any) under use of community residing in the vicinity of the Project Area.

4.4 PHYSICAL ENVIRONMENT

This physical environment elaborate the settings of physical parameters including topography, land use, soils, geology, seismicity, climate, water resources, and other parameters as described in the following sub-sections:

4.4.1 Topography

The Project Area is characterized by rugged mountainous topography with barren rock exposures along with glacial deposits. The valley has passed the stage of youth and now is at the stage of maturity as indicated by its 'U' shaped nature. It has been formed by glaciation. It is quite evident from the presence of scree deposits, talus cone material, colluvial and alluvial material that in the past both glacio-fluvial and colluvial activities were in action.

Within a radius of one hundred km there are 33 lofty peaks ranging from 5,000 to 8,000 m above sea level. The peak of Rakaposhi is 7,788 meters high. The northern mountains are permanently covered with snow. There are several glaciers in these mountains, the most important are Baltura, Yazghil, Khurdopin, Pasu, Hisper, Cijerab, Braldu and Mulungutti. It consists of three valleys i.e. Gilgit, Nagar and Hunza.

There are numerous mountains of above 7,500 meters above sea level and thus the area is a paradise for mountaineers and tourists. Most of the mountains are barren and without any vegetation, but the soil is very fertile, forests of juniper and birch are at above the height of 2,000 meters.

4.4.2 Regional Geology

The geology of GB is dominated by the impact of the northward migrating Indo-Pakistan and Eurasian plates. The most important tectonic element features are salt range thrust, potwar plateau, Panial thrust (PT) and main boundary thrust (MBT), Peshawar basin and Kashmir basin separated at Hazaras Syntaxis, main central thrust (MCT), main mantle thrust intended to the north by Nanga Parbat Syntaxis, Kohistan island Arc complex and main Karakorum thrust. In the Hanzel valley, the igneous and metamorphic rock types of Kohistan Island Arc are exposed which ranges from cretaceous to quaternary in age. The geological map of the area is shown in **Figure 4-1**.

4.4.3 Site Geology

The site visit validates that the granodiorite and amphibolites are the rock units prevail in the Project Area. These rocks cover part of the Project Area otherwise; most of the area is covered with overburden comprising morainic material, colluvial, debris slides and avalanches and stream bed deposits. Geology observed at respective project component is tabulated below **Table 4-1**.

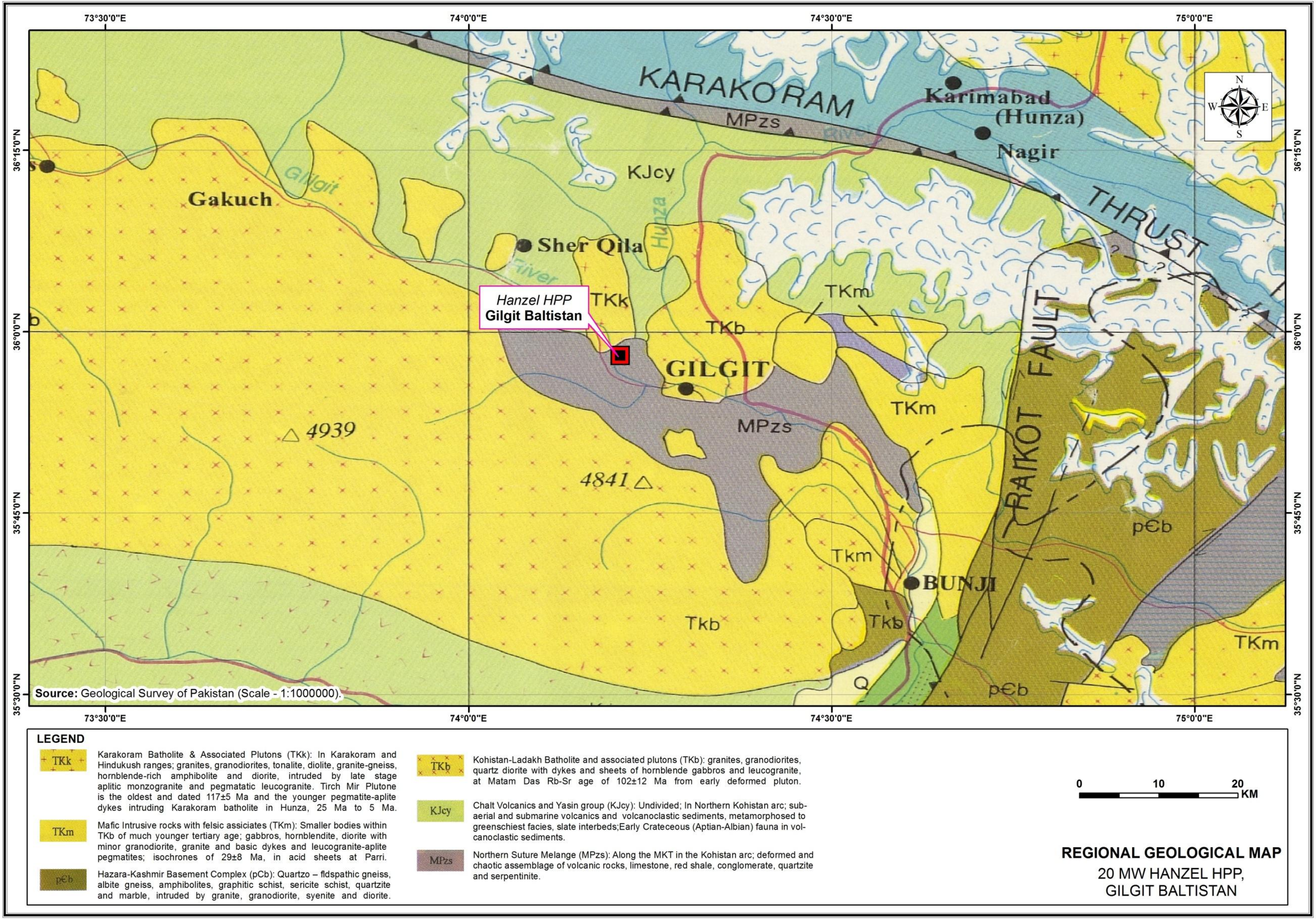
Table 4-1: Brief Geology at the Project Structures Location

Sr. No.	Project Structure	Geology
1	Weir	Granodiorite on left abutment and Moraine plus Deposits on right abutment
2	Sandtrap	Moraine
3	Headrace/Power Channel	Moraine, Alluvium and Amphibolite rock
4	Forebay	Moraine and Rock Deposits
5	Power House	Alluvium

Source: Feasibility Review Report, June 2017

(This Space is Intentionally Left Blank)

Figure 4-1: Regional Geological Map



4.4.4 Seismicity

The Project Area is located in the "Gilgit" seismic province and mostly shows E-W trending folds and faults. The deformation within this zone is primarily the result of thrusting and of deep crustal decollement processes associated within the collision of the plates. Teleseismic data for northern Pakistan shows a concentration of seismic activities in three main zones around the Project Area.

- The Hindukush region in the NW;
- The Daral - Tangier – Haran valley region in the NE; and
- The Indus – Kohistan seismic zone in the SE.

In general deep seismicity (70 to 300 km) is related to the Hindukush zone, while shallow seismicity (<50km) is dominant in the Kohistan area. The strongest earthquake occurred in November 20th, 2002 in the Nanga Parbat syntaxis with a magnitude of 6.2 mb with epicenter near Doian in Astore valley and this event is closely associated with Raikot Sassi Fault Zone.

The theoretical PGA values vary between 43 cm/s^2 (0.04 g) and 210 cm/s^2 (0.22 g). Considering the important Main Boundary Thrust as a source for future earthquakes with an intensity of M = 7 at a depth of 20 km (200,000 m) and a minimum horizontal distance of 30 km (300,000 m) an assessment of the PGA at Gilgit would result in a maximum value of 262 cm/s^2 (0.27g).

Probabilistic analyses have been carried out using the approach developed by Cornell. It is based on

- Definition of earth quake sources Hazara Arc, Kohistan Island Arc, Hindukush Seismic Zone;
- Magnitude frequency relationship keeping in view the tectonic setting of the area and its historical development, and upper bound magnitude of M = 8 has been used;
- Attenuation relationship; and
- Upper bound magnitude assessment to each earthquake source.

The assessment of the seismic probabilistic hazard in the Project Area affected by fault ruptures during the earthquake shows the following results for 50% (10%) of probability of exceedance:

- Design life 50 years: 0.15 g (0.24g)
- Design life 100 years 0.18 g (0.28g)

The seismic design parameters for the project (50 years lifetime) are recommended as a Maximum Design Earthquake (MDE) of 0.25 g with 10% probability of exceedance with a corresponding return period of 475 years, and an Operation Basis Earthquake (OBE) of 0.15 g with 50% probability of exceedance and 75 years return period[5]. The Project Area as per Building Code of Pakistan (BCP), 2007 (Seismic Provisions) falls entirely in the Zone 3 as shown in **Table 4-2** and **Figure 4-2**.

Table 4-2: Peak Ground Acceleration (PGA) Values of Seismic Zones of Pakistan

Zone	PGA (g)
1	0.05 to 0.08
2A	0.08 to 0.16

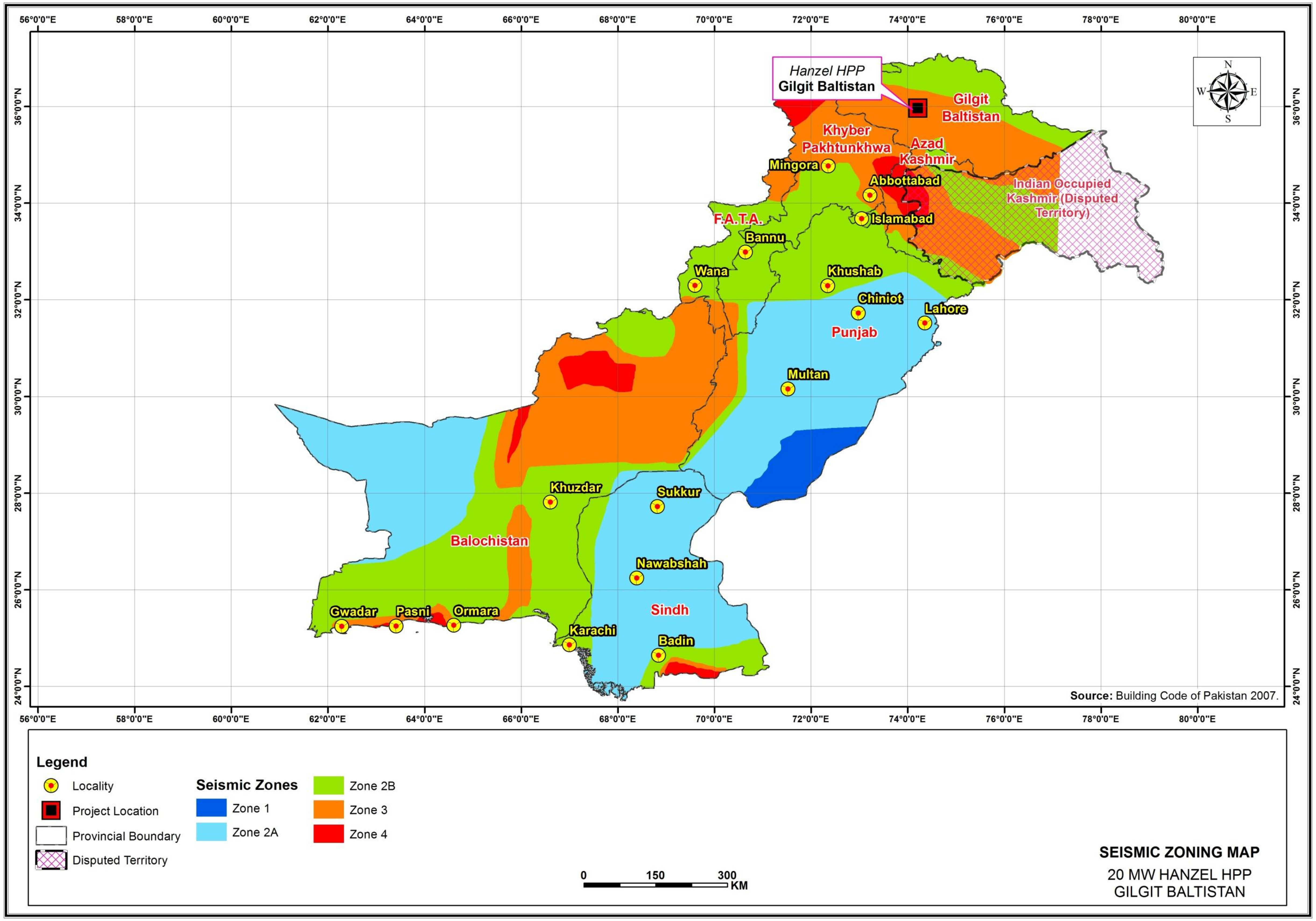
[5] Feasibility Report, 2009.

Zone	PGA (g)
2B	0.16 to 0.24
3	0.24 to 0.32
4	> 0.32 g

Source: Building Code of Pakistan (Seismic Provisions – 2007), Ministry of Housing and Works

(This Space is Intentionally Left Blank)

Figure 4-2: Seismic Zoning Map



4.4.5 Climate

The dominant weather of the city is winter, which lasts eight to nine months a year. Gilgit District is surrounded by glaciers. Major contribution of flow is due to the glacier melt. River flow can, therefore, be highly variable and pose threats to the stability of landscapes especially in the vicinity of streams. Future temperature projections by Global Climate Models (GCMs) suggest that the temperature in Gilgit may become 7°C higher than the present level by the end of the 21st Century.

Gilgit is the nearest weather station and the climatic data has been obtained from EPA, GB. The climate of the district is characterized by cold winter and warm and dry summer. The summer season in low lying valleys is hot but at high altitudes it is very pleasant. The data for the various climatic parameters of Gilgit is presented in the following sub-sections:

a) Temperature

The coldest month is December in which the mean minimum temperature is -6.8°C recorded during the year 1999. July is the hottest month with the mean maximum temperature of 39.7°C recorded during the year 1990. Mean monthly temperature data of the region for the years 1984-2013 is presented in **Annex-3**. The annual temperature for the year 1984-2013 is shown in **Table 4-3** and **Table 4-4**.

Table 4-3: Annual Maximum Temperatures (ºC)

Sr. No	Year	Annual
1	1984	23.5
2	1985	24.2
3	1986	22.7
4	1987	23.3
5	1988	24.6
6	1989	22.6
7	1990	24.9
8	1991	23.3
9	1992	23.3
10	1993	24.2
11	1994	24
12	1995	23.7
13	1996	23.5
14	1997	24.8
15	1998	25
16	1999	24.8
17	2000	25.3
18	2001	25.9
19	2002	25
20	2003	24.3
21	2004	24.8
22	2005	24
23	2006	24.5
24	2007	25
25	2008	25
26	2009	23.9
27	2010	24.1
28	2011	24.8
29	2012	23.6

Sr. No	Year	Annual
30	2013	25

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

Table 4-4: Annual Minimum Temperatures (ºC)

Sr. No	Year	Annual
1	1984	7.9
2	1985	8.2
3	1986	7.6
4	1987	7.1
5	1988	7.7
6	1989	6.7
7	1990	7.4
8	1991	7.2
9	1992	7.5
10	1993	7.1
11	1994	8.1
12	1995	7.2
13	1996	6.5
14	1997	7.4
15	1998	7.6
16	1999	7.4
17	2000	6.2
18	2001	6.7
19	2002	6.8
20	2003	7.2
21	2004	8
22	2005	7
23	2006	8.3
24	2007	7.6
25	2008	8
26	2009	7.9
27	2010	7.6
28	2011	8.2
29	2012	7.9
30	2013	8.2

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

b) Rainfall

The maximum rainfall occurs during the monsoon season in the months of July and August. The variation of monthly rainfall for the year 1984 & 2013 is attached as **Annex-3**. However, the annual mean rainfall is given in **Table 4-5**.

Table 4-5: Mean Annual Rainfall (mm)

Sr. No	Year	Annual
1	1984	104.7
2	1985	101
3	1986	133.6
4	1987	199.4
5	1988	136.2
6	1989	159.6
7	1990	89.3
8	1991	118.4

Sr. No	Year	Annual
9	1992	94.3
10	1993	94.6
11	1994	119.2
12	1995	108.3
13	1996	251.7
14	1997	128.7
15	1998	167.9
16	1999	206.8
17	2000	97.2
18	2001	88
19	2002	112.4
20	2003	225.6
21	2004	147.1
22	2005	149.8
23	2006	132.6
24	2007	84.3
25	2008	170.7
26	2009	141.1
27	2010	267.5
28	2011	158.7
29	2012	147.4
30	2013	153.5

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

c) Wind Speed and Direction

The wind data is being recorded on daily basis for 1200 and 0000 UTC. The monthly mean for the wind speed is calculated and attached as **Annex-3** for the years 1984-2013 in knots. The Annual mean wind is shown in **Table 4-6** to **Table 4-8**.

Table 4-6: Mean Wind at Synoptic Hours (1200 UTC) in Knots

Sr. No	Year	Annual
1	1984	1.8
2	1985	1.7
3	1986	2
4	1987	2.1
5	1988	1.6
6	1989	2
7	1990	1.5
8	1991	2
9	1992	1.6
10	1993	1.7
11	1994	1.9
12	1995	1.5
13	1996	1.3
14	1997	1.6
15	1998	1.5
16	1999	1.9
17	2000	2.5
18	2001	2.3
19	2002	1.9
20	2003	2
21	2004	2.2

Sr. No	Year	Annual
22	2005	2.1
23	2006	2.6
24	2007	2.4
25	2008	2.6
26	2009	2.3
27	2010	1.4
28	2011	2.4
29	2012	3.3
30	2013	2.3

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

Table 4-7: Mean Wind Direction at Synoptic Hours (0000 UTC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1984	S23E	S45E	S67E	W	N77W	S6E	S40E	S23W	S45E	W	W	W
1985	S67W	N72W	S31W	E	S34E	W	S56E	S37W	E	S67W	S18W	S45W
1986	S66W	S73W	N10W	W	S83W	S	S45W	N	S45W	CALM	S	N23E
1987	S73W	W	S38E	S45E	S75E	W	S45W	W	N45E	W	S38W	S73W
1988	N87W	N80W	N56W	S68W	S70W	CALM	S52W	N84W	S62W	S74W	S66W	N23W
1989	S45W	W	N87W	S70W	N74W	S29E	S63W	W	W	S18E	W	N82W
1990	S28W	S45W	N45W	S45E	S45W	S76W	S56E	S20E	S68E	N	S45W	S67E
1991	S75W	N82W	N78W	N45E	W	S18E	N75E	S45W	S60W	S23W	CALM	S23W
1992	S3E	N85W	S45W	S69W	N67W	S64W	S78E	S9E	S66W	S45W	CALM	CALM
1993	S58W	N15E	S66W	S12W	N75W	N38W	S55W	S18W	S45W	S60W	S23W	S34W
1994	S74W	S82W	S68W	S23W	S11W	S45W	S45W	S23E	S45E	W	W	N76E
1995	CALM	S	W	S45W	N23W	N45W	S45W	S	S23E	N45W	CALM	S28W
1996	W	N50W	S41E	S27E	S5E	S45W	W	N23E	E	N77W	CALM	N45W
1997	W	S72E	N36E	S45E	S45W	N45W	S45E	S	S45W	CALM	E	CALM
1998	E	W	N66W	W	S41E	S57W	S45E	CALM	S27W	S66W	CALM	CALM
1999	W	W	N24W	W	S23W	S45E	S41E	S56E	W	W	W	W
2000	W	S85W	S71W	S45W	E	S38W	S45W	CALM	S38W	CALM	W	W
2001	S	S75W	N	N45E	E	W	CALM	E	E	W	CALM	CALM
2002	CALM	CALM	S	E	N45E	W	W	CALM	S60W	CALM	W	CALM
2003	CALM	N45E	S	W	CALM	N60E	CALM	S66W	W	N45W	CALM	CALM
2004	W	S76W	S77W	W	S45W	E	S45E	CALM	S23E	S45W	CALM	W
2005	W	CALM	S	N45W	E	W	CALM	S60W	CALM	W	CALM	CALM
2006	CALM	CALM	N14E	CALM	W	CALM	S80W	N45W	S75W	W	CALM	N45E
2007	CALM	W	CALM	N82W	S65W	N45W	W	S55W	N45W	S45E	CALM	CALM
2008	S68W	S68W	N63W	S16E	CALM	CALM	S75E	CALM	CALM	W	S45E	S57W
2009	S83W	W	S72W	CALM	E	S75E	N62E	E	S67W	W	CALM	S82W
2010	W	CALM	E	N45W	E	CALM	CALM	CALM	S62W	CALM	CALM	CALM
2011	CALM	CALM	W	S45E	W	N68E	E	S62E	N79W	CALM	W	CALM
2012	W	S45W	W	S45W	E	S23E	S45E	W	W	W	W	S63W
2013	S	S45E	S45W	E	E	E	CALM	CALM	CALM	CALM	CALM	CALM

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

Table 4-8: Mean Wind Direction at Synoptic Hours (1200 UTC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1984	S38W	S11E	S56W	S2W	S50E	S56E	S66E	S	S32E	S64W	S45W	S45W
1985	S53W	S37W	S66W	S26E	S57E	S54E	S74E	S76E	E	S22E	N80W	S76E
1986	S27E	S63W	S9E	S4E	S50E	S65E	S77E	S	S37E	S45W	S66W	N23E
1987	S	S47E	S10E	S72E	S32E	S49E	S24W	E	S56E	CALM	S	S27W
1988	S64W	S19E	S29W	S	S45E	S49E	S62E	S76E	S5W	S16E	S45E	S84W

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989	S55W	S20W	S34W	S57W	S43E	S43E	S35E	S66E	S38E	S41E	S45E	S18W
1990	S42E	S45W	S	S21W	S56E	S53E	S49E	S28E	S66E	S68W	S66E	S50E
1991	W	S55W	N88W	S34W	N45E	S3W	S60E	S57E	S41W	S52W	S52W	S31E
1992	S79W	S87W	N85W	S69W	S45E	S52E	E	S	S53E	S53W	S23W	S23E
1993	S73E	N87E	S10E	S2W	S38E	S9E	S77E	S2E	S70E	S28W	S27W	S67W
1994	N83E	S22W	S4W	S7E	S64E	S45E	S43E	S32E	S67W	S58W	N45W	N73E
1995	S45E	S40E	S80E	S36E	S61W	S60W	S65E	S71E	S6W	S11W	S45W	E
1996	S45E	S47W	S21E	S20E	S83E	S63E	S82E	S24E	S31W	CALM	W	E
1997	S60E	S22E	E	S12E	S45E	S83E	S45E	S42E	S60E	S77E	CALM	CALM
1998	W	S41W	S10W	S81E	S51E	S28E	N71E	S66E	S64E	N79W	CALM	CALM
1999	S23E	N50W	S79W	S82W	S76E	S89E	S64E	S81E	S45E	S45E	S	CALM
2000	W	S15E	S70W	S80E	N83E	S85E	N25E	S83E	N73E	S23E	W	S
2001	E	S40E	S42E	S85E	S69E	E	N81E	S60E	S21E	E	E	E
2002	S58E	E	S75E	S74E	S76E	S45E	S31W	S63E	S80E	N79E	CALM	E
2003	S60E	S34W	S61W	S87W	S83E	S72E	S67E	S38E	S45E	S23W	S45W	W
2004	E	N84W	S54W	S19E	S62E	S44E	S57E	S85E	S60W	S45W	CALM	W
2005	W	S65W	S43W	S85W	S69E	S64E	S84E	S50E	N37W	S14W	S22W	S45W
2006	S27W	N45W	S23W	S20E	S59E	S42E	S18E	E	S68E	W	E	W
2007	W	W	S72W	S	S47E	S66E	S75E	S05W	S45E	S36E	CALM	CALM
2008	S36E	S36W	S33W	S75E	S76E	S80E	S73E	S76E	S68E	E	E	W
2009	S68W	S80W	S76W	S06W	S67E	N82W	S86E	S77E	S62W	W	N23E	W
2010	W	W	S52W	W	E	S83E	S76E	E	W	E	CALM	CALM
2011	CALM	N13W	S62W	E	S76E	N87E	S12W	S36W	S82W	W	S45E	CALM
2012	S45W	S76E	S87W	S78E	S86E	S62E	S82E	E	S63E	S11E	N45W	CALM
2013	W	S03W	S03E	S32E	S45E	S86E	N85E	W	N83E	S75E	CALM	W

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

d) Relative Humidity

The data for relative humidity is being recorded on daily basis for 0000 and 1200 UTC and is attached as **Annex-3**. The Annual mean for relative humidity 0000 and 1200 UTC, which is calculated for these timings for the years 1984-2013, is presented in **Table 4-9** and **Table 4-10** respectively.

Table 4-9: Relative Humidity at 0000 UTC (%)

Sr. No	Year	Annual
1	1984	----
2	1985	70.4
3	1986	76.9
4	1987	81.6
5	1988	80.4
6	1989	78.6
7	1990	77.3
8	1991	80.4
9	1992	77.9
10	1993	78.3
11	1994	80.8
12	1995	78.4
13	1996	79.7
14	1997	76.4
15	1998	77.3
16	1999	76.4
17	2000	73.3

Sr. No	Year	Annual
18	2001	73.2
19	2002	78
20	2003	80.5
21	2004	78.1
22	2005	80.9
23	2006	78.9
24	2007	76.3
25	2008	76.7
26	2009	76.1
27	2010	80.8
28	2011	77.9
29	2012	73.9
30	2013	75.6

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

Table 4-10: Relative Humidity at 1200 UTC (%)

Sr. No	Year	Annual
1	1984	----
2	1985	35.9
3	1986	41.2
4	1987	41.4
5	1988	36.5
6	1989	37.9
7	1990	39.3
8	1991	43.6
9	1992	42.7
10	1993	38.6
11	1994	42.2
12	1995	39.6
13	1996	39.8
14	1997	34.3
15	1998	38.1
16	1999	37.9
17	2000	34.7
18	2001	32.8
19	2002	35.6
20	2003	38.9
21	2004	36.3
22	2005	38.9
23	2006	40.1
24	2007	37.6
25	2008	38.5
26	2009	40.3
27	2010	42.1
28	2011	39.8
29	2012	39.9
30	2013	38.8

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

4.4.6 Water Resources

Sources of water supply for Gilgit include lakes, springs, reservoirs and ground water. Glacial melt is the primary source of water supply. Glacial water flows in the form of nullahs, which eventually discharge into the Gilgit River. The nullahs in and around the city are Jutial, Konudas, Kargah and Danyor. Jutial Nullah provides the city with most of its irrigation and drinking water. The Gilgit and Hunza are the major rivers of Gilgit.

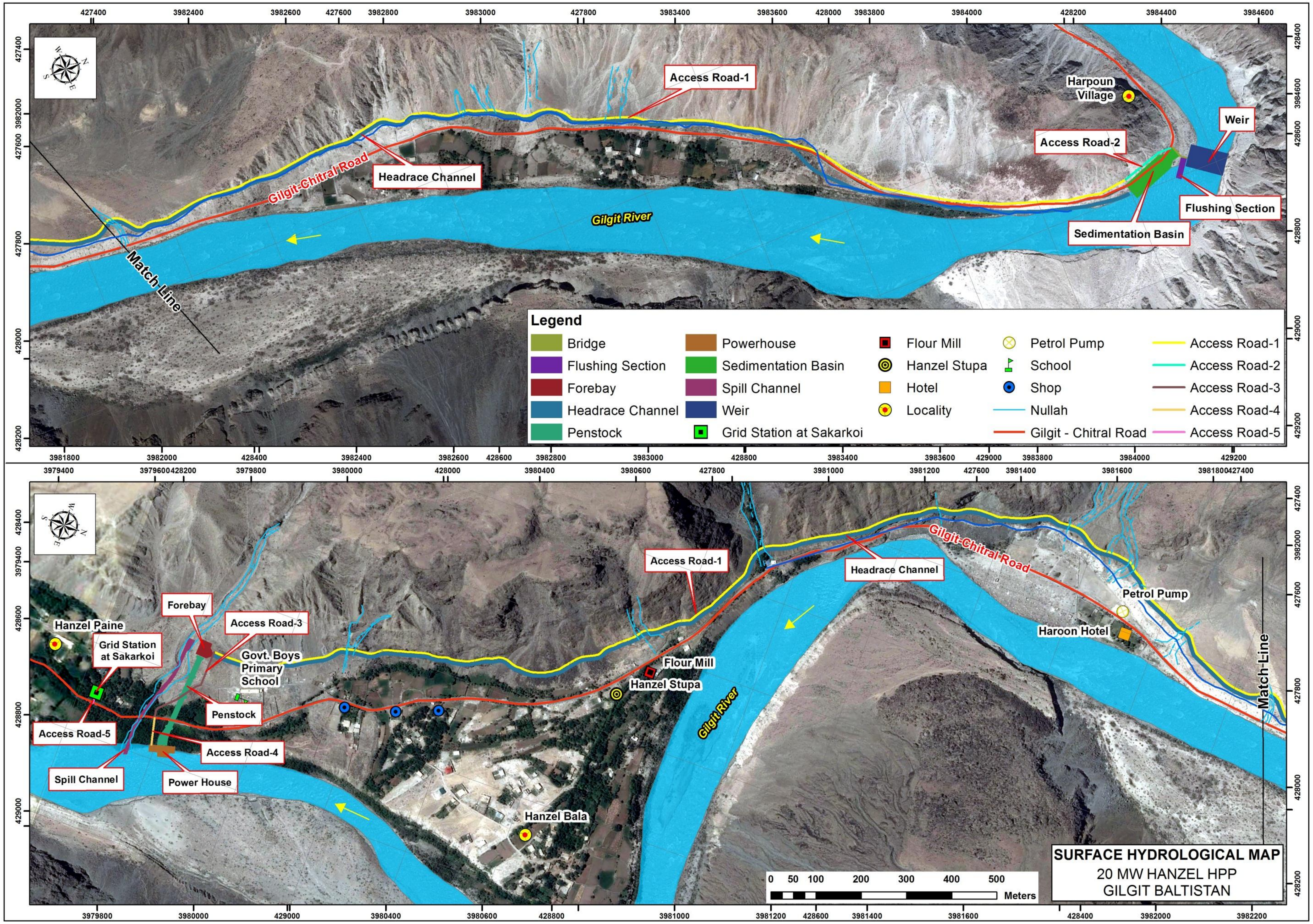
4.4.6.1 Surface Water

The district has two important rivers, namely the Gilgit and the Hunza. The basins of these two rivers are divided in almost two dual halves. The Gilgit River has its source in Shandur Lake. It passes through the territories of Gupis and Punial and reaches a place called Danyor near Gilgit where it is joined by the Hunza River, which comes from Shimshal and Montir area. There are several lakes in the district. Phandar, Nalter and Shandur lakes are the important ones.

The major surface water source from weir to power house site is the Gilgit River, Spring water through water channels which supplies water mainly for drinking and irrigation purpose. The area is rich in water for irrigation purposes. There are nullahs/hill torrents fed by snow melt from mountains in large quantity from which the people construct small irrigation channels to irrigate lands in villages. The locals of Hanzel Bala and Hanzel Paine utilize both River and Spring water for irrigation. The main surface water sources in the Project area are shown in **Figure 4-3**.

(This Space is Intentionally Left Blank)

Figure 4-3: Surface Hydrological Map



4.4.6.2 Hydrology

Following is brief description of the hydrology of the Gilgit River.

a) Catchment Area

Gilgit River is a right bank major tributary of Indus River. The catchment area of Gilgit River at Gilgit gauging station (1430 m.a.s.l) is 12,095 km^2 while upto proposed weir site it is about 11,491 km^2.

The map showing main rivers within catchment area of this project is shown in **Figure 4-4**.

Gilgit River originates from Ghizar River at an elevation of about 4,300 m.a.s.l at Shandur pass and flows westward joining Yasin and Ishkuman River and ultimately falls into Indus River. The main tributaries of Gilgit River are Sosat Gah, Balti Gah, Dhanial Gah, Yasin River, Gupis Gah, Roshan Gah and Darmodaro Gah. The watershed area is surrounded by Hindu Kush Mountains. Highest elevation recorded in the catchment is 5,378.6 m.a.s.l (17,649 ft) near Ghutbar. Lowest elevation at proposed HPP site is 1,717 m (5,634 ft). Gupis is the main climatological station in the catchment. In relatively lower elevations Gilgit river flows from elevation 1,760 to 1,420 m.a.s.l from single to the confluence with Hunza River with average slope of 0.62%.The elevation of` Gilgit River from the confluence with Hanzel River to Partab Bridge varies from 1,420 to 1,280 m.a.s.l with average slope of 0.35%.

The river originates from large glaciers at Khakush Gal and Shunji Gal. Bala Gal is another area of glaciers. Shunji glacier is at an altitude of 3,594 m.a.s.l and flows through narrow gorges. The catchment is characterized by a number of glaciers of varying size. The area is also enclosed by high mountains. The height of the catchment varies from 5,478 to 2,880 m.a.s.l approximately.

Mean elevation of catchment area is 3,548 m.a.s.l. The river has an average bed slope of about 1.17% at the proposed site. It is reported that more than 80% of the catchment is located in mountains above an elevation of 3,962 m.a.s.l which either remains under snow cover or receives precipitation in the form of snow.

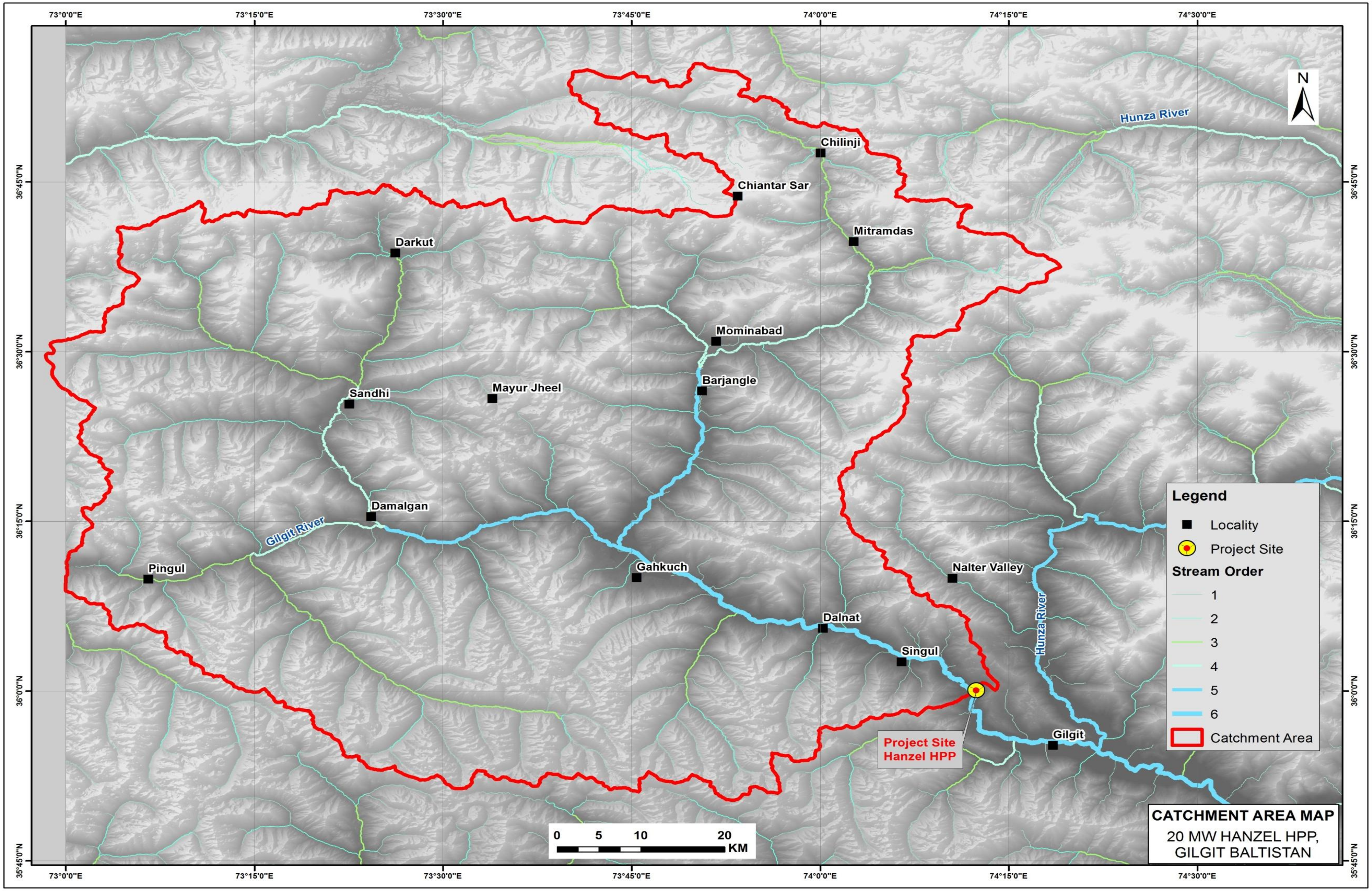
Due to the geographical location of the catchment area and its precipitation, temperature, runoff and flood characteristics, the Gilgit river catchment is classified as a region 3: “moderately effected by monsoon rain” according to the regional catchment approach. In this region, floods occur during spring and summer. They mainly originate from snowmelt. Precipitation can contribute to maximum floods.

There is one stream gauging station on Gilgit River at Gilgit. The gauge was installed by Surface Water Hydrology Project, WAPDA on left bank of Gilgit River under bridge at Gilgit (Latitude 350 56’N, Longitude 740 19’E) 5.6 km (5,600 m) upstream of its confluence with Hunza and about 37 km (37,000 m) upstream of Indus River. This is the longest record of daily flows that exists at Gilgit on Gilgit River.

Because the proposed hydropower project is quite close to the Giglit gauging station (about 17,000 m upstream from gauge), records of Gilgit River at Gilgit were considered for the present study. Data from the station has been utilized for extension of flow series at proposed HPP.

(This Space is Intentionally Left Blank)

Figure 4-4: Catchment Area Map



b) Drainage Pattern

The river has large catchment area with dendritic drainage pattern. It is fed mainly by snow melt water and glacier. Springs located within the valley also contribute to enhance the water discharge of the river.

c) Recorded Flows

By utilizing the feasibility data and current available data, the mean monthly discharge of Gilgit River at Hanzel is presented in **Table 4-11**.

Table 4-11: Mean Monthly Discharges – Gilgit River at Hanzel

Months	Discharge (m^3/s)
January	59.5
February	52.5
March	46.8
April	58.9
May	214.8
June	663.8
July	862.2
August	663.0
September	330.0
October	149.3
November	92.2
December	71.6
Annual	**273.6**

Source: Feasibility Review Report, June 2017

Availability of water for different percentages of time is given in **Table 4-12.** It may be observed that the planned diversion of 38 m^3/sec of water (including 2 m^3/sec of flushing discharge) is available for 98.6 % of time.

Table 4-12: Availability of Discharge – Gilgit River at Hanzel

Percentage (%) of Time	Discharge Equalled or Exceeded (m^3/s (cumec)
0.06%	2830
5%	926
10%	759
15%	644
20%	539
25%	429
30%	322
35%	221
40%	161
45%	124
50%	102
55%	87
60%	77
65%	69
70%	63
75%	58
80%	54

Percentage (%) of Time	Discharge Equalled or Exceeded (m^3/s (cumec)
85%	51
90%	47
95%	43
100%	32

Source: Feasibility Review Report, June 2017

d) Sediments

The solid material moving in nullahs/streams/rivers consists of dissolved and suspended matter and bedload. The suspended load is distributed across the whole flow section of the river, whereas the bedload moves on or near the bed of the river. Both types of sediment transport are dependent on the characteristics of the river such as slope, turbulence, etc. as well as on the characteristics of the catchment such as geology, topography, vegetation and rainfall intensity.

e) Design Discharges for Nullahs

There are total four (04) nullahs on the right bank of the Gilgit River; three out of four requires suitable drainage crossing structures. The fourth nullah is likely to affect the design of spill channel. The catchments of these nullahs are delineated in **Figure 4-5** and their hydrological characteristics are provided in **Table 4-13**.

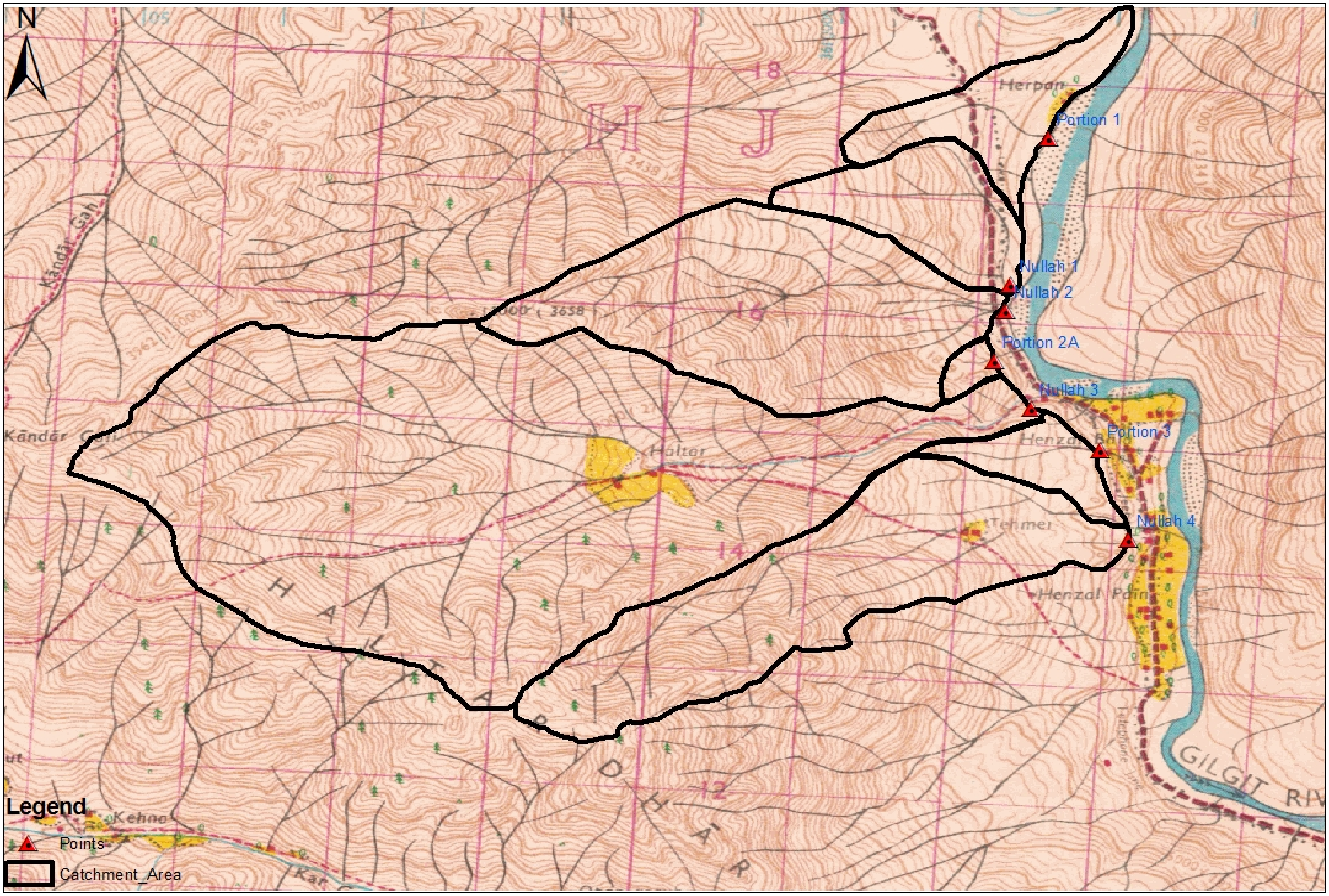
Table 4-13: Hydrological Characteristics of Nullahs

Point	Catchment Area (km^2)	Stream Length (m)	Top Elevation (m)	Bottom Elevation (m)
Nullah 1	0.810	1960	2501.000	1577.000
Nullah 2	3.230	3680	3573.000	1571.000
Nullah 3	11.200	6920	4361.000	1586.000
Nullah 4	3.310	4740	3925.000	1570.000

Source: Feasibility Review Report, June 2017

(This Space is Intentionally Left Blank)

Figure 4-5: Catchment of Nullahs



f) Floods

Previous studies[6] indicated that the origin of floods generated in the watershed is by the melting of snow and ice, whereas the contribution of rainfall seems to be making not much effect on the floods.

Basic data for calculation of floods are not available at Gilgit Gah. However, peak values are available for 43 years (1960-2003) of Gilgit River at Gilgit. Gilgit River is a tributary of Indus River and therefore the peak floods in Gilgit at the proposed HPP can be estimated with this data. Thus, the available data series were considered as one of the available information for the estimation of major floods. For the Hanzel dam site a 1000-year return period has been assumed to be sufficient for design of the intake and dam structures as proposed in the feasibility report. Subsequent analysis use 1000 year flood (2,933 cumecs) as design flood. The consultant do not recommend altering the design flood estimate of 2,933 m^3/sec for the reason that this figure is quite close to upper 95 % confidence limit of 1000 year flood estimate, and that a flood of this magnitude has actually been observed at Gilgit in 2005 in the 48 years flood record of the station.

4.4.7 Groundwater

Drinking water is also being supplied by the Public Health Department, Government of Gilgit Baltistan. Piped network is available for supply of good quality water which is either being pumped from ground or obtained from natural stream. In Project Area local people mostly use spring water for drinking which is being provided through piped network.

The water quality results of the above sources are presented in the below section;

c) Water Quality

To determine the existing water quality of different water sources, seven (07) water samples were collected by an EPA approved Punjab Environmental Laboratory for the laboratory testing. The detailed environmental monitoring report is attached as an **Annex- 4**.

The sampling locations are shown in **Figure 4-6**.The laboratory test results of surface water wastewater and groundwater samples are listed in **Table 4-14** to **Table 4-16** respectively:

Table 4-14: Surface Water Quality Test Results

Analysis Parameter	Units	SW-01 Gilgit River (Upstream of Weir)	SW-02 Gilgit River (Between Weir and Power House)	SW-03 Spring Water Near Barbuch	SW-04 Spring Water Collection Tank Near Barbuch	SW-05 Gilgit River (Downstream of the Power House Near Girls High School)
Temperature	^0C	07	08	06	08	07
pH	pH unit	7.67	7.71	7.65	7.59	7.52
Total Dissolved Solid	mg/l	56.0	42.0	38.0	50.0	85.0
Biological Oxygen Demand	mg/l	<2.0	<2.0	<2.0	<2.0	<2.0
Chemical Oxygen Demand	mg/l	<5.0	<5.0	<5.0	<5.0	<5.0

6 HEPO, WAPDA: Comprehensive Planning Region – 6 Yasin, 1999.

Analysis Parameter	Units	SW-01 Gilgit River (Upstream of Weir)	SW-02 Gilgit River (Between Weir and Power House)	SW-03 Spring Water Near Barbuch	SW-04 Spring Water Collection Tank Near Barbuch	SW-05 Gilgit River (Downstream of the Power House Near Girls High School)
Total Suspended Solids	mg/l	42.0	39.0	12.0	11.0	14.0
Oil & Grease	mg/l	<10.0	<10.0	<10.0	<10.0	<10.0
Turbidity	NTU	4.0	5.0	2.0	4.0	<5.0
Dissolved Oxygen	mg/l	6.2	5.2	6.4	5.3	6.1
Pesticides	mg/l	ND	ND	ND	ND	ND
Potasium	mg/l	0.02	ND	0.05	ND	0.03
Nitrogen	mg/l	<0.03	<0.03	<0.03	<0.03	<0.03
Phosphorous	mg/l	ND	ND	ND	ND	ND
Phenolic Compound	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Chloride (Cl)	mg/l	5.82	3.88	5.82	5.82	3.88
Fluoride (F)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Cyanide (Cn)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Detergents	mg/l	ND	ND	ND	ND	ND
Sulphate	mg/l	223.91	152.70	116.07	199.62	141.59
Sulphide	mg/l	ND	ND	ND	ND	ND
Ammonia	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorine	mg/l	<1.0	<1.0	<1.0	<1.0	<1.0
Cadmium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5
Lead	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	mg/l	0.05	0.23	0.10	0.12	0.3
Boron	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
Selenium	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
Total Toxic Metals	mg/l	0.07	0.23	0.15	0.12	0.33

ND= Not Detectable

(This Space is Intentionally Left Blank)

Figure 4-6: Environmental Monitoring and Sampling Location Map

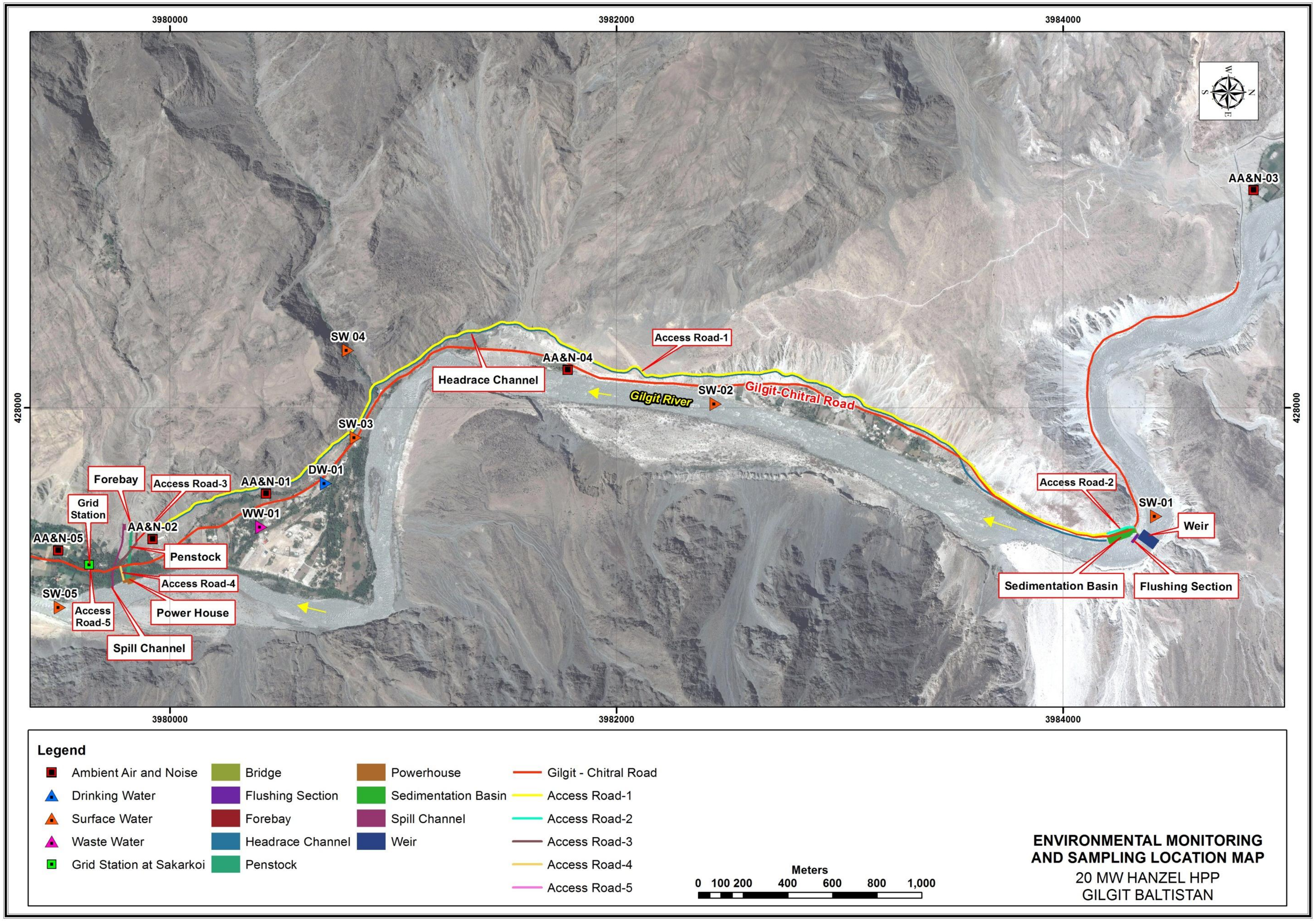


Table 4-15: Wastewater Results

Parameters	Analysis Method	Unit	LOR	Result: Wastewater Sample from Collection Pit	NEQS*
Temperature	-	^0C	-	23.0	30
pH	APHA-4500H+ B	pH unit	0.1	7.97	6-9
Total Dissolved Solid (TDS)	APHA-2540 C	mg/l	1.0	2767.0	3500
Biological Oxygen Demand	APHA, 5210	mg/l	2.0	8.6	80
Chemical Oxygen Demand	APHA-5220 D	mg/l	5.0	25.0	150
Total Suspended Solids	APHA-2540 D	mg/l	5.0	31.0	200
Oil & Grease	USEPA-1664	mg/l	10.0	<10.0	10
Turbidity	APHA-2130 B	NTU	5.0	5.0	-
Dissolved Oxygen	APHA-4500-O	mg/l	-	6.4	-
Pesticides	APHA-6630-B	mg/l	-	ND	0.15
Potasium	APHA-3500-K-B	mg/l	-	ND	-
Nitrogen	APHA-4500 Norg	mg/l	-	ND	-
Phosphorous	APHA-4500-P C	mg/l	0.03	<0.03	-
Phenolic Compound	APHA-5530 D	mg/l	0.001	<0.001	0.1
Chloride (Cl)	APHA-4500Cl- B	mg/l	0.5	287.51	1000
Fluoride (F)	APHA-4500F- C	mg/l	0.01	<0.01	10
Cyanide (Cn)	APHA-4500CN F	mg/l	0.01	<0.01	1.0
Detergents	APHA-5540- C	mg/l	-	ND	-
Sulphate	APHA-4500-SO4-C	mg/l	0.41	1506.4	600
Sulphide	APHA-4500-S2 E	mg/l	-	ND	1.0
Ammonia	APHA-4500-NH3 B	mg/l	0.002	<0.002	40
Chlorine	APHA-4500Cl G	mg/l	1.0	<1.0	-
Cadmium	APHA-3500Cd B	mg/l	0.01	<0.01	0.1
Chromium	APHA-3500Cr B	mg/l	0.01	<0.01	1.0
Copper	APHA-3500Cu B	mg/l	0.5	<0.5	1.0
Lead	APHA-3500-Pb B	mg/l	0.01	<0.01	0.5
Mercury	APHA-3500-Hg B	mg/l	0.001	<0.001	0.01
Nickel	APHA-3500-Ni B	mg/l	0.01	<0.01	1.0
Zinc	APHA-3500-Zn B	mg/l	0.5	<0.5	5.0
Arsenic	APHA-3500As B	mg/l	0.01	<0.01	1.0
Silver	APHA-3500Ag B	mg/l	0.01	<0.01	1.0
Barium	APHA-3500Ba B	mg/l	0.1	<0.1	1.5
Manganese	APHA-3500-Mn B	mg/l	0.1	<0.1	1.5
Iron	APHA-3500-Fe B	mg/l	-	0.83	8.0
Boron	APHA-4500B C	mg/l	0.1	<0.1	6.0
Selenium	APHA-3500Se C	mg/l	0.005	<0.05	0.5
Total Toxic Metal	-	mg/l	-	0.83	-

ND: Not Detected LOR: Limit of Reporting

**NEQS for Municipal and Liquid Industrial Effluents, 2000.*

All the parameters are in compliance with the NEQS except Sulphate as shown in **Table 4-15**.

Table 4-16: Water Quality Results for Drinking Water

Parameter	DW 01: Drinking Water sample from Tap in Hanzel Bala Village	*NEQS for Drinking Water
Colour	<5.0	≤ 15 TCU

Parameter	DW 01: Drinking Water sample from Tap in Hanzel Bala Village	*NEQS for Drinking Water
Taste	Sweet	Non objectionable/ Acceptable
Odour	Odorless	Non objectionable/ Acceptable
pH	7.98	6.5 - 8.5
Turbidity (NTU)	ND	<5
Total Hardness as $CaCO_3$ (mg/l)	70.56	<500
Total Dissolved Solids (mg/l)	91.0	<1000
Arsenic (mg/l)	<0.01	≤0.05
Chlorides (mg/l)	3.88	<250
Cyanide (mg/l)	<0.01	< 0.05
Phenolic Compounds (mg/l)	<0.001	--
Residual Chlorine (mg/l)	<1.0	0.2-0.5
Aluminium (mg/l)	<0.1	< 0.2
Cadmium (mg/l)	<0.01	0.01
Copper (mg/l)	<0.5	2
Chromium (mg/l)	<0.01	< 0.05
Mercury (mg/l)	<0.001	< 0.001
Antimony (mg/l)	<0.005	< 0.005
Nickel (mg/l)	<0.01	< 0.02
Barium (mg/l)	<0.1	0.7
Manganese (mg/l)	<0.1	< 0.5
Lead (mg/l)	<0.01	< 0.05
Selenium (mg/l)	<0.005	0.01 (P)
Boron (mg/l)	<0.10	0.3
Pesticide (mg/l)	ND	---
Fluorides (mg/l)	<0.01	≤1.5
Nitrite (mg/l)	<0.003	< 3
Nitrate (mg/l)	0.6	< 50
Zinc (mg/l)	<0.5	5.0
E. coli or Thermotolerant (MPN/100ml)	0	Must not be detectable in any 100 ml sample
Total Coliform Bacteria (MPN/100ml)	55.0	Must not be detectable in any 100 ml sample

** National Standards for Drinking Water Quality, 2010.*

It is concluded that almost all the measured parameters of the Drinking water including physical and chemical, are within the permissible limits. While the microbiological analysis results are exceeding the prescribed limits i.e. microbes must not be detectable in a 100 ml sample.

4.4.8 Ambient Air Quality

Air quality in the Project Area appears to be good based on observation during the field visit. Domestic sources of air pollution, such as emissions from wood and kerosene burning stoves as well as small diesel standby generators in some households, are well dissipated. No other industrial pollution sources are present in the vicinity.

The other major source of air pollution is dust arising from construction and other ground or soil disturbance. Near the access roads, when vehicles pass, dust levels will increase. The nearby road is metalled but dust levels are elevated when vehicles pass intermittently over the road.

The details of the meteorological parameters such as wind speed, wind direction, ambient temperature and ambient relative humidity is presented in **Annex- 4**.

To record the ambient air quality, instrumental air monitoring was carried out at five (05) different locations inside the Study Area (locations of selected points are shown in **Figure 4-6**. Monitoring was carried out for SO_2, NO_2, CO, CO_2, VOC and Particulate Matter (PM_{10} & $PM_{2.5}$).

The results, presented in **Table 4-17**, were compared with the NEQS for ambient air 2010 (i.e., effective from January 01, 2013), limiting values of the corresponding parameters. All parameters were found to be within the applicable NEQS limiting values. For international standards, air quality must be monitored for a minimum of one (01) year to be representative of all seasons. Although CO_2 was monitored during the baselines monitoring, there are no standards available for comparison as it is not a criteria pollutant.

Table 4-17: Summary of the Ambient Air Monitoring

Parameter	Unit	Duration (Hours)	LDL	AA-1 Hanzel Paine (Existing Gilgit Chitral Road)	AA-2 Hanzel Bala Village (Forebay and Power House Site)	AA-3 Harpoon Village (Weir Site)	AA-4 After Weir Site near Barbuch	AA-5 Hanzel Paine (Girls School)	NEQS (μg/m³)
NO_2	μg/m³	24	1.00	1.64	1.63	1.80	1.75	1.83	80 24Hrs
NO	μg/m³	24	1.00	0.39	0.39	0.45	0.44	0.48	40 24Hrs
SO_2	μg/m³	24	1.00	0.76	1.63	0.86	0.84	0.89	120 24Hrs
CO	μg/m³	8	0.01	0.34	0.35	0.35	1.53	0.35	05 08Hrs
CO_2	μg/m³	1	1.00	401.0	408.0	410.0	405.0	404.0	-
PM_{10}	μg/m³	24	1.00	37.57	37.40	38.47	38.06	38.49	150 24Hrs
$PM_{2.5}$	μg/m³	24	1.00	13.0	12.3	11.8	19.2	10.23	35 24Hrs
TSP	μg/m³	24	1.00	50.57	49.70	50.27	57.26	48.72	500 24Hrs
O3	μg/m³	1	1.00	3.62	0.15	4.05	3.87	4.08	130 μg/m3 01Hr
VOCs	μg/m³	1	0.01	0.19	3.59	0.24	0.20	0.18	-

LDL= Lowest Detection Limit
NEQS= National Environmental Quality Standards
μg/m³= Micrograms per Cubic Meter

4.4.9 Background Noise Levels

Major sources of noise observed in the Study Area/AOI are vehicular traffic and commercial activities. The background noise level monitoring was carried out at five (05) sites **(Figure 4-6**). The monitoring points were selected with reference to the location of receptors. The results of noise level surveys are shown in **Table 4-18** and compared with the NEQS for noise. The NEQS has defined four categories of areas for noise level (i.e., residential areas (a), commercial areas (b), industrial areas, (c) and silence zone (d), with limiting values of 55 dB, 65 dB, 75 dB and 50 dB, respectively).

Table 4-18: Baseline Noise Levels Monitoring Results

Averaging Time	NEQS dB (A)	Average Value in dB (A)				
		NL-1 Hanzel Paine (Existing Gilgit Chitral Road)	NL-2 Hanzel Bala Village (Forebay and Power House Site)	NL-3 Harpoon Village (Weir Site)	NL-4 After Weir Site near Barbuch	NL-5 Hanzel Paine (Girls School)
Day-time (0600 to 2200) 16 h	65	48.35	54.61	49.93	54.06	51.88
Night-time (2200 to 0600) 8 h	55	44.41	47.34	47.58	50.91	42.63

As the area is not surrounded by any industries but there are several hotels and shops so the Noise levels measured during the monitoring are compared with Category C i.e. Noise Levels for Commercial Areas as specified under NEQS for Noise, therefore, 65 dB (A) during day time and 55 dB (A) during night time was used as a reference standard.

The above results show that the average noise values at these points are well within the applicable limits.

4.4.10 Solid Waste and Sewerage System

Solid waste was found to be stored in the forms of heaps at Hanzel Road side. However, GB Waste Management Company is operational for the proper management of solid waste in GB.

In the Study Area, no conventional solid waste management system exists. Most of the solid waste is found to be stored in the form of heaps at various locations near the villages and open burning of waste is a common practice. The organic and livestock waste is collected in the designated area which is used to prepare compost utilized by farmers in their agriculture fields as a fertilizer. The major constituents of solid waste in the area are paper, plastic, and organic waste (food waste, garden waste, animal waste). The areas lack proper sewerage system with only some open drains constructed in the vicinity for the discharge of wastewater. In general, villages are discharging its sewage through small open drains. These drains discharged the sewage into the low level areas available in each village.

4.5 ECOLOGICAL ENVIRONMENT

Ecological study of the AOI has been carried out during the site visits, standard ecological assessment technique based on primary and secondary information, discussion with Government departments and meeting with groups of communities/public living in and around the Project area coupled with expert visual observations was used for the assessment. Following is the description of the baseline ecological environment of the area.

4.5.1 Flora

Hanzel is located in a river valley at 11 km (11,000 m) distance from Gilgit city. The climate is arid, as monsoon systems break against the southern slopes of Himalayas, about 150 km (150,000 m) south of Gilgit, and the average annual rainfall ranges from 120 to 240 millimeters (4.7 to 9.4 inches). Agriculture depends on water that is diverted from mountain streams and rivers fed by snow melt at higher altitudes. The biodiversity of Gilgit and its surroundings is adapted to these extreme variations in climatic and geographical conditions.[7]

The vegetation of the Study Area falls in the Dry Sub-Tropical Shrub Zone and Dry Temperate Coniferous Forest Zone. The former is located at lower elevations and southern slopes of mountains especially along the Gilgit and Hunza Rivers. The latter consists of forests found in the inner or northern slopes of the Himalayas and are less susceptible to monsoons. The dry temperate coniferous forests occur between elevations of 1,500 to 3,400 meters. These forests are characterized by fewer deciduous tree species, although coniferous species predominate.

Forests occur in the valleys, including the Naltar and Bagrot Valleys and also in the vicinity of the Jutial Nullah. Typical tree species in these forests include *Picea smithiana, Cedrus deodara* and *Pinus willichiana*. Smaller shrubs include *Acacia nilotica Quercus ilex* and *Juglans regia* and scattered shrubs of *Artimesia maritima, Indigofera gerardiana*, *Sambucus ebulus, Salix tetrasperma Sorbaria tomentosa, Morrusalba* and *Plectranthus rugosus*. These forests not only provide habitat for faunal species but also provide timber to the locals used for domestic and commercial purposes.

The indigenous species are xerophytic in nature including mainly willow Ilenthus and poplar, whereas eucalyptus, frash ber, etc. are found in Study Area. The details of vegetative species found in the Study Area are given in **Table 4-19**.

Table 4-19: Names of Trees in the Study Area

Sr. No.	Common Name	Scientific Name
1	Bhaid (Willow)	*Salix tetrasperma*
2	Thoth(Mulberry)	*Morrus alba*
3	Ilenthus	*Ilenthus spp*
4	Khail	*Pinus roxburghii*
5	Poplar	*Populus alba*
6	Kikar	*Acacia nilotica*
7	Palosa/Phulahi	*Acacia modesta*
8	Walnut	*Juglans regia*
9	Frash	*Tamarix aphylla*
10	Eucalyptus	*Eucalyptus camaldulensis*
11	Ber	*Zizyphus moritiana*

A total of 2,240 trees with major species of Willow, Mulberry, Ilenthus and Poplar etc. of various sizes with girth ranging from 10’’ to 15’ and above are present in Project Area in linear non-linear pattern, mainly on the north eastern side of the area. Among grasses Khabbal *(Cynodon dactylon)*, Dhaman *(Ptyas mucosa)* and Khawi *(Cymbopogan jawarancusa)*.[8] The direct and indirect assessment, in cutting of total 2,240 trees and plant approximately 1,040 trees and plants will be affected at headrace channel, 1,200 from penstock and power house area and at the time of study, September 2017 no tress were at weir & forebay.

Table 4-20: Number of Trees in Project Components

Tress Cutting Area/ Zone	Number of Tress.
Headrace Channel	1,200
Penstock and Power House	1,040

[7] Ahmed. I. and Iftikhar. M. May. 2014. Revised Working Plan for Government Managed Private Coniferous Forest of Chilas, Darel & Tangir Sub-Divisions. Diamer. District, Gilgit-Baltistan. Forest Department.
[8] *Sheikh, M. I. 1993. Trees of Pakistan. Pakistan Forest Institute Peshawar*

4.5.2 Fauna

a) Wildlife Mammals

Mammals of the Study Area and GB include members from the family of *Vespertilionidae*, *Canidae, Felidae, Sciuridae, Muridae* and *Mustelidae*. Large mammals, like the Snow Leopard (*Panther auncia*) Common Leopard (*Panthera pardus*) Wolf (*Canis lupus*) and Red Fox (*Vulpes*)[9] have been reported in the hills. In addition, small mammals, such as bats and rodents, have been reported inside the Study Area. The list of mammals is indicated in **Table 4-21**.

Table 4-21: Names of Mammals in the Study Area

Sr. No.	Mammals	IUCN Red List Status
1	Astore Markhor (*Capra falconeri falconeri*)	Near-threatened
2	Himalayan Ibex (*Capra sibirica*)	Least Concern
3	Snow Leapord (Panthera uncial)	Vulnerable
4	Jackal (*Canis* sp.)	Least Concern
5	Fox (*Cannisvulpes*)	Least Concern
6	Rabbit (*Rodentia* sp.)	Least Concern
7	Pig *(Artiodactyla* sp.)	Least Concern

b) The Astore Markhor

The Astor markhor or flare-horned markhor (*Capra falconeri falconeri*) is a sub-species of the endangered markhor in GB and Kargah game sanctuary. To the West it reaches the Eastern most parts of Afghanistan. The range of the Astor markhor is very scattered. At one time considered an "endangered species", conservation efforts have had some success and the largest subpopulation in Pakistan may now exceed 1,000 individuals. As a result, the International Union for Conservation of Nature has rated its status as "near-threatened".

The Astor markhor lives in the scrubland of the surroundings in ‘Kargah Game Sanctuary’ and open woodland that clothe the rugged slopes of the mountains among which it lives at altitudes of up to 3,600 m (11,800 ft). It seldom goes above the tree line; in summer it feeds largely on grasses and leaves but in winter it mainly browses on shrubs and woody material. One or two kids are born after a gestation period of 135 to 170 days and the kids may fall prey to golden eagles.

c) Himalayan Ibex

The Himalayan Ibex is found in surrounding areas of Hanzel especially in ‘Kargah Game Sanctuary’ ibex is symbol of arid and rocky mountain of Karakoram, Hindukush and Himalayas of GB. The males have heavy body, large horns, long Hears while females have small body small horns. Its presence in its natural habitat is essential to maintain healthy ecosystem. Himalayan ibex are found at about 3,660 m to over 5,000 m height in Pakistan, in summer but these can be seen at below 2,135 m during snow fall in winter. The Himalayan ibex is widespread in the higher mountain ranges of Karakoram, Hindukush and Himalayan mountain ranges, of GB. The Trophy hunting programme of same specie began in the 1980s. It is carried out under the Convention on International Trade of Endangered Species of Wildlife and is allowed only in notified areas of GB.

---

[9] Mir, A. 2006. Impact Assessment of Community Based Trophy Hunting in MACP areas of NWFP and Northern Areas. Mountain Area Conservancy Project.

The threats that Himalayan ibex of the area face are the illegal hunting, human disturbance, habitat loss and competition for forage with domestic livestock. However, the ibex has a wider distribution and is plentiful and its future survival is not so threatened in GB largely due to the inaccessibility of its habitat, due to extensive concentration of high mountain ranges in the extreme north western regions.

d) Reptiles, Insects, Amphibians

Reptile species found in and around the city are dominated by the family Agamidae. Species reported include Himalayan Agama Laudakia himalayensis, Pakistan Agama *Laudakia Pakistanica* and Blue Rock Agama *Laudakia tuberculata*. Geckos are represented by Baltistan *Gecko Altiphylax stoliczkai* and Batura Bent-toed *Gecko Cyrtodactylus baturensis*. The Bengal Monitor *Varanus bengalensis* has also been reported from the area. Most of these species have not been assessed for their conservation importance in the IUCN Red List. Among the amphibians, toads from the family Bufonidae are present including Batura toad Bufotes *pseudo Raddei* and Ladakh toad Bufolastastii.

e) Birds – Avifauna

Many bird species have been reported in and around the Study Area. These include passage migrants, vagrant, resident, breeding and irregular visitors. The migratory birds descend from higher altitudes during the winter months. Typical bird species found here include Snow Partridge Lerwa, Chakor Alectoris Chukar, Common Quail Coturnix, Common Hoopoe Upupa epops, Common Swift Apus, Rock Pigeon Columba Livia and Common Kestrel Falco tinnunculus. No endangered or critically endangered bird has been reported from the area. The common birds observed and reported in the Study Area are given in **Table 4-22**.

Table 4-22: Birds Found in Study Area

Sr. No.	Common Name	Scientific Name	IUCN Status
1	Chakor	*Perdix perdix*	Threatened
2	Ring Dove	*Zenaida* sp.	Vulnerable
3	Rock Pigeon	*Columba livia*	Threatened
4	Myna	*Acrido therestritis*	Least concern
5	Crow	*Corvous corone*	Threatened
6	Paddy bird/ Pond Heron	*Ardeola grayii*	Threatened
7	Common Snipe	*Gallinago gallinago*	Threatened
8	Grey Patridge	*Perdix perdix*	Threatened
9	Quail	*Coturnix coturnix*	Threatened
10	Hoopoe	*Upupa epops*	Threatened
11	Koel	*Eudynamys scolopacea*	Threatened
12	Common Bulbul	*Pycnonotus barbatus*	Threatened
13	House Sparrow	*Passer domesticus*	Least concern

f) Fisheries

About 20 species of fish have been recorded from the GB areas mainly dominated by the snow trouts and the loaches. The trout species are mainly confined to the upper reaches of the rivers where suitable trout habitats are available. The high altitude fauna is mainly concentrated in the upper reaches of the Hunza, Indus and in the Deosai Plateau. The fishes found in lower side altitude are mainly found in the river Indus and its tributaries in the Diamer district. The area has greater potential for trout fish and many trout hatcheries have been established in different areas but still a lot needs to be done.

The role of fish in supporting the livelihood of rural communities in GB has not been well documented. However, fish constitute a source of food protein and vitamin A for many mountain communities. Most of the fish caught by local people is consumed within households, but it is also sometimes offered for sale.

In Study Area, the trout species are socioeconomically important since they not only provide food for the local communities but are also used for commercial fishing and attract tourists for recreational fishing.

Gilgit River is one of the most productive rivers in the area. It has less turbidity as compared to other major rivers of the area and hence has the biggest fish diversity of the indigenous fish fauna, the most common being *the Salmo trutta fario, Racoma labiata, Schizothorax plagiostomus, Triplophysa microps, Triplophysa tenui cauda, Triplophysa trewavasae, Triplophysaya sinensis, Glyptosternum reticulatum.*

g) Indigenous Fish Fauna found in Gilgit Baltistan

The GB region of Pakistan is blessed with great water resources comprised of rivers, streams, and alpine lakes fed by the snowmelt and glacier waters. These freshwater resources harbor several fish species, which are the important component of biodiversity of area. The fish fauna in GB is relatively poor due to high turbidity, low water temperature, high water speed, low benthic productivity, and long stretches of narrow gorges of rivers. The fish species in GB are predominantly Palearctic having elements of Central Asian Highlands with some mix of Oriental Region. The studies reveal that there are about 19 species of native fishes found in the GB areas. All the fish fauna belong to four families. Four species of fish recorded from GB area are exotic and out of the native species, 4 are endemic to GB areas while several others have restricted range confined to one or two localities. For example, species *Triplophy sastoliczkai*, *Ptychobarbusconirostis* and *Schizopygopsis stoliczkai* are only found in eastern water heads up to Kachura close to Skardu Town. Fish fauna of Gilgit River is shown in **Table 4-23**.

Table 4-23: Fish Fauna of Gilgit River

Sr. No.	Scientific Name	Common Name	IUCN status
1	*Oncorhynchus mykiss*	Rainbow trout	Threatened
2	*Salmo trutta*	Brown trout	Critically Endangered
3	*Racoma labiata*	Kunar snow trout	Not Evaluated
4	*Carassius auratus*	Goldfish	Least Concern
5	*Cyprinus carpio*	Common carp	Threatened

4.5.3 Ecological Sensitive Area

GB holds several protected areas, which plays very important role in ecological balances including our Study Area, which needs effective management systems. Wildlife sanctuaries provide greater protection than do national parks under the existing laws. Game reserves only regulate hunting and afford no protection to the habitat. However, the GB Forest & Wildlife Department publications & steps towards ecological/environmental peace will now clearly delineate the boundaries of these protected areas which lead towards ecological balances; hence the protected areas have vague boundaries. The responsibility of protected areas and their management lies with the Forest, Wildlife and Environment Department of GB. NGOs working on conserving the ecological resources and community-uplift schemes include the World Wide Fund for Nature (WWF), the International Union for Conservation of Nature (IUCN), the Snow Leopard Foundation and the Wildlife Conservation Society (WCS).

The Kargah Area has been declared as the community controlled hunting area, which is more than 5 km away from the Project Area (Notification attached as **Annex-5** under conservancy name “Kargah Gilgit” in May, 2013 under GB Wildlife Preservation Act, 1975).

4.5.4 Agriculture

The Project Area consists of fertile agricultural land of good productivity. The major sources of irrigation to the crops are springs & Gilgit River. Main crops grown in the area consist of Wheat, and Maize while vegetable crops include Potatoes, Onion, Capsicum, Tomato, Peas and Wheat crop is grown approximately over 85% of the total Project Area whereas vegetables were present over rest of the area. Raising of orchards are not common in the area, as vegetable crops are grown for use by the domesticated livestock. Yield and Income of various crops grown in the Study Area are given in **Table 4-24**.

Table 4-24: Average Yield and Income of Various Crops

Sr. No.	Crop	Average Yield/Acre	Average Income/Acre
1	Wheat	1,500-2,000 kg	Rs.35,000/- to 40,000/-
2	Maize	3,000-3,500 kg	Rs.40,000/- to 45,000/-
3	Vegetables	---	Rs.100,000/- to 125,000/-

4.5.5 Livestock

Livestock raring is common in the Study Area and is an important source of income for the rural population. Cattle, Goats and sheep are seen, freely grazing in open areas or in fallow agricultural fields. Almost all the households, who have their link with agriculture, are keeping Livestock. Field data shows that, household keeps livestock in large herds, depending upon the household landholding size and capacity to store the crop residues, fodder and had to feed animals during the winter. The trend of livestock keeping in the area is decreasing due to different environmental Impacts, climatic changes, in sudden shifts of social life standards of the masses. The reduction in grazing areas with the passage of time is also a major threat to the future of livestock raring in the Study Area.

4.6 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

4.6.1 Socio-Economic Aspects

The socioeconomic baseline covers the demography, administrative and political settings, religious and cultural, economic aspects, infrastructure and facilities, security situation, gender, and NGOs. The basic objective of the socio-economic survey was to identify the living standard and socio-economic characteristics of the people of the Project Area and to assess the possible impacts of the proposed project on the population. The settlements, in which socioeconomic survey was conducted as per methodology described in below;

4.6.2 Methodology Adopted for Data Collection

During the socio-economic survey 62 household were selected as a sample size. Estimated population of the Study Area villages is taken through village profile survey of the Project Area.

The sample size was calculated based on the Standard Statistical Formula (SSF) with using a confidence level of 95% and confidence interval 10%. These households were selected by using systematic random sampling technique, which is a type of probability sampling. Questionnaires were developed to collect the baseline data, based on the demographic and socio-economic indicators. Interviewing technique was used as a tool for data collection. In order to quantify the existing baseline conditions of the Study Area, collected data was digitized and analyzed by using Statistical Package for Social Sciences (SPSS) software.

During the socio-economic survey, people were informed about the project objective, size of its physical components like weir, spillway, headrace channel, forebay, penstock, powerhouse and infrastructure. In particular, apprehensions of the locals regarding the proposed project were discussed. Extensive question and answer sessions were held to clarify the project related works and activities in detail. Comprehensive consultations including scoping sessions and Focus Group Discussions (FGDs) were also held in the above mentioned localities to know the apprehension and suggestions about the proposed Project.

4.7 SETTLEMENTS OF THE STUDY AREA/AOI

Study Area included the following major settlements:

- Hanzel Bala;
- Hanzel Paine; and
- Harpoon.

4.8 ADMINISTRATIVE SETUP

GB administrative set-up largely mimics the set-up existing in rest of Pakistan with a provincial administration headed by Chief Secretary and assisted by a provincial secretariat encompassing core and line departments. However, being a newly established province, the Secretariat and departments are in process of development and evolution. The Secretariat now consists of 17 Departments, each headed by a Secretary. As a norm, the Secretaries for key posts like P&D, Finance, Home Department etc. are from Federal Services and often from outside the region.

There are ten (10) districts in Gilgit–Baltistan, four in Baltistan division and six in Gilgit division (including Diamer region). The number rose from 7 to 10 after addition of 2 districts in Baltistan and separation of Hunza-Nagar district. Each district is further divided into tehsils and union councils. The seven districts are headed by Deputy Commissioners with most line departments present and headed by Deputy Directors. The area has two clear regional divisions i.e. Gilgit Region and Baltistan region and most departments have Directors for each region who oversee Deputy Directors at the District and Assistant Directors at Sub-District levels.[10]

The local government system is based on a Legislative Council (Provincial Assembly), elected by people in all six districts through voting, headed by a speaker, technocrats and women members are later elected/selected through a proper system.

Chief Secretary is administrative head of all departments, controlling all the affairs on behalf of Chief Minister, Government of Pakistan.

Inspector General of Police, heads the police department, with deputy superintendents in all six districts. Based on the social survey below is the socio-economic baseline information of the project area.

4.8.1 Demography

a) Population and Family Size

Based on the District Census Report, 2017 Gilgit has population of 922,745[11]. The household surveys as per methodology, indicated that household size is 9 persons. Based on the social survey the gender wise distribution of the 62 respondents families are given in **Table 4-25.**

[10] https://en.wikipedia.org/wiki/Gilgit-Baltistan#Government

[11] https://en.wikipedia.org/wiki/2017_Census_of_Pakistan

Table 4-25: Gender and Age of the Population in the AOI

Sr. No.	Age Group (Years)	Male		Female		Total	
		No.	Percentage	No.	Percentage	No.	Percentage
1	0-4	27	9.2	21	7.7	48	8.5
2	5-9	37	12.6	22	8.1	59	10.4
3	10-19	55	18.8	71	26.1	126	22.3
4	20-39	79	27.0	75	27.6	154	27.3
5	40-49	71	24.2	53	19.5	124	21.9
6	50-59	17	5.8	17	6.3	34	6.0
7	60 and above	7	2.4	13	4.8	20	3.5
Total		**293**	**100**	**272**	**100**	**565**	**100**

Based on the social survey carried out in September, 2017

Based on the social survey, the maximum population falls in the age group between 20 and 39 years and it is this group that are responsible for most daily life routine activities.

The sex ratio is an important demographic indicator, which is defined as the "number of males per hundred females". As per social survey, sex ratio based on the household was 109 males per 100 females. The sex ratio depends on the factors such as the sex ratio at birth, differential mortality rates between the sexes at different ages, and losses and gains through migration. Like other areas of Pakistan in the GB, sons are preferred because (i) they have a higher wage-earning capacity, (ii) they continue the family line; and (iii) they are generally recipients of inheritance.

b) Marriage and Marital Status

Endogamy is the prevalent style of marriage. Most of the people are monogamous as second marriage is expensive. Mothers have very little role in decision-making about marriages of their sons and daughters. Neither the groom nor the bride is allowed to choose his or her life partner. The traditional arranged marriage has long been an integral part of the local culture. As against love marriage, it is the concept in which the parents and family members search for the prospective bride or groom, through their acquaintances or relatives. The decision of the parents is considered final; however, sometimes the bridegroom is consulted before the final decision. As per social survey, the majority of respondents (i.e. 90.33%) are married and only 3.23% are separated from their wives while 6.44% are unmarried as shown in **Figure 4-7**.

(This Space is Intentionally Left Blank)

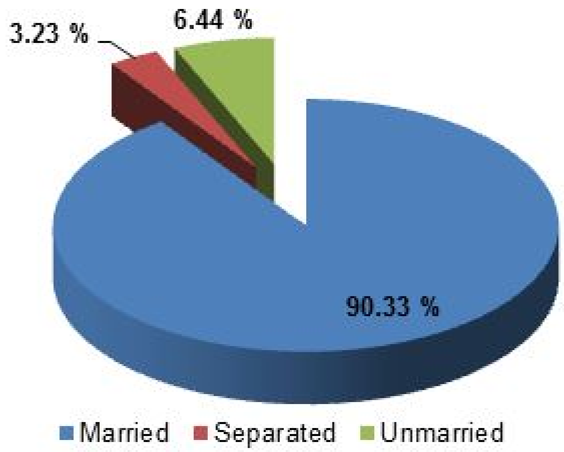


Figure 4-7: Marital Status of the Respondents in the AOI

c) Literacy

According to the census of 1998, the educational indicators for GB are below national average with a literacy rate of 37.85% (Male 52.62% Female 21%). It is distressing that preference of schooling for male children is still a pervasive phenomenon.

Educational level of the respondents is shown in **Figure 4-8**. The majority (i.e. 25.8%) are illiterate while 21% have primary education. The percentage of intermediates, graduates and post graduates is very low compared to those who have done middle and matric.

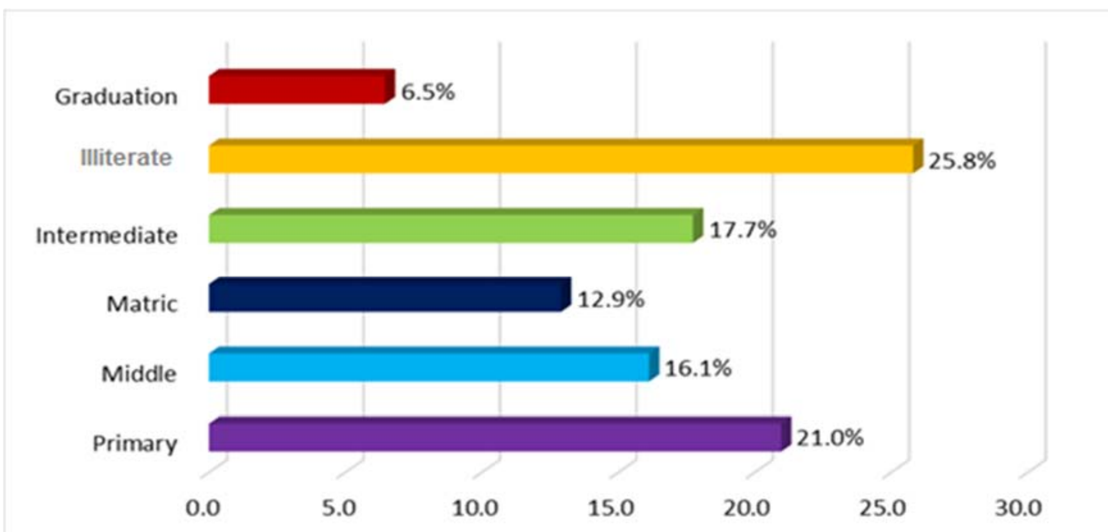


Figure 4-8: Educational Level of the Respondents in the AOI

As mentioned above local give least priority to the female education. Based on the field survey and discussion with the locals, it is noted that female literacy rate is lower compared to males. Locals give least importance to female education. Few reasons of low literacy rate among women are discussed below:

- The major cause of women illiteracy is increase in population, which is playing a negative role in this deprivation of female education. A family having more children and less income will prefer to educate the boys of the family, while the girls will be given embroidery or sewing skills;

- There is also misconception that females have to manage home after marriage whereas males have to earn for livelihood, so education matters only for males and not for females;
- Some families do not like their daughters to study in co-education institutes thus depriving them of higher education;
- The social setup is male dominated and girls restricted to homes and cannot go out freely thus any male of the family has to take responsibility for grocery purchasing etc. This sometimes seems difficult to them. There is also a sharp division between female oriented work and male oriented work. Females are not allowed to work in all sectors therefore their education is not considered valuable; and
- The number of schools for females are few in the area such as girls of the Harpoon village do not come to middle school Hanzel due to long distance. Girls have to travel a long distance to reach the schools or colleges. For this reason most parents prefer to give them religious education.

d) Languages

Shina is the basic language spoken in the AOI while other key languages spoken in the Gilgit area are Brushaski, Wakhi and Khowar. Urdu and English are the official languages spoken. While other languages include Pushto and Punjabi are spoken and understand.

e) Housing

Housing characteristics is one of the major indicators for the assessment of the living standard of the population. Most of the houses are owned by one influential resident of house who is male. However, some joint ownership also exists. Majority of the houses have ordinary construction, with moderate standard buildings made of cement and bricks.

Approximately 56.5% houses are pacca (made from brick, stone, and mortar) and 43.5% are semi-pacca (made of clay, inferior bricks and plastered with mortar). Types of housing structures in the area are given in **Figure 4-9**.

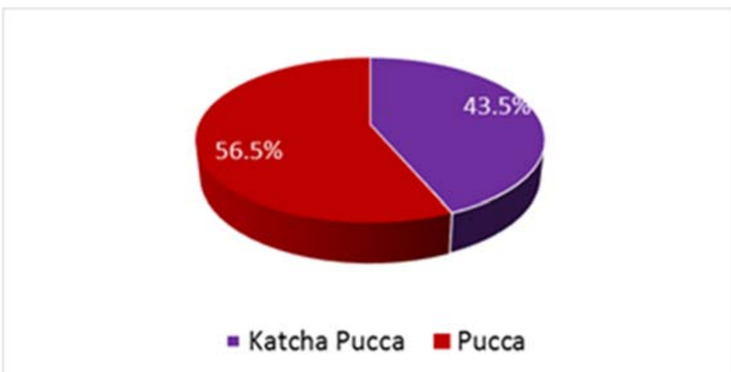


Figure 4-9: Housing Conditions in AOI

The majority of the respondents have 1-2 rooms in their houses; few of them are having 3 or more rooms. The type of the toilet used by the household indicates living conditions and is strongly related to the health and hygiene of the household members. Most of the people (98%) have flush type of latrine while only 2% is using open types such as fields or barren land.

4.9 ECONOMIC ASPECTS

a) Occupations

Types of occupation of the respondents in the AOI are shown in **Figure 4-10**. Working as a labour is the main source of income in the whole AOI (i.e. 33.9%), followed by labour, private jobs, shopkeepers and government job sector. Several respondents have multiple occupations; therefore, the question was multiple response questions. Hence, the percentage in the graph below is not showing a total of 100%.

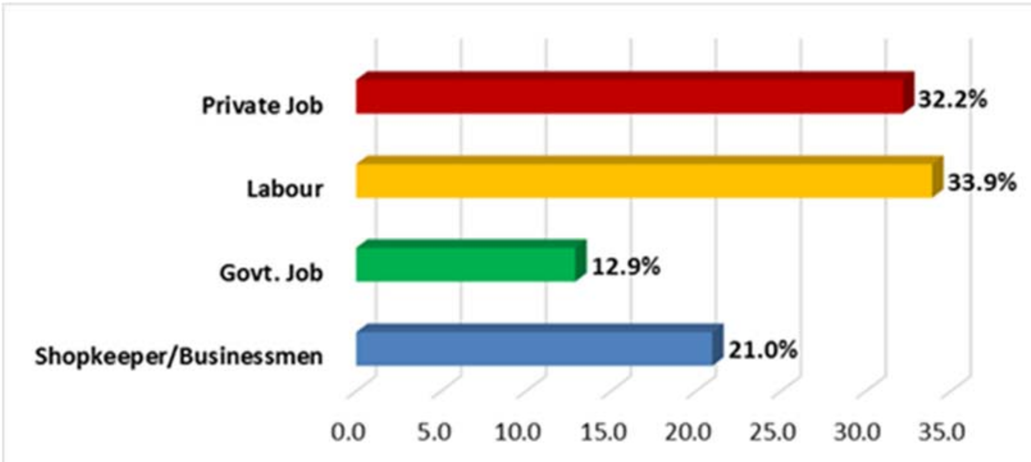


Figure 4-10: Occupations/Employment in the AOI

b) Income Levels

Income is an indicator for assessing the livelihood/well-being of the household. The highest percentage income group 29% has monthly income of Rs. 20,001-25,000, followed by group (16.1%) having an income of Rs. upto 15,001 to 20,000. Only 6.5% people earn Rs. 6,001 to 12,000 per month as shown in **Figure 4-11**.

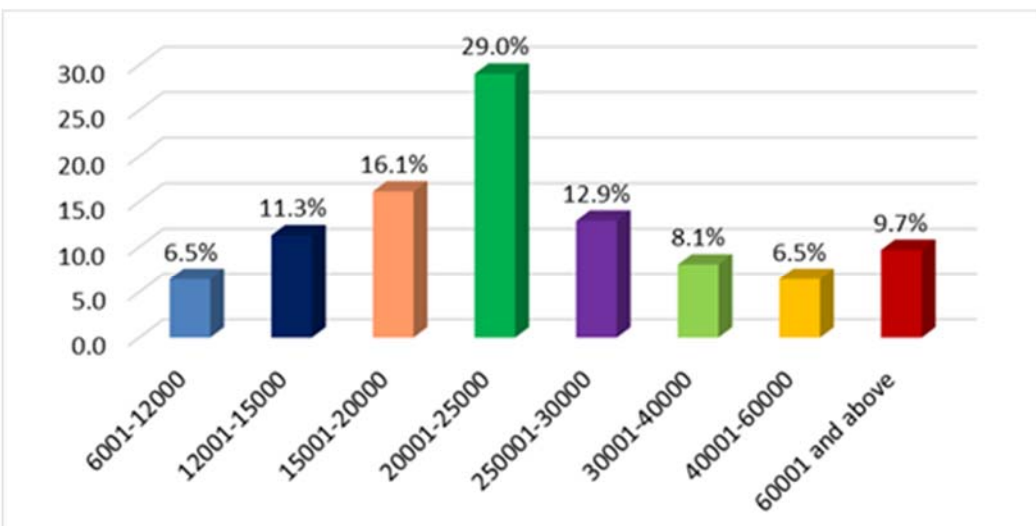


Figure 4-11: Average Monthly Income Pak Rupees in the AOI

During the field surveys, it was observed that in case of farming households, the major sources of income were from crops and livestock (dairy products). For non-farm or landless households, the main sources of income are activities, such as business, shopkeeper, government employment, private employment, and labouring. However, due to nearby city area and less availability of agriculture land only few houses are fully dependent on farming. based on the socio-economic baseline survey it was observed that mostly people have good income in the Project Area. They are economically well off, because they have jobs, grocery shops, restaurants on main Ghizer road and this road also main tourist road for Ghizer to Chitral.

c) Expenditure

Figure 4-12 shows average monthly expenditure for different income groups. The highest percentage of expenditure is 25.8% that is the group which spend Rs. 15,001 to 20,000. While only few respondents whose expenditures are more than their income, manage their livelihood on the basis of weekly income. They are mostly labourer who takes loan for grocery from the shopkeeper.

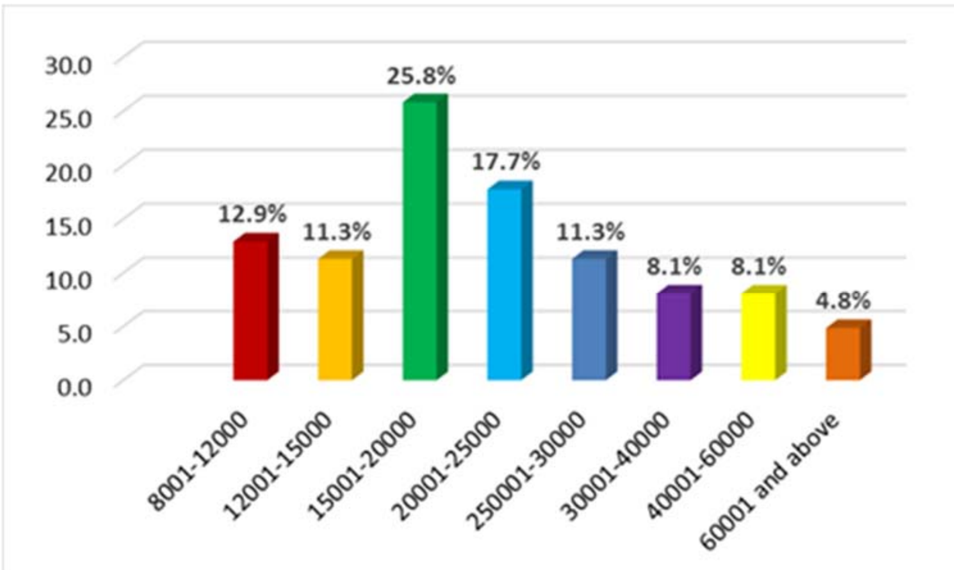


Figure 4-12: Average Monthly Expenditure in the AOI

The annual expenditure and pattern of the expenditure provides an indication for assessing the standard of living of a household. The expenditure on food items includes cereals, pulses, flour, sugar, cooking oil/ ghee, and milk while the expenditure on non-food items are education, medical treatment, clothes, shoes, and toiletries.

d) Money Borrowed

Table 4-26, shows that significant majority i.e. 93.5% of respondents did not borrow money during the fiscal year 2016-2017. While only 6.5% money was borrowed during that time.

Table 4-26: Amount Borrowed in the AOI

Sr. No.	Last Year Borrow Money	Number	Percentage
1	No	58	93.5
2	Yes	4	6.5
	Total	**62**	**100.0**

Generally, the credit is obtained to supplement the income to meet the routine and some extra expenditure of the household including investment, social needs and other unforeseen situations such as illness (medical care), marriage, education, and livestock. Credit is also obtained for agricultural needs (such as equipment, seeds and fertilizers) from both the formal (banks) and informal sources (e.g., friends, relatives, and landowners).

e) Amount Borrowed

Based on social survey, out of 63 respondents only 04 respondents take loan for different purposes. Results shows that 2 respondents borrowed amounts from Rs. 20,000 to 40,000 while remaining 2 respondents borrowed Rs. 10,000 to 20,000.

f) Purpose of Money Borrowed

The money borrowed by the residents was mainly used for marriage, health, business, and children education as illustrated. All the respondent's borrowed money from their relatives and so do not have to pay any interest.

g) Agriculture Practice

In the wake of rough terrain and harsh climatic agriculture activities are practiced on limited scale. Only maize and wheat is grown which is not enough to meet even the in-house needs. At small scale vegetables also grown but only domestic use and not for commercial. The average landholding size is about 2-3 kanal per family of all the three villages.

The land in the Project Area is owned by individuals of the Hanzel Bala. Individual land under cultivation is also used for fodder collection and grazing livestock whereas communal land is used for grazing, collecting fodder, supplying of fuel wood, peat, etc.

The optimum cropping pattern refers to the allocation of the cropped area under different crops during the year in order to attain maximum output within the existing resources. As per social survey, most of the respondents have agriculture land but due to limited level it is not fulfilling the requirement of the family therefore, agriculture land is considered additional source of income. The chief source of irrigation in Hanzel Bala and Hanzel Paine is spring water.

4.10 RELIGIOUS, ARCHAEOLOGICAL AND CULTURAL ASPECTS

a) Religion

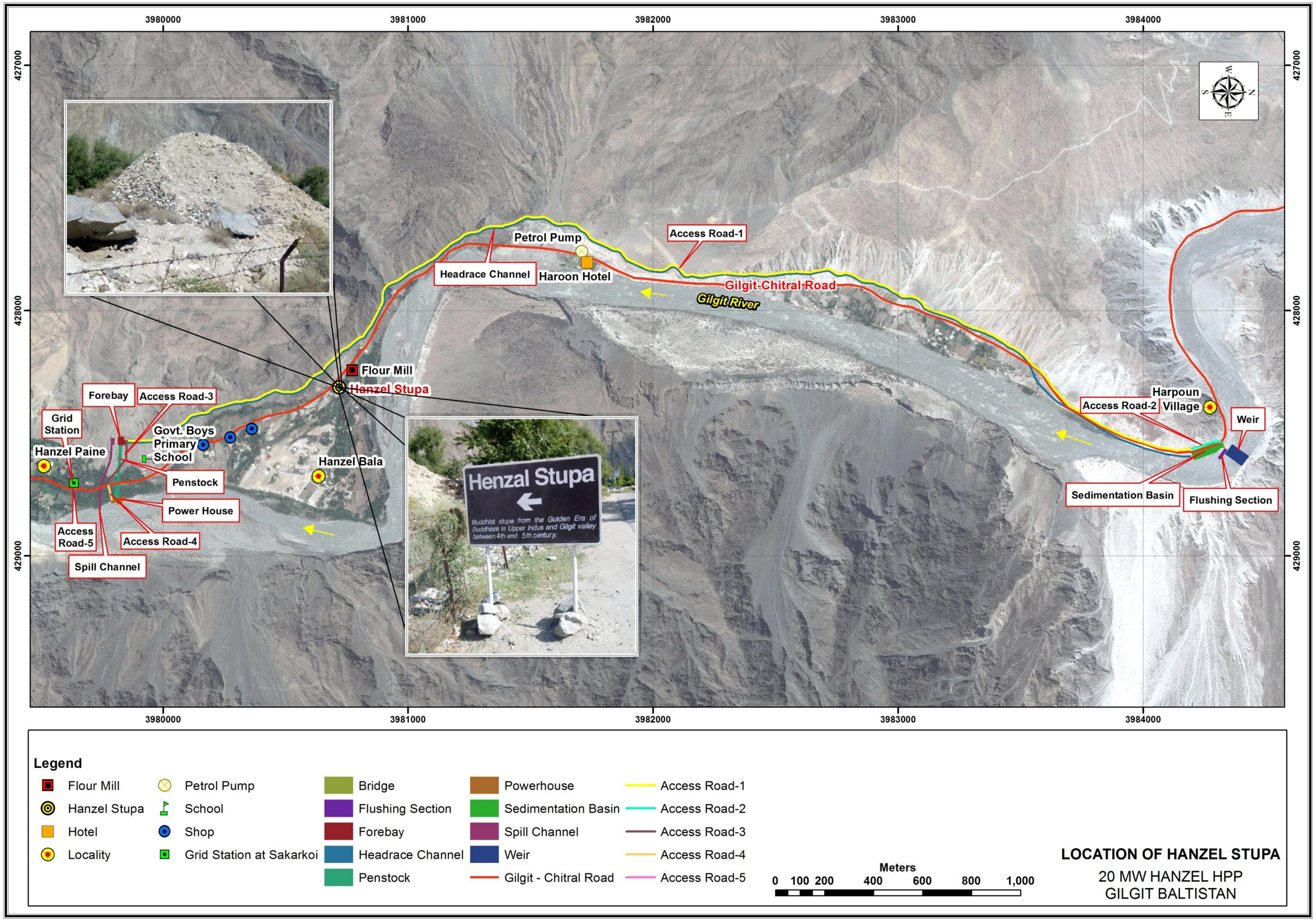
Majority of the inhabitants are Muslims belonging to different communities i.e. Sunnies, Shias and Ismailies. However, as per social survey in the three villages of the AOI more than 95% are Sunni while remaining 10% belong to Ismaili and Shia sect.

b) Archeology

In the Project Area one archeology site Hanzel Stupa exist. There is no direct impact foreseen on these archeological features, however, during construction and operation stage special measure for its safety may be required. The Notification showing this Stupa is protected is presented in **Annex-6**. The location of the Hanzel Stupa is shown in **Figure 4-13**.

(This Space is Intentionally Left Blank)

Figure 4-13: Location of Hanzel Stupa



c) Family System

Joint family system is the dominant culture in the AOI. Out of 62 households, 3 respondents have two wives. It was observed that the family structure in the area was very strong and members played a pivot role in solving their social and cultural problems.

Most of the families are living in joint family system comprising grandparents, uncles, aunties and lot of cousins, whereas only a small percentage of families are living as a single family (nuclear family system). Although the joint family system is generally undergoing a radical change, with a greater influence of media and education, people of the AOI do not feel good about this change. Because while living in a joint family system a lot of emotional attachments are enhanced and they feel that by separating in nuclear family system, their relationships will be damaged and family ties will be weakened.

As per the locals, joint family system is basically a form of organization. In this organization there are defined norms and values to be followed strictly by all the members. All the members have their defined tasks and responsibilities to perform. There is equal share of each and every member of the family in the available resources in the form of money, food and other requirements and locals feels better in joint family system as compare to nuclear family.

During the discussion with the locals, it was clarified that large family size is also treated as the strength of the family.

It is the duty of woman to take care of her home. As such, from her very childhood, a girl child is taught cooking, cleaning and dish washing by her mother and other ladies in her family. She is also taught to attend to guests and strangers politely and elegantly because it is thought to greatly reflect upon her upbringing.

One common trait you will find is that children show utmost respect to their elders. It is deemed disrespectful in GB to refer to an elder by his / her name. Instead people prefer calling them uncle and aunt, especially if the person is very elderly.

d) Festivities

There are mainly two types of festivals i.e. religious and cultural. Religious festivals include: Eid-e-Ghadir, Edi-ul Fitr and Eid Miladunnabi (the birth anniversary of Prophet Muhammad-Peace be upon Him). There are some other important events specific to different communities of interpretation which are celebrated with complete peace and fraternity.

e) Decision-making Methods and Conflict Resolutions System

The methods for decision-making about social conflicts in the AOI are “Panchayat” (an assembly of wise and respected elders), court, “Jirga” (traditional assembly of leaders that make decisions by consensus), caste groups and others (method constituted on the spot considering major issues and scope of the conflicts).

People prefer “Panchayat” in the AOI compared to court or other legal system because this method is more effective. “Panchayat” provide timely justice while other methods are complex and require time as well as money.

The people have a tradition to help each other in the hour of need. Common conflicts arise from time to time which are solved by the community at the local level. Generally, in case of a conflict between two individuals, only the families or closest friends take sides of the conflicting rivals so there are rare chances that personal conflict will transform into an ethnic dispute.

4.11 INFRASTRUCTURE FACILITIES

a) Educational Facilities

Social survey depicts the educational facilities in the AOI. An education facility in any village predicts the highest level of education that can be achieved. In all the three villages of the AOI only one primary school for boys and one middle school for girls exist in Hanzel Bala. While for higher studies children have to go Gilgit city which is about 11km (11,000 m) from the Project Area. However, in Gilgit city have all level of educational facilities such as women college, boy's college, Karakoram University and also exist several private educational institutions.

b) Health Facilities

Health facilities are inadequate in the AOI. Only one dispensary is working which is not adequate to meet the requirement of the locals. Therefore, they have to go Gilgit city for the treatment. Bad sanitary conditions, insufficient medical facilities and meager parental care, all contribute to the prevalence of ill health and high rate of mortality in the area. District headquarter hospital Gilgit is the major hospital in the area and the inhabitants go to this hospital for medical treatment.

c) Major Diseases in the Project Area

Health department has adopted regular reporting mechanism to collect information on diseases and other variables. According to information captured from the consolidated reports, maximum patients visit the health facilities complaining of acute respiratory infections, patients suffering with fever from different causes, Hypertension, diarrhea and dysentery has been reported to visit the public health facilities. Urinary Tract Infections, Pneumonia and Asthma are also reported.

d) Civic Facilities

Wastewater is disposed off in the open spaces just outside the houses. There is no proper sewerage system exist of all the three villages. No street lights and play grounds exist in the AOI. However, public water supply is available in the Hanzel Bala and Hanzel Paine while locals of the harpoon village are forced to drink Gilgit River water, therefore, they are suffering different water borne disease especially they are facing kidneys issues. There is no bank and post office. Other civic facilities available in the villages are given in **Table 4-27**.

Table 4-27: Civic Facilities Available in the AOI

Sr. No.	Village	Drainage System	Street Lights	Grocery Shops	Play Grounds	Medical Stores	Gas	Electricity	Telephone Line	Water Supply
1	Hanzel Bala	X	X	✓	X	X	X	✓	✓	Public
2	Hanzel Paine	X	X	✓	X	X	X	✓	X	Public
3	Harpoon	X	X	✓	X	X	X	✓	X	X

e) Sanitation / Drainage Facilities and Solid Waste

The sanitation is very poor in the AOI. There is no sewerage system, no solid waste management, thus the standards of cleanliness are poor in the AOI. Along the Ghizer road several shops, restaurant exists for travelers however, there is no system for disposal of solid waste generated from these restaurants. Therefore, solid waste can be seen easily in the area. Waste water generated from the houses as well as restaurants become part of the Gilgit River.

One small level floor mill also exist in Hanzel Bala and wastewater generated from this mill directly dispose off in the River.

f) Sources of Drinking Water

Water supply exist in the Hanzel Bala and Hanzel Paine villages, however, in Harpoon village there is no water supply. Therefore, people are forced to use river water for drinking purpose.

4.12 SECURITY SITUATION AND MOVEMENT OF THE FOREIGNERS

At present, security & safety situation in the area is satisfactory. During the social survey, locals informed that there have been no incident of any threat to lives or goods of foreigners visiting the area and there is no animosity towards foreigners. In the AOI there is a reasonably liberal atmosphere for women. The local culture recommends modest dress for both men and women.

4.13 GENDER ASPECTS

The emancipation of women is a campaign to give women equal rights and status with men. The emancipation of women (i.e., their liberation from economic and sexual oppression, their access to higher education and their escape from narrow gender roles) is not easily achieved due to the traditional setup. In this society, males dominate. Cultural tradition, social practices and low female literacy ratio have left women in a vulnerable position. Women are restricted to performing household work and are excluded from decision-making both on the domestic front and at the community level. Women’s access to education and health care is limited because such services are not available close to home in the AOI. Women also take active part in agricultural activities, collect fuel wood and fetch water, in addition to household work and family duties, but their due status is not given by the society.

Women in the AOI are also vulnerable through economic, social and psychological poverty. Economic poverty is due to lack of assets and low endowment of human capital. Social poverty derives from the inability of the society to accept women’s equality and their economic, political and cultural rights, while psychological poverty is a product of the subjugation of women, under the dictates of customs and traditions, which deprives them even of control over their own lives.

In the set-up women are kept under-educated or uneducated. They are mainly dependent on male members of the family for economic reasons and cannot take decisions regarding their own lives. They have no say in family matters and are not asked about their preference for marriage. Yet for the paucity of rights, women play a vital part in the society through performing essential, albeit menial, tasks and supporting their families (e.g., collection of firewood from distant places, nurturing children, and cooking and cleaning for the family).

Information which was collected through secondary sources and group discussion with locals shows that major problems faced by women in the area are lack of primary health care and the lack of education opportunities. Other problems include laborious work such as woods collection for cooking and heating. These tasks not only affect their health but also take up major portion of their time.

4.14 NGOs

There is no single registered NGO working in the AOI.

4.15 LAND DETAILS

The estimated land required will be 142 acres (57 hectare) based on the project footprint and topographic survey for the project execution, which will be further verified upon the mobilization of the EPC Contractor. The land-use of the area is shown in **Figure 4-14**.

The land that will be required for the weir, spillway, headrace channel, forebay, penstock, powerhouse, contractor's camps, access roads, bridges and operator's colony is about 15 acres (6 hectare).

The land-use maps showing the project components are given in **Figure 4-14**. The break-up of land to be acquired for each component is shown in **Table 4-28**.

Table 4-28: Land Acquisition Details

Sr. No.	Landuse Class	Total Area (Acres)
1	Built-up Area	0.47
2	Graveyard	0.12
3	Cultivated Land	7.87
4	Water Tank	0.00
5	Road	1.64
6	Track	0.32
7	Gilgit River	9.27
8	Stream/ Nullah	4.25
9	Barren Land	117.99
Total Area (Acres)		**141.92**

Source: Topographic Survey and GIS Estimation, 2017

A road of about 200 m has to be constructed from Hanzel for access to powerhouse. A jeep-able track exists almost up to forebay site, which will be upgraded for heavy traffic. Hanzel Road runs along the headrace alignment but at lower elevation. During the construction of the project headrace channel and up gradation of the existing road to powerhouse an alternate route for use of local people will be constructed. The existing road connects two important districts of Gilgit and Ghizer. It would also be used by the EPC Contractor during construction. The EPC Contractor has to keep it functional during construction and restore it to its original state after the construction activities are over.

(This Space is Intentionally Left Blank)

Figure 4-14: Landuse Map of the Land Acquisition Boundary

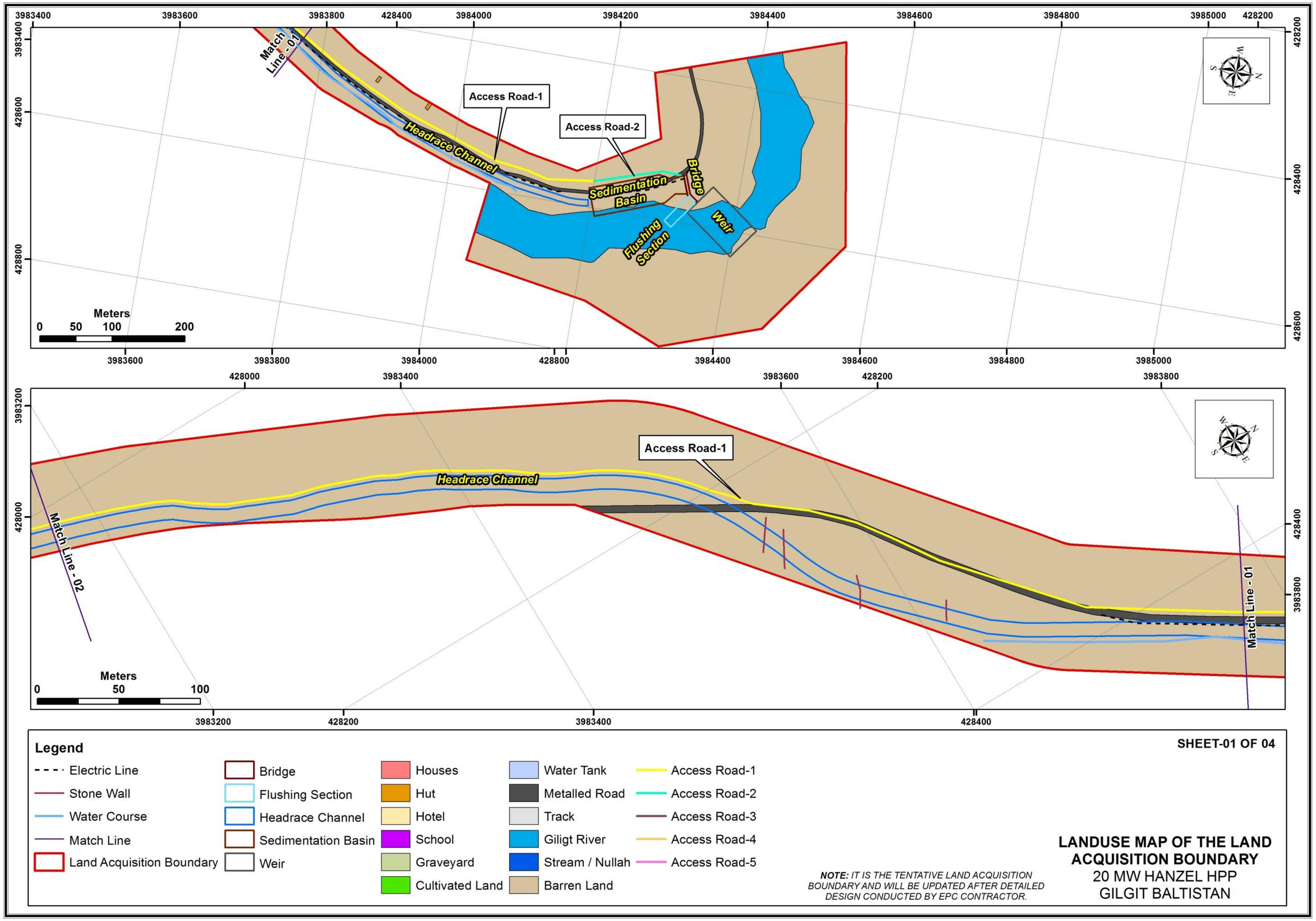


Figure 4-14: Landuse Map of the Land Acquisition Boundary

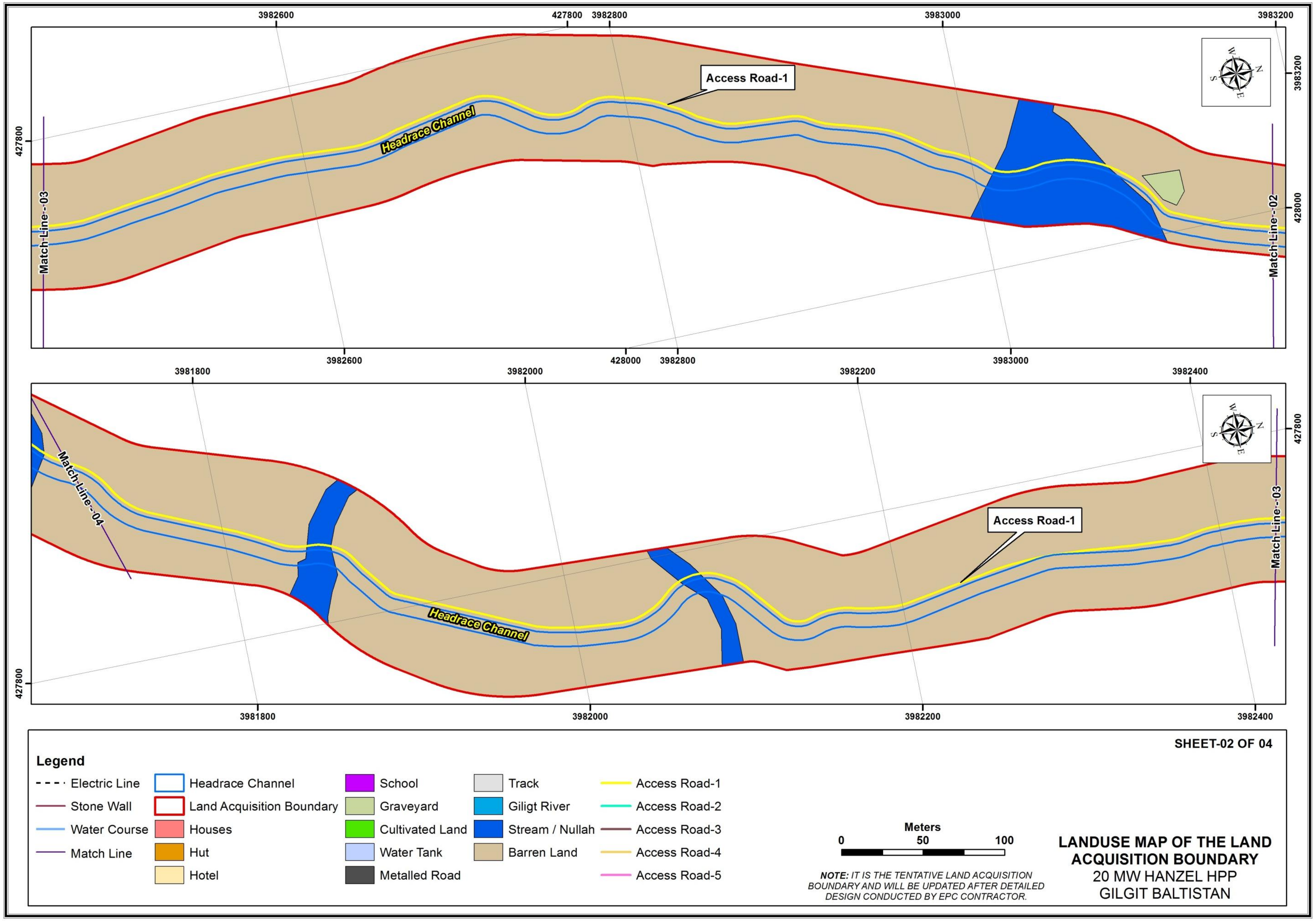


Figure 4-14: Landuse Map of the Land Acquisition Boundary

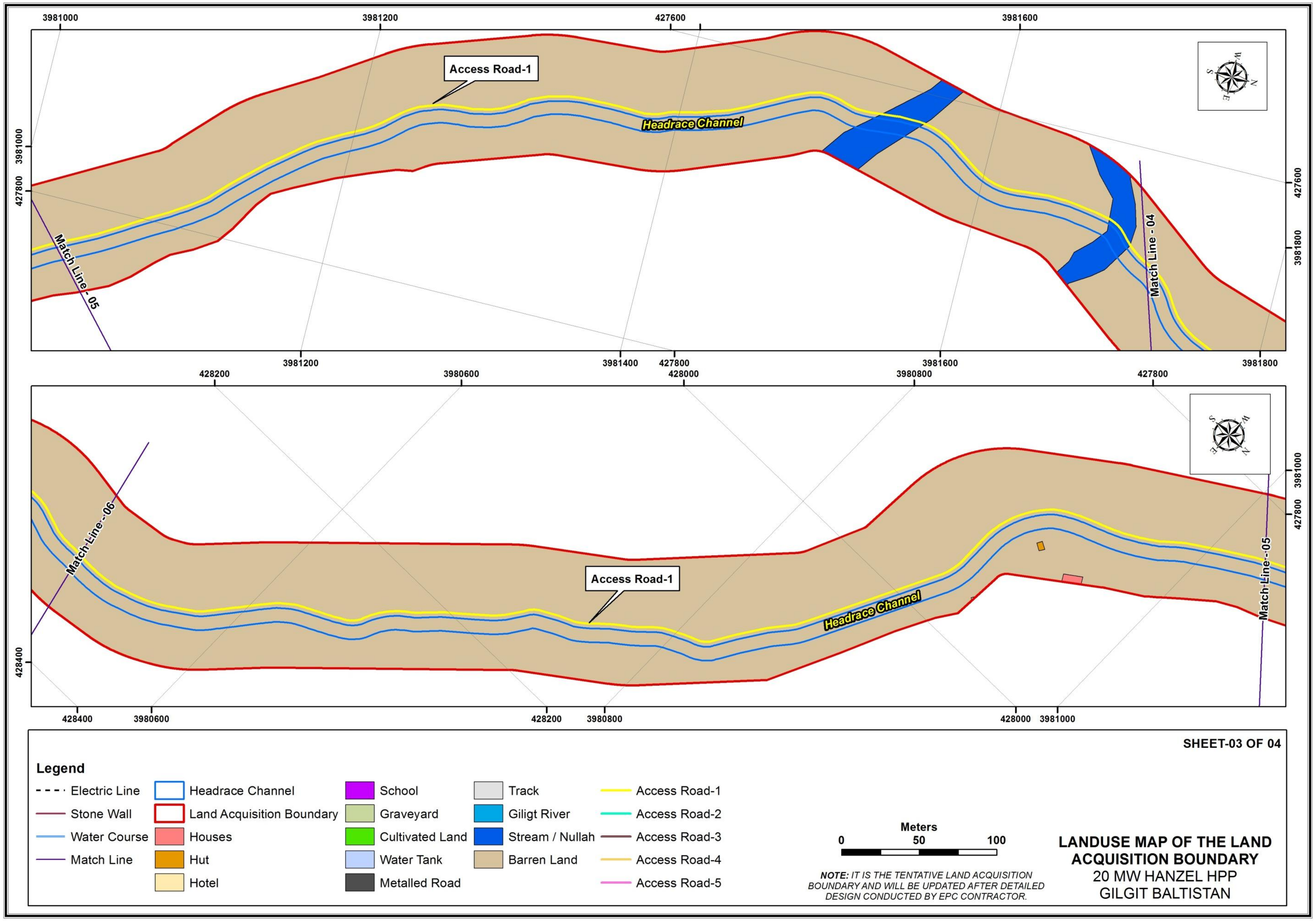
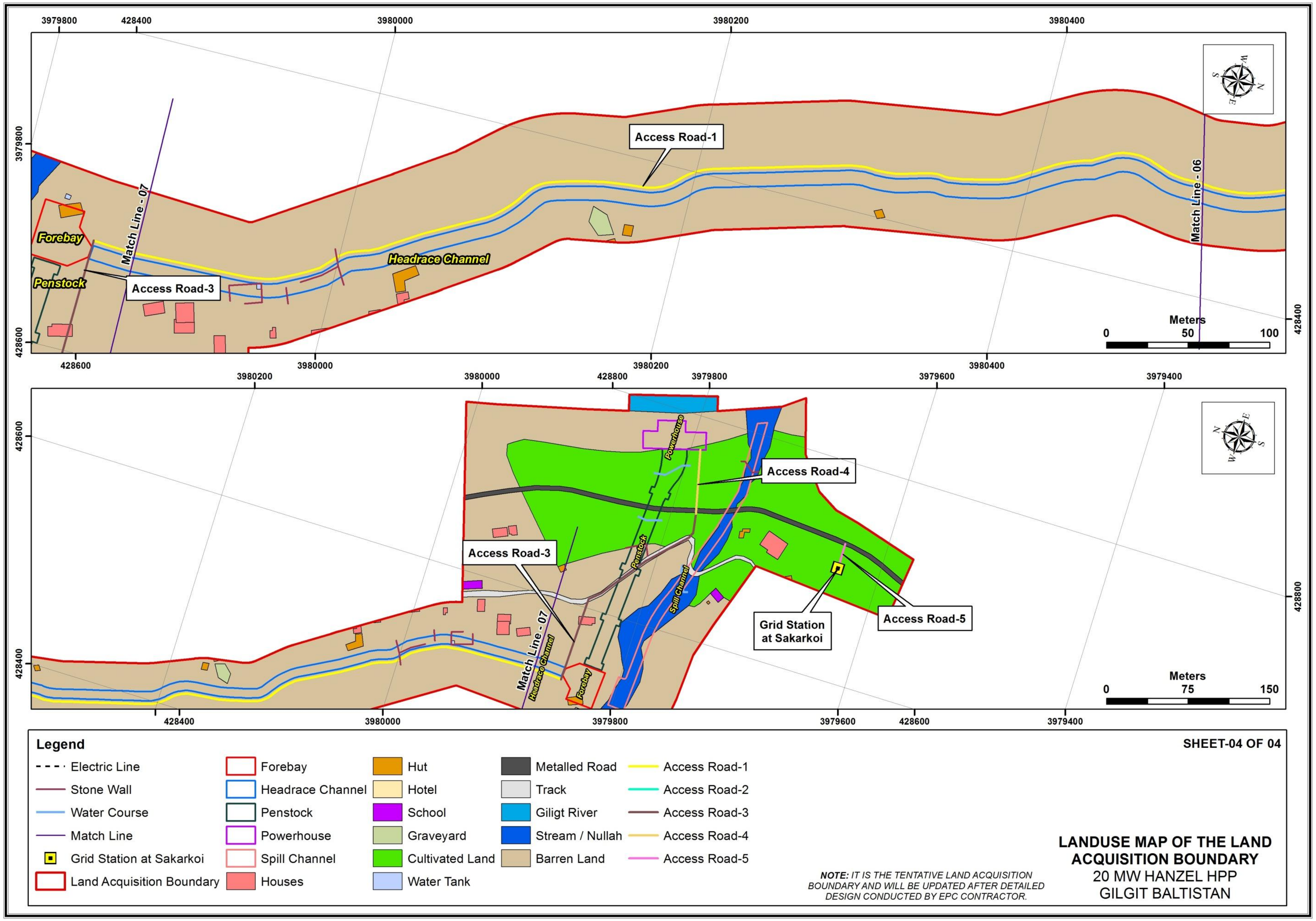


Figure 4-14: Landuse Map of the Land Acquisition Boundary



CHAPTER 5 – STAKEHOLDER CONSULTATIONS

5.1 GENERAL

Stakeholders' involvement especially the local population and key concerned stakeholders, is an important feature of the environmental assessment and can lead to a better and more acceptable decision-making regarding the project design and implementation. Public involvement, undertaken in a positive manner and supported by a real desire to use the information gained to improve the Project design, will lead to better outcomes and lay the basis for on-going positive relationships between the stakeholders. It gives the feeling of an ownership to the local population. Public involvement is necessary for smooth implementation of the project and especially the local community whose support is also required for the success of the project.

The project management and implementation authorities are committed for undertaking public consultation at Provincial and local levels as a part of project planning/design for getting necessary environmental permissions.

5.2 OBJECTIVES

The objectives of stakeholder consultation were to contribute to the openness, transparency and dialogue. Special efforts were made to ensure that the communication with the public should be efficient and well balanced. The concerned stakeholder groups were identified to participate in the assessment process.

The objectives of public involvement include:

- Informing the stakeholders about the proposed project;
- Providing an opportunity to those who remained unable to present their views and values, therefore allowing more sensitive consideration of mitigation measures and trade-offs;
- Providing those involved with planning the proposal with an opportunity to ensure that the benefits of the proposal are maximized and that no major impacts have been overlooked;
- Providing an opportunity for the public to influence the project design in a positive manner;
- Increasing public confidence in front of proponent, reviewers and decision makers;
- Providing better transparency and accountability in decision making;
- Reducing conflict through the early identification of contentious issues, and working through these to find acceptable solutions;
- Creating a sense of ownership of the proposal in the minds of the stakeholders; and
- Developing proposals which are truly sustainable.

5.3 STAKEHOLDER IDENTIFICATION

Considering the importance of the project, consultations were carried out at all possible levels i.e. departmental and local level. The process of consultation is an on-going process which continues during the project life cycle and even after the submission of this report and so on. Stakeholders were identified, categorized and consulted at departmental level i.e. with GB-EPA, Forest Department, Wildlife Department and Fisheries Department of GB and at village level (Direct and Indirect Affectees and Locals).

Consultation were carried out through meetings and consultations with locals, village people, directly affected people, local NGOs etc. during the baseline survey of the Study Area. Consultations were held with the following;

5.3.1 Department Level Stakeholders

- Environmental Protection Agency, GB
- Forest Department, GB
- Wildlife and Park Department, GB
- Directorate of Fisheries Department, GB
- Agriculture Department, GB
- Archaeology Department, GB
- Revenue Department, GB
- Women Development Department, GB
- Social Welfare Department, GB
- Education Department, GB

5.3.2 Village Level Consultations

- PAPs and local communities
- Hanzel Bala
- Hanzel Paine
- Harpoon

5.4 CONSULTATIONS

A series of public consultations were required to get the feedback/concerns of the different category of stakeholders including provincial departments, district level departments, potential PAPs, local community and other general public residing in the Study Area.

5.4.1 Concerns/Feedback

Feedback received during public consultation includes both project related concerns and other/general concerns.

Project related concerns and suggestions are related to the willingness of people to accept project loss of land, issues related to livelihood, electricity and compensation / relocation / resettlement, drinking water supply and sewerage, health facilities, road infrastructures, education, women issues, agriculture and security. Brief Introduction about the proposed project, its various components, positive and negative impacts and other technical details related to environment, social and economic considerations are provided before the consultation to stakeholders.

Details of department officials contacted are given in **Table 5-1**

Table 5-1: List of Government Officials Consulted

Sr. No.	Name of Person	Designation	Name of Department/ Office	Contact Number
1	Mr. Shahzad Shigri	Director, Environment	EPA, GB	05811-920679 0300-3689340
2	Mr. Waqar	Scientific Officer, Environment	EPA, GB	0312-9903139
3	Mr. Yaqoob	Conservator Officer	Wildlife and Parks Department, GB	05811-920146 03555-258739
4	Mr. Ikram-u-din	Agriculture Officer	Agriculture Department, GB	0346-8487788
5	Mr. Aftab Mehmood	Divisional Forest officer	Forest Department, GB	05811-920272 0346-3000849
6	Mr. Ghulam	Director,	Directorate of Fisheries, GB	05811-920695

Sr. No.	Name of Person	Designation	Name of Department/ Office	Contact Number
	Mohiuddin	Fisheries		0355-5550695
7	Mr. Ahmed Iqbal	Patwari	Revenue Department	0345-2830260
8	Ms. Abida	Deputy Director	Women Development	05811-920294
9	Mr. Yausaf	District Officer	Social Welfare	05811-920768
10	Mr. Izharullah	Deputy Secretary	Youth Affairs, Museum and Archaeology	05811-920173
11	Mr. Faizullah Khan Lone	Director Education	Education Department	05811-960000

5.4.2 Departmental Consultations

The following is the details of issues/points raised/discussed during the consultation:

Table 5-2: Details of Issues/Points Raised/Discussed during Department Level Consultations

Sr. No.	Departments	Stakeholder Observations/ Concerns	Response
1	Director and Scientific Officer, EPA, GB	The project background, components, benefits and other specific details were discussed.	No Action Required.
		It was emphasized by the official that GB Environmental Protection Act, 2015 should be followed to comply with the legal requirements.	The IEE study has been conducted specifically to comply with the GB, Environmental Protection Act, 2015. Moreover, this information has also been included in the chapter describing the relevant laws and legislation.
		The official told that the Environmental Assessment Guidelines for Hydro Electric Projects by GB, EPA is in draft form and in process of publishing officially.	The environmental team has been consulted these sectoral guidelines. However, if published officially during the finalization of the IEE study, it will be included in the chapter describing laws and regulations.
		The fishing potential in the Gilgit River near Hanzel area starts from the mid of the march and stopped when the turbidity from Yasin River flows downstream to Gilgit River.	Thanks for this information.
		The hydrology and flow data should be included in the study.	The details about hydrology, catchment area and flows of Gilgit River are included in Baseline Chapter.
		The official emphasized that the 10% of the mean monthly flow should be released downstream during the each month.	Water requirement for downstream should be incorporated in the overall design of the project by

Sr. No.	Departments	Stakeholder Observations/ Concerns	Response
			the EPC Contractor. The average monthly discharge for lean month i.e. march is 46.8 m^3/s (from 1960-2014) out of which approximately 37.25 m^3/sec of water will be diverted through Headrace/Power Channel. The remaining water is more than 10% that will be released downstream at the weir site.
		The fish species should be protected specially the trout fish which is present in the clear water and flows downstream from March. Moreover, it is recommended by the official that some fish passage should be made to allow the movement of fish upstream and downstream.	The information regarding the aquatic ecology has been given in the baseline chapter. Appropriate sized fish ladders should be provided in the design by the EPC Contractor to ensure the free movement of fish from downstream to upstream and vice versa.
		The velocity of the water from the outfall structure at power house should be zero so that fish will not get disturbed.	This aspect should be considered by the EPC Contractor in the overall design of the project.
		The Headrace/Power Channel should be buried so that it will not affect due to landslides. Moreover, the slope stability study should be conducted for the project.	Depending upon the nature of slopes, headrace channel will most probably be covered at certain reaches. Comprehensive slope stability analysis shall be done for detailed / construction stage design by EPC Contractor for cut and fill (if required) cross sections of headrace channel.
		Bridges should be constructed at the intersections of the road with project components so that movement of the locals will not get affected during the construction activities.	The layout plans of the project has six (06) bridges on the existing road so that the movement of the locals will not hinder.

Sr. No.	Departments	Stakeholder Observations/ Concerns	Response
		The Hanzel area is under the community controlled hunting area and about 80% of the revenue generated from hunting of Ibex is given to the locals. It should be ensured that construction worker will not hunt any wildlife specie at the site.	Thank-you for the information. The baseline chapter has the details about the community controlled hunting area. It is mentioned in the impact and mitigation section that Hunting, killing, shooting, poaching or injuring wildlife fauna shall be strictly forbidden.
		EPA official stressed that the environmental mitigation cost should be included realistically in the IEE study.	The environmental mitigation cost has been included in the EMP Chapter along with the details and specific requirements.
		Local people may have positive response to this Project if they are given preference in jobs.	It has been recommended that clauses should be added in the contracts of Contractor to hire local labours if/where the required skills exist. Normally this is the norm for owners to have an employment policy with one aspect of hiring the locals.
		The official told that approximately 4 trees needs to be planted for each tree cut as a thumb rule for the development works in GB.	Information noted with thanks. It is recommended in the EMP under tree plantation plan that 22,400 plants need to be planted to compensate the tree cutting.
2	Forest Department, GB	The project is appreciable in view of the prevailing electricity shortage but DFO Commented that tree cutting should be avoided as far as possible and minimum possible number of trees should be cut, if necessary.	NESPAK Ecologist agreed and assured him tree cutting will be minimum.
		He was of the opinion that as per Governments policy, 10 times number of plants should be raised,	NESPAK Ecologist told the DFO that a plantation plan shall be part of the report and it shall be mandatory for the Proponents to plant 10 trees (at least) as compensation for every single tree.

Sr. No.	Departments	Stakeholder Observations/ Concerns	Response
		He further suggested that a proper plantation plan should be prepared and if required land is not available near the project site, forest department can be of help in providing the land for plantation.	NESPAK team told him that a proper tree plantation plan would be part of the report with a recommendation that plantation should be carried out through Forest Department.
		New power projects are necessary in view of current power shortage. Every effort shall be made by the all departments to support the HPP.	Comment noted down.
		These projects are in national interest and any negative impact on wildlife can be properly dealt with by adopting mitigation measures to provide water point, Wildlife Corridors & railing on both side of Headrace/Power Channel to avoid any inconvenience.	The impacts have been assessed and mitigations have been devised in the impacts and mitigation section of the report.
3	Wildlife Department, GB	The conservator wildlife strongly recommended that possible corridors & water points of Ibex & Markhor must be in proper consideration to avoid any impact on their movements for different purposes in project area.	After brief discussion the concerned officer was informed that railing on both side of the Headrace/Power Channel, Wildlife crossing bridges/Pathways & water points will be recommended to EPC contactor & same has been recommended in report as discussed.
		He mentioned that the project area is notified “community Controlled Hunting Area” & Near or adjacent to “Kargah Game Sanctuary” So, apply for NOC is mandatory.	The proponent will obtain the NOC from concerned Department.
		He suggested that suitable mitigation measures should be undertaken to compensate for the loss of trees, as the flora and fauna are inter related for instance trees are used for resting, nesting and roosting by the avifauna.	Conservator was informed that, a plantation plan is part of the report and 10 times more trees shall be planted in lieu of effected trees.
		He also gave very useful information regarding the baseline conditions of the fauna in and around Project Area.	The information is incorporated in Baseline of Ecological Environment.
4	Fisheries Department, GB	Director Fisheries recommended fish ladders for free & Undisturbed movement of aquatic life to avoid any loss to biodiversity.	Appropriate sized fish ladders should be provided in the design by the EPC Contractor to ensure the free

Sr. No.	Departments	Stakeholder Observations/ Concerns	Response
			movement of fish from downstream to upstream and vice versa.
		The concern official highlighted that toxic wastewater must not be disposed of in canal and other water bodies unless or until treated.	NESPAK Ecologist replied that his valuable opinion has been noted down and care shall be taken that composition /chemistry of water is not changed.
		The official strongly recommended 30% of total water flow for normal life of aquatic fauna & some type of structure to avoid fish intake into Headrace/Power Channel.	The EPC contractor will make bound to adopt both recommendations.
		Director Fisheries mentioned that some minor impact is expected so, one (01) Bio-diversity Fishers hatchery is recommended to enhance the fish culture.	After the detailed discussions between Ecologist NESPAK & Fisheries Director on hatcheries, Both experts agreed & concluded one Biodiversity hatchery to compensate the loss is recommended to include in the EPC contract.
		He also gave us very useful information, regarding kind of fishery in overall GB & GB River	NSEPAK representative thanked the official.
5	Agriculture Department, GB	The project should be executed while ensuring that the Project will not cause any significant negative impact on the flora of the area or the wildlife.	The relevant mitigation measures have been designed in the report after assessing the impacts.
		It is good to know about efforts being made to overcome the electricity shortage. On knowing that the HPP is being set up near to agricultural lands, some sacrifice has to be given to gain a bigger purpose. Further, this loss shall be compensated to a large extent by increasing yield per acre of the area and by bringing barren land under cultivation due to increased power for irrigation through local available water.	Agriculture department should take practical measures to compensate loss of agriculture by increasing yield per acre of the area and by bringing barren land under cultivation due to availability of more electricity.
6	Revenue Department	Land will be acquired as per Land Acquisition Act, 1894 and section-IV has been implemented. However, revenue department have 2015 rates in Gilgit district i.e. 1 million for cultivated land and 0.5 million for barren land.	Compensation should be given as per market price.

Sr. No.	Departments	Stakeholder Observations/ Concerns	Response
		In the proposed project private and government land will be acquired for headrace channel, forebay and power house area. However, quantification of private and government affected land will be finalized after submission of design by the ministry of water.	The concern has been noted down.
		There is also some issues of the revenue department with the local community of Hanzel Bala regarding ownership of the land.	The concern has been noted down.
		Government and contractor should provide employment opportunities to the PAPs in the proposed project.	The concern has been noted down and recommended to make part of the EPC contract.
7	Women Development Department	Vocation training in different field should be provided to the local women.	The concern has been noted down.
		Women development department have professional trainers and they can provide training to the local women in the field of stitching, embroidery, beautician etc.	The concern has been noted down.
		These training can be one, two or three months and it has about 2 million per month cost which have to bear by the ministry of water.	The concern has been noted down.
		Local norms and cultural values, especially women's privacy should not be disregarded by any contractors or foreigners during the course of the Project.	The concern has been noted down.
8	Social Welfare Department	Employment preference should be given to the locals as people in and around the area.	The concern has been noted down.
		Occupational health and safety should be taken care with respect during construction of the headrace channel, four bay and power house.	The concern has been noted down.
		Settlements including grocery shops, restaurants i.e. being affected in Hanzel Bala along the headrace channel should be avoided and in this area tunnel option should be considered except open channel.	The concern has been noted down.
		Water carrying through tunnel is best option and its also reduce the resettlement impacts.	The concern has been noted down.
		If tunnel option is not possible then compensation of affected houses, land and shops should be given at	The concern has been noted down.

Sr. No.	Departments	Stakeholder Observations/ Concerns	Response
		fair rates and livelihoods should be restored to the PAPs.	
		Livelihood restoration of the affectees due to this project is the primary responsibility of the government.	The concern has been noted down.
		Government and contractor(s) can involve themselves in social welfare activities by providing free ambulance service in the area, free transportation facility for school/college especially for female students. Because there is no higher level education facility.	The concern has been noted down.
		Education and health facilities should be provided free of cost to the Hanzel Bala, Hanzel Piane and Harpoon villages residence.	The concern has been noted down.
		Government should involve social welfare department for wellbeing of PAPs in different programs.	The concern has been noted down.
		Social welfare department have vocation training program which can be started for the locals	The concern has been noted down.
9	Education Department	Govt. boys primary school Hanzel exist just foothill near the forebay area and during construction school will be disturbed to blasting and other construction activities.	The concern has been noted down.
		In this primacy school about 100 children are studying. Without proper planning construction may cause accidents risks for children as well as staff members.	The concern has been noted down.
		Therefore, before starting any construction activity near this area school should be relocated to avoid any incident.	The concern has been noted down.
		It is the responsibility of the contractor that alternative school should be provided before the start of construction so that education of the children will not affect.	The concern has been noted down.
		In this case ministry of water have to take approval and sign agreement with the education department for relocation of school building.	The concern has been noted down.
		New school building should be nearest of the existing building.	The concern has been noted down.
		In new school building about 8-10 rooms should be constructed and it should be seismically safe.	The concern has been noted down.
		Noise producing construction activity	The concern has been

Sr. No.	Departments	Stakeholder Observations/ Concerns	Response
		should be avoided during school hours.	noted down.
10	Assistant Director, Archaeology Department GB	Salient features of the Project and its components and locations were explained to the officials.	This was a briefing session to present the Project background and current status.
		The official told that the "Hanzel Stupa" near to the Project site on the right bank of the Gilgit River is an Archeologically important monument and is notified by the concerned Archaeology Department which needs to be protected during the construction works.	The notification from the Archaeology Department is attached as an Annex-5. Moreover there is no direct impact foreseen on this monument. The contractor shall take protective measures for the protection during the construction especially during the blasting activities.

5.4.3 Village Level Consultations with PAPs

A series of public consultations were conducted to get the feedback/concerns of the different category of stakeholders including potential PAPs, local community and other general public residing in the Study Area. Three (03) consultative meetings were held with more than 20 participants in the Study Area. The major categories participated in these meetings were local population, community groups, landowners, tenants and potential PAPs. Majority of the people who participated in these consultations are mature/elder persons because as per the local culture, elders have the right regarding any decision. However, young people participated in the consultations.

These consultations were carried out from September 17 to 19, 2017 with the direct and indirect affectees. Major consultation with the PAPs/local community and general public were carried out in Hanzel Bala, Hanzel Paine and Harpoon. The details of the participants are given in **Table 5-3**.

Table 5-3: Participants during Village Level Consultation

Sr. No.	Village	Name	Father's Name
1	**Hanzel Bala**	Zubair Ahmed	Fida Muhammad
2		Maqbol Alam	Yar Muhammad
3		Imtiaz Ali	Asfand Yar
4		M.Nazim	M. Faqeer
5		Tariq Husain	Sikander
6		Habib Ur Rehman	Ameer Husain
7		Ghulam Sheir	Khan Abad
8		Khurshed	Haji Mehmood
9		Bahadur	Alam Noor
10		Sheir Khan	Sahib Khan
11		Jameel Ahmed	Ajab Khan
12		M. Tariq	Karro Khan
13		Anees Khan	Jamil Ahmed

Sr. No.	Village	Name	Father's Name
14		M. Zahid	Bashir Ahmed
15		M. Jalal	Rasheed Ahmed
16	**Hanzel Paine**	Zaidullah	Hazrat Mir
17		Khairul Amin	Rasheed Ahmed
18		Akhtar Riaz	Khairul Amin
19		Mahzob Khan	Scmer Ali
20		Mirwali	Abdul Wali
21		Lashkar Khan	Sehib Khan
22		Abdul Yasin	Sahib Noor
23		Tariq Ahmed	Abdul Jaleel
24		M. Rehman	Malik Maskeen
25		Hor Khan	Ahmed Din
26	**Harpoon**	Rajmeer Khan	Ghulam Qadir
27		Sadir Ayub	Kamal Din
28		Momin Shah	M. Gul
29		Miraj Din	Kamal Khan
30		Ghulam Shabir	Noor Khan
31		Aziz-ur-Rehman	Anwar Ali
32		Jumma khan	Ghulam M.

The following points were raised/discussed during the consultation:

Table 5-4: Details of Issues/Points Raised/Discussed during Village Level Consultations

Sr. No.	Stakeholder Observations/ Concerns	Response
1	Locals demanded total 6 cusec (0.17 cumec) water for irrigation purpose from the proposed channel, 2 cusec (0.056 cumec) for each village.	The concern has been noted down.
2	Currently spring water will be used for cultivation, therefore, headrace channel from spring to the barren land should be constructed before the start of the project.	The concern has been noted down.
3	Except the above 6 cusec (0.17 cumec) water, they demanded additional 4 cusec (0.113 cumec) water for irrigation purpose from river and for this they demanded 2 electric pumps at river.	The concern has been noted down.
4	Access road to the uphills at different locations should be constructed.	The concern has been noted down.
5	Locals of the Hanzel Bala, Paine and Harpoon said that during the construction phase of the Project, noise, dust and traffic problems on Gilgit- Ghizer Road will adversely affect their health as well as business. Similarly, their mobility will be disturbed specially during the construction of the headrace channel and weir.	The concern has been noted down.
6	Locals demanded that this should also be ensured by the government that the locals will get free electricity or subsidy from this Project on priority basis.	The concern has been noted down.
7	They recommended that locals should be given preference for skilled and unskilled jobs at proposed project during construction and operational phase of the project.	The concern has been noted down.
8	PAPs must not only be compensated with land for land or money for land but they should also be compensated by	The Govt./Proponent should do more consultation with the PAPs

Sr. No.	Stakeholder Observations/ Concerns	Response
	the government in re-establishing their livelihood in the resettled area.	and proper compensation should be given, and their concerns should be addressed. The Govt. should provide livelihood assistance to the PAPs in the form of loan, training etc.
9	PAPs of the Hanzel Bala requested that a committee should be framed at Govt. level to address land acquisition issues involving locals as well.	The concern has been noted down.
10	The PAPs whose business is being affected not only compensated in cash or inland but they should also be compensated by the government in re-establishing their livelihood in the nearby area, so that their livelihood will not be affected.	The concern has been noted down.
11	Some locals demanded that alternate land for business on the Ghizer road instead of market price will be acceptable to them. Some showed concerns that cash compensation should be given to the PAPs directly and political/patwari interference should be avoided. PAPs informed that price of land in nearby area have been increased to about Rs. 200,000 per Marla on the road which is too costly for them; therefore, government should facilitate them in purchasing land as per market price.	The Govt./Proponent should do more consultations with the PAPs and proper compensation should be given and their concerns should be addressed. The Govt. should provide livelihood assistance to the PAPs like loans, trainings etc.
12	PAPs of Hanzel Bala said that due to the acquisition of land for proposed project, their livelihood will be lost; existing shops and farming on agricultural land is their sole source of income and they do not possess any technical or vocational skills. They will not be able to fulfill the basic needs of their family. Therefore, locals demanded fair compensation to be provided so that they can purchase alternate land easily.	The Govt. /Proponent should conduct more rounds of consultations with PAPs and their concerns should be addressed.
13	PAPs of shops at Hanzel Bala told that no one wants to sell their land in the area because there is good income from these shops and especially we earn lot money in summer season from the tourists whose travelled from Gilgit to Ghizer.	Noted down
14	PAPs said that for the sake of national interest they are ready to give their land but on current market price.	Noted down
15	They said if govt. adopt tunnel option except open channel it will reduce resettlement issues at maximum level and their livelihood will not be affected.	Noted down
16	Govt. should provide community center, playground, parks and girls high school in the area.	Noted down
17	Owners within the proposed power house area demanded fair compensation for the tree cutting and their land that will be acquired for the project.	Compensation should be given according to the Land Acquisition Act, 1894 and other applicable laws. The tree plantation should be followed while planting new trees.

Sr. No.	Stakeholder Observations/ Concerns	Response
18	Drainage and sewerage system are totally nowhere and people use domestic draining channels which leads to a pond and become source of pollution.	The comment is not directly related to the project scope. The Govt. should consider this for social uplift of the area.
19	The residents of the Study Area are in favour of the project as they feel that jobs will be created during the construction stage of the project. Moreover, they are of the view that project facilities can be also be used by the locals as well.	The comment has been incorporated in the report and it has been recommended that project should share its facilities like dispensaries with the locals. It is also recommended that proponent should take some Confidence Building Measures (CBMs).
20	Residents of the Study Area shown concerns regarding the provision of the safe drinking water and irrigation water.	The proponent has planned to provide three (03) water outlets from the headrace channel to supply drinking and irrigation water supplies for the three (03) villages namely Harpoon, Hanzel Paine and Hanzel Bala.
21	Residents of the Study Area demanded that the existing road (right bank of Gilgit River) should not be blocked or an alternate road should be constructed so that the movement of the locals will not be hindered.	The lay out plans show that there are six (06) bridges on the existing road; one where the headrace channel crosses the road, the second where penstock crosses the road and the third is at the location where spill channel crosses the road. The existing road connects two important districts of Gilgit and Ghizer. It would also be used by the EPC Contractor during construction. The EPC contractor has to keep it functional during construction and restore it to its original state after the construction activities are over.

5.5 STAKEHOLDER CONSULTATIONS FRAMEWORK FOR CONSTRUCTION AND OPERATION PHASES

Key stakeholders of the Project include government department of Gilgit such as Environmental Protection Agency, Agriculture Department, Forest Department, Wildlife Department, Public Health Department, Fisheries Department and Project directly affected people, land owners and local people. The community members will be compensated by project proponent and they will be encouraged to participate in project activities during construction and operation phases. The consultations will be made in future to facilitate the community at the local level.

The consultations will be carried out during the construction and operation phases of project. Efforts will be made to maximize the consultations during the project implementation. The consultations will be carried out with the objectives to develop and maintain communication linkages between the project promoters and stakeholders, provide key project information to the stakeholders, and to solicit their views on the project and its potential or perceived impacts, and ensure that views and concerns of the stakeholders are incorporated during the implementation with the objectives of reducing or offsetting negative impacts and enhancing benefits of the proposed project. The framework for the future consultations is elaborated in **Table 5-5**.

Table 5-5: **Future Consultations Framework**

Sr. No.	Stakeholders	Project Phase	Frequency of Consultation
1	Government Departments	▪ Pre-Implementation ▪ During the Project Implementation ▪ At Closure period	▪ One round of consultation before start of implementation of project. ▪ Monthly during construction stage, bi-annually during operation phase and once before the closure of the project.
2	Project Affected Persons	▪ Pre-Implementation ▪ During the Project Implementation ▪ At Closure period	▪ One round of consultations before start of implementation. ▪ Fortnightly during construction stage, bi-annually during operation phase and once before the closure of the project.
3	Surrounding Villages	▪ Pre-Implementation ▪ During Project Implementation ▪ At Closure period	▪ One round of consultation before start of implementation. ▪ Quarterly during construction stage and bi-annually during operation phase and once before the closure of the project.
4	Local Elders	▪ Pre-Implementation ▪ During Project Implementation ▪ At Closure period	▪ One round of consultations before start of implementation of project. ▪ Monthly during construction stage, bi-annually during operation phase and once before the closure of the project.
5	Women	▪ Pre-Implementation ▪ During Project Implementation ▪ At Closure period	▪ One round of consultations before start of implementation. ▪ Fortnightly during construction stage, bi-annually during operation phase and once before the closure of the project.
6	NGOs, Local CBOs or other Civil Society Groups	▪ Pre-Implementation ▪ During Project Implementation ▪ At Closure period	▪ One round of consultations before start of implementation of project. ▪ Fortnightly during construction stage and bi-annually during operation phase and once before the closure of the project.

(This Space is Intentionally Left Blank)

CHAPTER 6 – SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 GENERAL

This section identifies the potential impacts due to the implementation of the proposed Project on the physical, ecological and socio-economic domains of the environment of the Project Area as well as Study Area. This section also identifies measures that will help to mitigate the Project's adverse environmental effects. Approaches used for identification of the potential impacts include checklists, overlays, interaction between Project activities and impacts etc.

6.2 METHODOLOGY FOR IMPACT IDENTIFICATION

6.2.1 Impact Matrices

Various IEE/EIA methodologies are available for identification of impacts including the checklist and project impact matrix. Among these methods, project impact matrix was used as impact identification methodology.

The Impact Evaluation Matrix was developed by placing project activities along one axis (i.e. Y-axis), and on the other axis (i.e. X-axis) for the different environmental parameters likely to be affected by the proposed project actions grouped into categories i.e. physical, ecological and socio-economic environment. For the impact assessment, project impact evaluation matrix is used by dividing the project action into different phases (design/pre-construction, construction and operational phases). A Project Impact Evaluation Matrix is shown in **Figure 6-1.**

(This Space is Intentionally Left Blank)

Figure 6-1: Project Impact Evaluation Matrix

Project Activities \ Environmental Impacts	Air Quality	Noise	Soil Contamination/ Erosion	Visual and Aesthetic Value	Surface Water	Increase in waste water generation	Flora	Fauna	Livestock	Fishery	Mobility of Locals	Cultural Issues	Gender Issues	Health & Safety of Workers	Archeological/Historical and Religious Sites	Human Health	Agriculture	Drinking Water	Livelihood	Improvement in Overall Economy	Resettlement	Water Flow
A. Design and Pre-construction Stage																						
Design Stage Investigations	x	x	o	o	o	x	x	x	o	o	o	x	x	o	o	o	x	o	●	o	o	o
Land Acquisition	o	o	o	o	o	o	o	o	o	o	x	x	x	o	o	o	x	x	x	x	x	o
B. Construction Stage																						
Clearing of Land, Digging and Excavation	x	x	x	x	x	x	x	x	x	o	x	x	x	x	x	x	x	x	●	o	o	o
Upgradation of access roads and construction of roads within the Project Area	x	x	x	x	x	x	x	x	o	o	x	x	x	x	o	x	x	x	●	●	o	o
Storage of Material	x	x	x	x	x	o	o	o	o	o	o	o	x	x	o	x	o	o	o	o	o	o
Construction Camps	x	x	x	x	x	x	x	x	o	o	x	x	x	x	o	x	x	o	●	o	o	o
Construction Works	x	x	x	x	x	x	x	x	x	x	x	o	x	x	o	x	x	x	●	o	o	o
Wier Site	x	x	x	x	x	x	o	x	o	x	x	x	x	x	o	x	o	x	●	o	o	x
Headrace Channel	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	o	●	o	x	x
Forebay	x	x	o	x	o	x	o	o	o	o	x	x	x	x	o	x	o	o	●	o	x	o
Spill Channel	x	x	x	x	o	x	x	x	x	o	x	x	x	x	o	x	o	x	●	o	x	o
Penstock	x	x	x	x	x	x	x	x	x	o	x	x	x	x	o	x	x	x	●	o	o	o
Powerhouse	x	x	x	x	x	x	x	x	o	x	x	x	x	x	o	x	o	x	●	o	o	o
Use of Heavy Machinery/Equip	x	x	x	x	o	x	x	x	x	x	x	o	o	x	o	x	x	x	●	o	o	o
Waste Water Disposal	o	o	x	x	x	x	x	x	x	x	o	o	o	x	o	x	x	x	●	o	o	o
Solid Waste Disposal	x	o	x	x	x	o	x	x	x	o	o	o	o	x	o	x	x	x	o	o	o	o
Leakage & Spillage of Oils and Chemicals	x	o	x	x	x	x	x	x	x	o	o	o	o	x	o	x	o	x	o	o	o	o
Security Fencing and Lightning	o	o	o	o	o	o	o	x	o	o	x	o	o	x	o	o	o	o	o	o	o	o
C. Operational Stage																						
Landscaping	●	o	o	●	o	o	●	●	o	x	o	o	o	o	o	o	o	o	●	o	o	o
Hydropower Operations	●	x	x	●	x	x	●	●	x	x	x	x	x	x	●	x	●	●	●	●	o	x

NOTE: The above matrix shows the imapct magnitude without any mitigation. With the application of mitigation, the magnitude of impacts will be either insigficant or low.

Beneficial		Adverse
●	Low	x
●	Medium	x
●	High	x

o Insignificant or No Impact

6.2.2 Overlays

In order to identify spatial based impacts, overlays were used. An overlay is based on a set of transparent maps, each of which represents the spatial distribution of an environmental characteristic (for example, land acquisition). Information for an array of variables such as land use, infrastructure, vegetation etc. is collected for the standard geographical units within the Study Area are recorded on a series of maps, typically one for each variable. These maps are overlaid to produce a composite map. The resulting composite maps characterize the area's physical, social, ecological, land use and other relevant parameters related to the location of the proposed intervention (weir, headrace channel, forebay, penstock, powerhouse and other allied components). An overlay map of the Project Area is attached as **Figure 4-14**.

6.2.3 Notion of Significance

The prediction of potential impacts is based on factual data; however, the significance of these impacts involves a value judgment technique. The significance of impacts may be categorized in terms of following parameters:

Nature	-	Direct or Indirect
Likelihood	-	Unlikely, Possible or Likely
Duration	-	Long, Medium or Short Term
Geographical Extent	-	Site Specific, Local or Regional
Reversibility	-	Reversible or Non-reversible

Based on above parameters notion of significance for each impact can be categorized as;

- **Low:** an impact for which no mitigation is necessary;
- **Medium:** an impact that requires effective mitigation; and
- **High:** an impact, which, if not mitigated, could stop the Project from proceeding.

6.3 POSITIVE IMPACTS DURING CONSTRUCTION AND OPERATIONAL PHASE

6.3.1 Environmental Benefits

The Gilgit Baltistan is known for their outstanding natural beauty, high peaks and landscape and it is a popular destination among tourists from both Pakistan and abroad. The GB offers tourists opportunities for outdoor activities such as hiking, fishing and trophy hunting. During construction phase, the related equipment and influx of people will temporarily affect the visual and landscape values of this relatively untouched area. However, during operation phase the existence of the weir, headrace channel, powerhouse and other structures will change the visual amenity of the Project area impacting on the surrounding landscape and views.

The project not only reduces or replaces equivalent electricity generation sources with all the associated environmental benefits but it will also help to avoid all associated pollution caused through extraction, processing, storage and transportation of conventional fuels required for fossil fuel plants.

Development of the Hanzel Hydropower project is likely to attract more tourists in the project area and will increase the local business and recreational activities. Impact relating to recreation activities is considered to be moderately positive.

6.3.2 Economic Benefits

The project will give rise to a number of economic benefits. The key economic expected benefits that are expected are discussed below;

a) Reduced electricity costs and less load shedding

The major potential benefit is reduced electricity costs, less load shedding and improvement in industrial production. Electricity rationing causes a major direct loss to the economy in terms of lost sales, disruption costs and the value of un-served energy to commercial, industrial and domestic users. The local area of the people is facing load shedding problem which will be reduced on the completion of the Hydropower Project.

b) Employment

Hanzel Hydropower Project will also provide skilled and unskilled jobs during the implementation phase and a limited number of jobs during operation and maintenance. This will be a bonus for the locals of the area; those are migrating to down country for employment. Considering the other planned hydropower projects in the region, a highly skilled human resource will be developed which can be used in these projects planned in near future.

c) Impact on the Local Economy

During the construction phase, the generation of local employment opportunities will act as a catalyst to stimulate the local economy. Increased incomes in the area will encourage the formation and growth of local businesses, which will result in new indirect employment opportunities. Both processes will alleviate pressure on land resources.

Similarly, the availability of cash from compensation payments will result in opportunities for investment. In combination with programs for assistance and advice, opportunities will arise both to improve agricultural productivity and to develop new businesses.

During the operation phase, the main economic benefits of the project will be those resulting from increased power availability locally. From discussions with local authorities and people in the project area, it is clear that there is considerable potential for development in the retail, construction and industrial sectors in the town. The lack of reliable, economic power supplies is considered a key constraint for development in the entire project area.

d) Impacts on Social Services

Access roads, bridges, will be built as part of the project and will facilitate the access for people to goods and services. After completion of the project, these facilities and infrastructure will be available to the general public. Local community members, considered to be medium sensitive socio-economic receptors because of their probable dependence on natural resources and lack of economic capital, will benefit from these facilities. Moreover health facilities created during the construction phase will be available to local communities. The impact of better communication and other social services is considered to be a moderate positive impact of the project.

6.4 EVALUATION OF IMPACTS DURING DESIGN/PRE-CONSTRUCTION PHASE

This section identifies the potentially significant adverse environmental and social impacts anticipated during the pre-construction phase of the project. Mitigation measures, where applicable have also been suggested.

6.4.1 Land Acquisition

a) **Impact**

The total land required for the Project execution is 142 acres (57 hectares) based on the project footprint and topographic survey[12]. Out of 142 acres (57 hectares), land acquired for the project components is 15 acres (6 hectare). The estimation of land requirement will be finalized after the mobilization of the EPC Contractor at the detailed design stage.

Majority of the land will be required for this project is government owned land which will be acquired as per the policy of government of GB. However, remaining private land will be acquired as per provision of LAA, 1894. This impact is Site-specific, Permanent, Irreversible, Likely, Highly Significant and needs to be encountered prior to the start of construction stage.

b) Mitigation

The hydropower plant construction mostly involves the government land which will be acquired according to the policy of Govt. of GB. On the other hand, private land is being acquired according to the provision of the LAA 1894. The process of land acquisition is in process and section-4 of land acquisition act, 1894 has been notified. As a part of the land acquiring process by the Water and Power Department, GB has already deposited an amount of Rs. 45 million (Forty Five Million) to date on account of payment for land acquisition to the Office of Deputy Commissioner/Collector. Moreover, Secretary Law GB has also authorized Deputy Commissioner/Collector to start the land acquisition in project area on urgent basis. The letter showing payment of the above mentioned amount is attached as **Annex-7**. The LAA is broadly grouped into eight (8) parts comprising 55 Sections dealing with the details of land acquisition and compensation. The main relevant Sections of LAA, 1894 are shown in **Figure 6-2**. Apart from other relevant sections, the sections describing the aspects to be considered and not to be included during the determination of compensation are as summarized below:

Section-23 (Matters to be considered in Determining Compensation): Section-23 testifies that in determining the amount of compensation to be paid for land acquired under this Act, the Collector shall take into account the followings:

- Market value of land at the date of publication of notification under Section-4;
- Damage sustained, by reason of the taking of any standing crops or trees at the time of the Collector's taking possession thereof;
- Damage (if any) sustained, at the time of taking possession of the land, by reason of severing such land from his other land;
- Damage (if any) sustained, at the time of taking possession of the land, by reason of the acquisition injuriously affecting his other property or his earnings;
- If in consequence of the acquisition of the land, the person interested is compelled to change his residence or place of business, the reasonable expenses (if any) incidental to such change;
- The damage sustained by diminution of the profits of the land between the time of the publication of the declaration under Section-6 and the time of taking possession of the land; and
- 15% over and above the cost of the land determined by the Collector as charges for acquisition.

Section-24 (Matters to be neglected in Determining Compensation): In accordance with Section-24, following matters shall not be taken into consideration in determining:

- The degree of urgency which has led to the acquisition;
- Any disinclination of the person interested to part with land acquired;

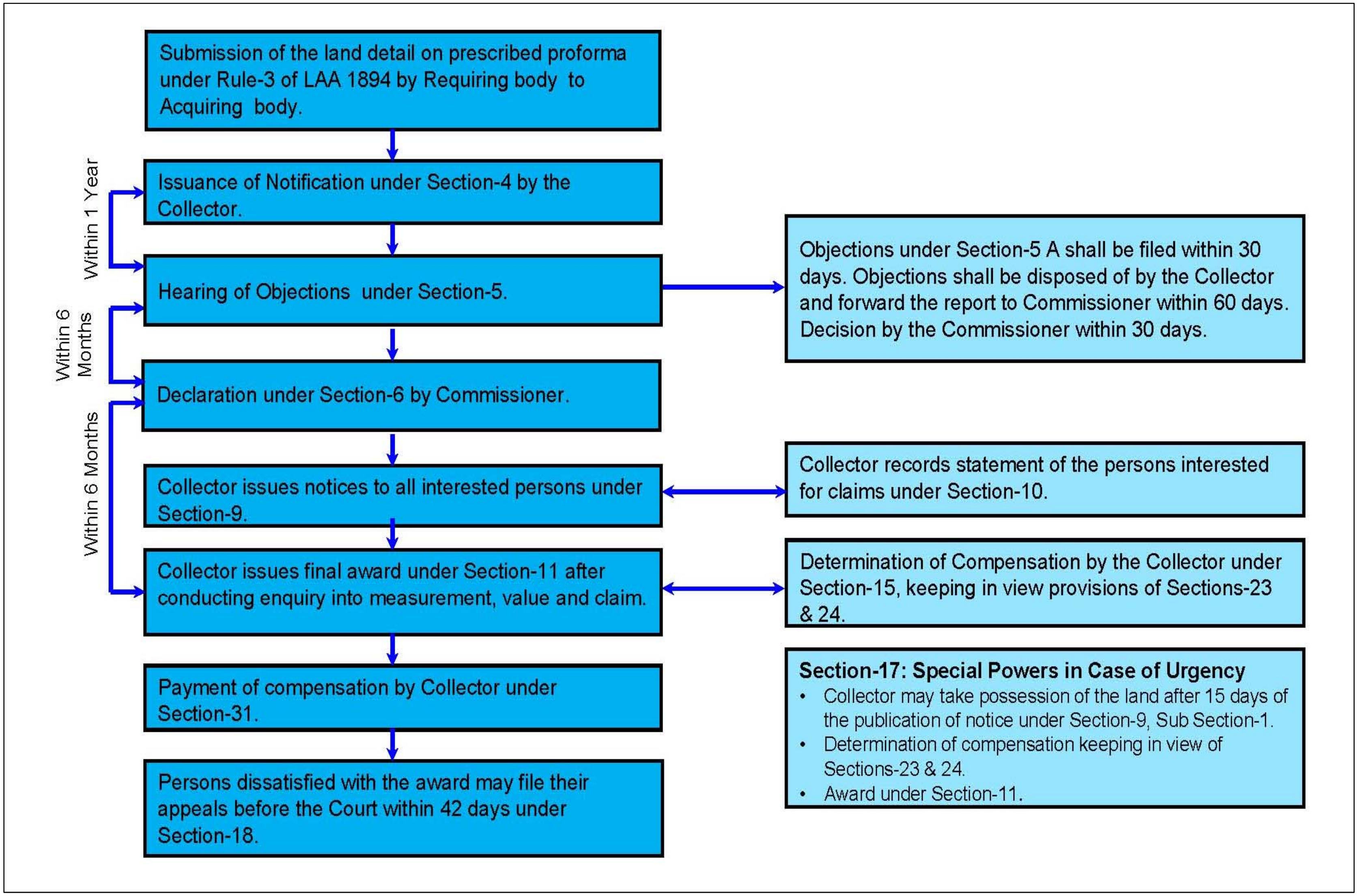
Topographic Survey and GIS Estimation, 2017

- Any damage sustained by him which, if caused by a private person, would not render such person liable to a suit;
- Any damage which is likely to be caused to the land acquired after the date of publication under Section 6, by or in consequence of the use to which it will be put;
- Any increase to the value of the land acquired likely to accrue from the use to which it will be put when acquired;
- Any increase to the value of the other land of the person interested likely to accrue from the use to which the land will be put; and
- Any outlay or improvements made without the sanction of the Collector after the date of the publication of the notification under Section-4.

The above provision will be strictly complied with during the determination and payment of compensation. Proper measures need to be taken to safeguard the livelihoods of the affectees apart from the compensation.

(This Space is Intentionally Left Blank)

Figure 6-2: Land Acquisition Process under LAA, 1894



6.4.2 Flora

a) Impact

During the pre-construction phase, activities such as installation of construction camps, construction of temporary roads & mobility of construction staff may damage the local vegetation/trees. As the heavy machinery and camps will be moved and installed, which require significant space due to which available vegetation is expected to be removed. This impact is Site-specific, Permanent, Irreversible, Possible, Medium Significant and needs to be encountered prior to the start of construction stage.

b) Mitigation

The camps, mobility of machinery and construction of temporary road should be proper planned and well designed to avoid any loss to local green cover. It is recommended to establish the construction camps where minimum or no vegetation exists. Similarly, the alternate routes for roads and points for camps are recommended where no loss of vegetation is expected.

The location of construction camp will be selected so as to have limited environmental effect during construction phase and to reduce the cost and land requirement.

The physical effects of roads, in particular on the hydrologic and geomorphic watershed processes, must have proper studies and the biological impacts have well understood. In the interests of brevity, this essay will be unable to parse apart the entire gamut of physical and biological effects of resource roads & other activities in great detail.

6.4.3 Fauna

a) Impact

As movement and installations of machinery and vehicles will take place so noise and habitat loss is expected. The routes of wildlife and other habitats may be affected due to camps set-up and machinery movements & installations. Temporary road may also affect the habitat of locally available fauna. This impact is Site-specific, Temporary, Irreversible, Possible and Low Significant.

b) Mitigation

The standard measures must be adopted to minimize noise due to machinery movements and installations. Wildlife movements and routes must be considered during activities and should be avoided to their maximum level. The alternate routes and points are recommended to avoid any damage to locally available fauna.

Camps shall be located at least 500 m away from the nearest wildlife and their source of food as well as water.

The camps shall be properly fenced and gated to check the entry of animals in search of eatable goods. Similarly, wastes of the camps shall be properly disposed of to prevent it being eaten by animals, as it may be hazardous to them.

6.4.4 Socio-Economic Environment

During the planning and design phase of the Project it is anticipated that there will not be any potentially significant adverse impact on the socio-economic environment. Locals may be temporarily disturbed due to the field investigations. This impact can be categorized as indirect, low, site-specific, short term, Probable and reversible.

No mitigations measures are required. Good engineering practices along with are required to avoid and reduce these low adverse impacts.

6.5 IMPACTS AND MITIGATIONS DURING CONSTRUCTION PHASE

The construction phase impacts are mostly of a temporary nature and their magnitudes are subject to the engineering management practices adopted during construction. Such impacts are related to soils (erosion and slope stability), water quality, noise, air quality and disruption to the biological environment, public health, interruption of communications, at-risk population / safety, community stability, and cultural and religious values / properties. The anticipated impacts during the construction phase are discussed herewith.

6.5.1 Water Flow and Requirements

a) Impact

During the construction phase, the Gilgit River water needs to be diverted to get the dry conditions for the construction of the weir and allied structures. The water flow pattern from downstream of weir site will be diverted towards headrace channel. The variation in flows will directly impact the operation of plant, downstream aquatic life and community. This impact is Site-specific, Temporary, Irreversible, Possible, Medium Significant.

b) Mitigation

If the EPC Contractor constructs a coffer dam partially or fully across the river or erects any other structure in the river bed which can break the supply of perennial river flow for irrigation or drinking purpose to downstream riparian or inhabitants, the Contractor shall ensure a regular supply of perennial river discharge to downstream riparian and inhabitants in accordance with their traditional rights. It should be obligatory for the project to release minimum water flood downstream the weir site throughout the year as environmental flow. Water requirement for downstream residents should be incorporated in the overall design of the project by the EPC Contractor.

6.5.2 Impact of Seismicity

a) Impact

The seismic zones map of Pakistan (**Figure 4-2**) shows the project area on the edge of zone 2 moderate damage. Teleseismic data shows a concentration of seismic activities in three main zones around the project area[13].

- The Hindukush region in the NW;
- The Daral - Tangier – Haran valley region in the NE; and
- The Indus – Kohistan seismic zone in the SE.

No change (+/-) in the impact of seismology risk of the area is expected during the project construction phase as none of the project activities is expected to be of such a powerful extent to influence the tectonic risk. However, the seismic potential of the region can disrupt the project construction activities at any time during construction phase of the project. This impact is Local, Temporary, Irreversible, Possible and High Significant.

b) Mitigation

All structures to be built must be designed giving maximum allowance to seismic factors. A very careful analysis of the situation will be required during the detailed design stage of the project by the EPC Contractor.

[13] Strategic Environmental Assessment of the Master Plan for Gilgit City, IUCN Pakistan (National Impact Assessment Programme)

The seismic design parameters for the project (50 years lifetime) are recommended as a Maximum Design Earthquake (MDE) of 0.25 g with 10% probability of exceedance with a corresponding return period of 475 years, and an Operation Basis Earthquake (OBE) of 0.15 g with 50% probability of exceedance and 75 years return period.

6.5.3 Landsliding

a) Impact

The construction activities for the proposed project interventions involving cutting of rocks, large scale excavation, dumping of soil and blasting and to create space for the headrace channel and forebay may disturb the stable geological formation of the area. High seismic potential and unstable geological formations are two major causes of land sliding in the area. These affects could promote bank instability and increase land slide in unstable area. Furthermore, due to the project activities, especially blasting of rocks in some areas, the formation will become loose and the risk of landslides will increase in the immediate vicinity of the construction sites, which may be considered as a high adverse impact of the project. This impact is Site-specific, Temporary, Irreversible, Likely, Medium Significant.

b) Mitigation

Blasting should be minimized where possible; if inevitable then low intensity explosive material should be used instead of high intensity explosive material. The headrace channel can be covered with RCC slabs at the top at places where the crossing of animal and human is foreseen. An aqueduct can also be provided at nullah/drain crossing. This aspect shall be investigated during the design of the project by the EPC Contractor. Some part of the headrace channel will pass through Amphiobolites where the excavation is difficult and need controlled blasting. Some safety measures along the slope side should be recommended in design to protect against sliding, particularly in rolling areas. It is strongly recommended to perform appropriate confirmatory geotechnical investigations all along the alignment of Headrace channel for assessing strength parameters of natural material either rocks, moraines or scree. This shall be done so that safety of this major project component and adjacent areas can be ensured through proper design of cut slopes.

6.5.4 Topography

a) Impact

Construction activities are not expected to impact the topography of the area significantly except for those areas where physical activities including digging and excavation areas, storing or dumping sites for excessive material, storing areas and movement of heavy construction machinery will be carried out. The excavated material will be generated due to the construction of various components of the project like power house, weir, headrace channel, forebay, penstock and tailrace. The area where excavated material is to be dumped will also be negatively impacted. This impact is Site-specific, Temporary, Irreversible, Possible and Low Significant.

b) Mitigation

The excavated material will require safe disposal by the Contractor. Most of the excavated material could be used in back filling of powerhouse, headrace channel main weir and making banks and concrete aggregate to be used in construction. A detailed development and operation plan for borrow areas must be prepared by the contractor at the pre development phase (before the starts of extraction of material from each borrow area). Contractor should strictly follow the provisions of approved plan in order to minimize any negative impact associated with the borrow areas. Likewise, excavated material should be dumped at suitable and approved disposal sites.

6.5.5 Soil Contamination

a) Impact

The construction activities may produce waste containing Carbon based compounds. All the carbon based compounds are toxic to varying degrees. Hydro Carbons (HCs), petrol, diesel etc. are toxic in nature. The insulation on electric wires and cables are made from hydrocarbon compounds, which are toxic. Paints and varnishes are also toxic in nature, which may be used during construction. If proper care is not taken for handling, storing and transportation of these toxic substances, these may cause damage to the health of the workers as well as their spills will contaminate the soil. This impact is Site-specific, Temporary, Irreversible, Likely and Medium Significant.

b) Mitigation

The contractor will carefully handle the material quarried during loading, unloading and transportation. The contractor will not leave the borrow pits in an unusable condition such that it could be filled with rain water and cause the problems for the community e.g. breeding place for mosquitoes etc. The contractor will ensure that the selected borrow areas are clearly demarcated, and indicate the maximum allowable depth of the pit before the soil is excavated. Barren or unfertile land will be preferred for use as a borrowing area than agricultural land.

Oil leakages, chemicals and other liquids spills should be avoided/minimized by providing appropriate storage places depending on the type of material for storage. Oil and other lubrication material should be stored in water proof tanks especially built for oil storage. These tanks should be built away from the main road and residential areas or safety purposes. Access to these tanks should only be allowed to the authorized personnel. Safety equipment like fire extinguishers should be placed near these places along with signs for danger and fire.

Workers must be familiar with the Material Safety Data Sheets (MSDS) of each chemical used at site. MSDS are provided with each chemical drum. Chemicals will be stored as per the instructions of MSDS. Utmost care should be taken during the handling of these chemicals. Precautions should be taken to prevent spills and all workers should be trained in proper handling, storage and disposal of hazardous or toxic materials.

6.5.6 Air Quality

a) Impact

Air quality will be affected by the fugitive dust, particulate matter and emissions (such as SO_2, NO_2, CO, etc.) from the construction machinery, vehicular traffic and equipment during the construction phase that will directly and temporarily impact ambient air quality. Emissions may be carried over long distances, depending on wind speed and direction, the temperature of the surrounding air, and atmospheric stability. This will also have negative impact on air quality and aesthetics of the area. This impact is Site-specific, Temporary, reversible, Likely and Medium Significant.

b) Mitigation

- Crusher and Concrete batching Plants should be installed at a fair distance from Hanzel and Harpoon village. Moreover, it is recommended that crushers should be equipped with dust suppression equipment comprising of scrubber and water sprays. This will significantly reduce the amount of dust released from the crushing plant. Sprinkling of water should be performed during the construction stage wherever there is potential source for dust in the project area;

- Spray water on spoil-heaps if there are dust generating materials accumulated during dry periods especially near schools, dispensaries etc.;
- Cover all dust generating loads carried in open trucks;
- Vehicles and other construction machinery should be properly tuned and maintained, to avoid hazardous level of emissions;
- The NEQS applicable to gaseous emissions and noise levels generated by the construction vehicles, equipment, and machinery should be enforced during the construction of works;
- Corrugated steel sheets should be installed around the Project boundary to minimize the dispersion of dust emissions into the nearby areas;
- Where necessary, dust emissions must be reduced by a regular sprinkling of water for keeping the dust settled, at least twice a day; and
- Avoid overloading trucks and cover trucks to minimize dust and loss of load from trucks during transportation.

6.5.7 Noise and Vibration

a) Impact

All the above activities will likely include the use of machinery and equipment such as generators, hammers, compressors, etc. and which are expected to be a source of noise and vibration within the Project site and its surroundings. If improperly managed, there is risk of nuisance and health affects to construction workers onsite. It is very unlikely that other nearby surrounding receptors will be affected from noise generating activities given their distance from the Project site. This impact is Site-specific, Temporary, Reversible, Likely and Medium Significant.

b) Mitigation

Apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc.; and Comply with the Occupational Safety and Health Administration (OSHA) requirements to ensure that for activities associated with high noise levels, workers are equipped with proper Personal Protective Equipment (e.g. Earmuffs). Low intensity explosive should be used in blasting activities instead of high intensity blasting material.

6.5.8 Wastewater Generation

a) Impact

Sewage and wastewater will be generated at the construction camps and from construction activities. If the generated sewage is not properly treated or disposed of, this may contaminate the irrigation channels and might affect the groundwater resources apart from soil contamination. Water from dewatering activities (during rainy season) has the potential to contain suspended solids and oil and grease and if disposed of untreated may affect the soil quality. Such contamination of irrigation channel may have highly adverse impacts on agricultural productivity. **Table 6-1** and **Table 6-2** shows the anticipated composition and estimate of the wastewater to be generated during the course of the construction phase of the project assuming that on average the water demand per person is 100 liters per day and that 80% of the water demand will become wastewater.

Table 6-1: Estimated Wastewater Generated by Workers in Construction Camps

No. Of Workers	Estimated Total Water Demand (liters/day)	Estimated Wastewater Generated (liters/day)
200 (on average)	20,000	16,000

Table 6-2: Anticipated Composition of Wastewater from Construction Camps

Sr. No.	Constituent	Unit	Range (Kl)
1	Total Dissolved Solids	mg/l	350-1200
2	Total Suspended Solids	mg/l	100-350
3	BOD_5	mg/l	110-400
4	COD	mg/l	250-1000
5	Total Nitrogen	mg/l	20-85
6	Total Phosphorous	mg/l	4-15
7	Chloride	mg/l	30-100
8	Sulfate	mg/l	20-50
9	Alkalinity	mg/l	50-200
10	Total Coliforms	colonies/100 ml	106-109
11	Grease	mg/l	50-150
12	VOCs	mg/l	100-400

Source: Adapted from Metcalf and Eddy, 1991

This impact is Site-specific, Temporary, Reversible, Likely and Medium Significant.

b) Mitigation

To avoid sewage, untreated wastewater, chemicals and oil spillage from draining into the irrigation channels nearby during construction activities, measures should be taken to contain the chemicals and treat the sewage and untreated wastewater. Contractor should not in any case dispose of these chemicals into the nearby irrigation channels and Gilgit River. Any visible oil and grease should be skimmed off the surface using absorbent pads. According to the National Environmental Quality Standards, BOD of all the surface discharges from domestic wastes should not exceed 80 mg/l. For Sanitary drainage, installation of proper temporary sanitary sewage disposal facilities for the entire site should be considered. These include provision for the construction camp & office and living area. The sanitary sewage facilities should be adequately sized.

6.5.9 Solid Waste

a) Impact

Considering the labourers (about 200) residing in the construction camp and the locally available labour, an average solid waste generation rate of 0.5 kg/capita/day[14] is adopted for the estimation of solid waste generation. Based on this assumption, a total of about 100 kg of solid waste will be generated from the construction camp daily. The major components of the labour camp waste will be garbage, putrescible waste, rubbish and small portion of ashes and residues. Other type of wastes may include inorganic construction wastes. These wastes will be

[14] Source: The World Bank Report 2012 – What a Waste: A global review of solid waste management. Based on UNEP estimates for waste generation in the Asia Pacific. Average is 0.45 kg/capita/day.

generated due to the construction activities and the materials used for construction. This waste would require proper disposal to minimize land and water contamination. This impact is Site-specific, Temporary, Reversible, Likely and Medium Significant.

b) Mitigation

- None of the solid waste will be disposed-off into the Gilgit River and nullahs;
- Solid waste generated during the construction at camp sites should be properly and safely disposed off;
- Arrangements should be made for collection of solid waste generated from the construction camp by placing the collection bins in the camp area;
- Additional communal containers should be placed near the construction camp which will receive waste from waste bins placed inside construction camp. Waste from these communal containers will be collected by Solid Waste Management Authority for its disposal;
- Containing all stored wastes within construction sites and avoiding littering and runoff;
- Optimizing and reducing waste production;
- Avoiding mix of different waste and minimizing waste disposal into the drain;
- Sorting the waste according to its type and origin;
- Storing selected materials in safe place in order to avoid contamination, especially if they will be shipped out for recycling;
- Preferring local recycling or reuse before shipping out for recycling before waste disposal;
- Properly disposing of all used fuel and lubricant oils in environmentally sound manner, either by recycling or for other use such as fuel for hot mix plant, etc.; and
- After construction has finished, removing all machinery and waste from the project area.

6.5.10 Flammable, Explosive and Hazardous Materials

a) Impact

Explosive materials will be required for rock excavation and penstock installation and other facilities. Other major flammable materials to be used during the construction activities include diesel, furnace oil, petrol, LPG, kerosene oil and machinery fuels. These materials present little risk to the environment, if properly transported stored and used; otherwise they are potentially very dangerous. Improper storage and handling practices for these flammable and explosive materials can pose dangers of fire and blasts in the area.

Unsafe disposal of excavated material may not only create the environmental degradation but also a nuisance for the surrounding community. Moreover, borrow areas, if left open, may prove hazardous to human beings, wildlife and livestock of the area. This impact is Site-specific, Temporary, Reversible, Possible and Low Significant.

b) Mitigation

Safety procedures should be developed and followed by the contractor and labour strictly while using, handling and storage of these materials and explosives. Contractors should be provided written instructions about the methods and safe practices of using flammable materials and explosives.

For safety of construction labour and immediate communities, it is suggested that contractor’s staff should be trained about the procedures of blasting, safe use, handling and storage of materials.

Emphasis should be to decrease the volume of mucking material by reusing and then the disposal at the marked area in environment friendly way. In order to reduce the volume of disposal material, maximum part of the excavated material can be used in other activities filling of borrow areas and natural depressions in the project area. In order to increase the aesthetics of the area, native grass can be planted by dumping the surplus material in the proposed residential colony with suitable soil cover.

6.5.11 Health and Safety

a) Impact

Throughout the construction phase there will be generic occupational health and safety risks to workers, as working on construction sites increases the risk of injury or death due to accidents. The following risks are generally associated to construction sites and apply for the construction of the Project and could include:

- Slips and falls;
- Moving machineries;
- Exposure to chemicals, hazardous or flammable materials; and
- Taking into account the Project site, construction workers are expected to work in hot weather conditions in summers, and thus are exposed to dehydration, heat exhaustion, and heat stroke.

This impact is Site-specific, Temporary, Irreversible, Possible and Medium Significant.

b) Mitigation

- Ensuring all occupational health and safety requirements in place;
- Understanding the use of Personal Protection Equipment (PPE) and ensuring its use properly;
- Installing lights and cautionary signs;
- Developing and ensuring implementation of safety and inspection procedures;
- Safe handling of toxic materials and other hazardous substances (If used);
- Implementing a system of penalties for violation of rules and regulations;
- Introduction to health and safety issues in construction sites by the Contractor;
- Providing education on basic hygienic practices to minimize spread of tropical diseases, including information on methods of transmission and protection measures for diseases;
- Assuring the availability of medical assistance in emergency or nonemergency situations and availability of other health related assistance such as first aid facilities; and
- Identifying in details the hazards which may be associated with the various activities to take place and the various measures to be implemented to reduce such risks. This includes for example safety devices for welding and cutting, work at elevated places.

6.5.12 Traffic

a) Impact

A total of 200 m sections of road around powerhouse and weir site will be affected during the construction period. The section of road for crossing of the Headrace/Power Channel, Penstock and spillway that will require to be upgraded or an alternate route during construction period of the project should be constructed to allow the occasional traffic mobility smoothly. There may be chances of accidents due to the increase in traffic volume. This impact is Site-specific, Permanent, Irreversible, Likey and High Significant.

b) Mitigation

The existing Hanzel road connects two important districts of Gilgit and Ghizer. To mitigate the

200 m sections of the affected road, approximately 550 m of the existing Gilgt-Ghizer road will be realigned at lateral intake and sedimentation basin will be the responsibility of the EPC Contractor during construction[15]. The EPC Contractor may utilize other alternate road from the nearby settlement after upgradation if find feasible for the smooth flow of traffic on Gilgit-Ghizer road. This will serve as alternate route during construction. However, the EPC contractor will make arrangements to keep it functional during construction and restore it to its original state after the construction activities are over. The proposed Project design includes six bridges or culverts as given in Section 3.3.4 of Chapter-3. The EPC contractor will prepare a Traffic Management Plan (TMP) in order to ensure safety to all road users during the construction of access roads and bridges. The plan will ensure the efficient operation of the road together with the construction activities. TMP will show the access roads for vehicles, speed limits, safety signs and lane restriction where applicable. The contractor will submit this plan to Supervision Consultant for review and approval.

6.5.13 Flora

a) Impact

The project will involve destruction of vegetation cover on construction areas particularly headrace channel and powerhouse. About 2,240 trees of small and medium sizes will be removed due to the layout of the project for which compensation will be made to concerned parties (local community/forest department.) The direct & indirect assessment, in cutting of total 2,240 trees and plant approximately 1040 trees/plants will be affected at headrace channel and 1,200 from penstock, spillway and power house area and at the time of study September 2017. However, no significant tress/Plants were found at Weir & Forebay immediate sites.

Exhaust of noxious gases from movement of heavy machinery and dust will pollute air which will adversely affect health and vigor of plants. During construction activities the Contractor's workers may damage the vegetation and trees (for use as fire-wood to fulfill the camps requirements).

Overall, it can be stated that given the relatively small areas affected and the present status of the vegetation in these areas no forest of other valuable habitat types, no rare or vulnerable species present in the AOI.

This impact is Direct, Site-specific, Short-term, Irreversible, Possible and High Significant.

b) Mitigation

Cutting of trees shall be avoided, as far as possible so, that negative effects on the process of natural regeneration of species are minimized. A tree plantation program shall be formulated with the recommendations and technical support of Forest Department, GB.

As a principal, ten trees shall be planted in place of felling of one tree in consideration of mortality. Water and Power Department, GB shall implement the program with the help of Forest Department or through a Contractor over locally available best land and with the consultation of District Forest Officer (DFO) Gilgit. As the land along the slopes generally belongs to the communities/individual owners, the Forest Department in turn shall involve the communities for carrying out plantation.

Open fires should be banned in the area to avoid hazards of fire in the area. Clearing of vegetation cannot be avoided at the areas specified for project structures, but damage to the

[15] Tender Document Contract No ICB-01, Volume -2A, Part I – Project Construction Requirements

natural vegetation may be minimized by establishing campsites, workshops and batching plants on waste/barren land rather than on forested or agriculturally productive land.

However, if such type of land is not available, it shall be ensured that minimum clearing of the vegetation is carried out and minimum damage is caused to trees and undergrowth. Construction vehicles, machinery and equipment will remain confined within their designated areas of movement.

The Contractor's staff and labour shall be strictly directed not to damage any vegetation such as trees or bushes. They shall use the paths and roads for movement and shall not be allowed to trespass through farmlands or forested areas. Contractor shall provide gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel shall not be allowed.

6.5.14 Fauna

a) Impact

During construction phase the existing population of mammals and reptiles of the construction areas will be affected due to disturbance arising from construction activities involving excavation, blasting, movement of machinery and vehicular traffic, movement of labour, camping, etc. The existing animals will leave the directly affected areas due to construction activities and human intervention. Some animals particularly reptiles may get killed during the earthworks operations. Moreover, the movements of the mammals and reptiles will be restricted during the construction phase.

The Project area is lying under Hanzel CCHA & near (Approximately 4,000 m) to Kargah game sanctuary so, rare wildlife movement is possible and disturbance through headrace channel is expected.

Birds as well will tend to move away from the construction areas and find shelter and food elsewhere due to the activities mentioned above for fear of being hunted / trapped.

Noise generated from blasting and machinery particularly during the night hours will even scare the wildlife residing in habitats located at some distance from the construction areas. Uncontrolled blasting may even disturb the wildlife of the Project Areas. Food and refuse at the Contractor's camps may attract animals that might in turn be hunted by the workers. This impact is Indirect, Site-specific, Temporary, Reversible, Possible and Medium Significant.

b) Mitigation

Care shall be taken during construction activities for avoiding purposely or chance killing of animals. Hunting, poaching and harassing of wild animals shall be strictly prohibited, and Contractor shall be required to instruct and supervise its labour force accordingly and clear orders should be given in this regard. The Contractor must be held responsible for instructing his work force accordingly and for enforcing this restriction. In addition, this shall have to be controlled by the Wildlife Department.

Special measures shall be adopted to minimize impacts on the wild birds, such as avoiding noise generating activities during the critical periods of breeding. Blasting and other noise generating activities shall not be carried out during the night by the work force, clear orders should be given. The Contractor must be held responsible for instructing his work force accordingly and for enforcing this restriction. In addition, this will have to be controlled by the Wildlife Department.

The EPC contractor must be bound during design & construction stages and it is highly recommended to provide permanent provision of pathways/bridges & permanent water points for locally available wildlife after and during construction of project.

Camps shall be located at least 500 m away from the nearest wild life area and their source of food as well as water. The camps shall be properly fenced and gated to check the entry of animals in search of eatable goods. Similarly, wastes of the camps shall be properly disposed of to prevent it being eaten by animals, as it may be hazardous to them.

Manpower working at construction site should be aware to protect wildlife. Noise produced by blasting and other construction activities may be kept to acceptable level. Any stray animals found may be handed over to game watcher posted at Hanzel village.

6.5.15 Aquatic Ecology

a) Impact

The fish fauna is poor due to low temperatures, high turbidity of water, high speed of flows, lack of nutrients in water, low benthic growth and long stretches of gorges through which river flows. Brown trout and rainbow trout are found in cold water and in upper tributaries of Gilgit River. The downstream movement of fish is not restricted due to construction of weir and a lot of water is available downstream of weir, hence impact on fish habitat is insignificant.

It is considered that with regard to the already low species population and diversity that exists in the area, this flow will be sufficient to maintain the viability of the aquatic system from the weir site to confluence of Gilgit River and tailrace channel. The impact on aquatic ecology during construction activities will be low adverse.

This impact is Direct, Site-specific, Permanent, Irreversible, Likely and Low Significant.

b) Mitigation

During the construction of the project by the EPC Contractor, special attention should be given to ensure to plug off the leakages of oil and other chemicals dispersants from turbine and machine engines to avoid hazardous effect on aquatic life.

The labour working at construction site should be aware to protect especially edible fish & to avoid fish catching by any means. As according to law of land fish hunt is prohibited with net, cages and by the use of dynamite.

The excavated material produced during construction has to be disposed off in a way that it does not enter into the Gilgit River.

6.5.16 Built-Up Areas and Infrastructure

a) Impact

As per project foot print, topographic and GIS surveys, approximately 13 houses, 2 schools, 1 hotel, 13 huts will be affected mainly during the construction of the headrace channel as the houses and other infrastructure are mainly exists on the foothills of the proposed headrace channel. This impact is Direct, Site-specific, Temporary, Irreversible, Likely and Medium Significant.

b) Mitigation

The loss of private built up area and infrastructure should be compensated according to the provisions of the LAA, 1894. Other government infrastructure should be relocated by the concerned department in consultation with the project proponent. It is recommended that school buildings should be constructed before the relocation of these institutions so that the education of the children and health will not get affected.

- Compensation will be paid to the affectees for the built-up areas like buildings, huts, animal sheds, electric motor sheds etc. on replacement cost basis and the land on existing agricultural land value;
- Payment of three (03) months house-rent will be made to the affectees while they will construct a new abode for their families;
- Full market price of any equipment (not shiftable) and cost of reconstruction including labour charges will be paid to the affectees; and
- Affectees will be allowed the salvaging of the demolished materials.

6.5.17 Agriculture

a) Impact

Based on the social survey the agriculture crops of the tract along the headrace channel in Hanzel Bala will receive significant adverse impact due to various operations such as movement of heavy machinery, blasting and construction of headrace channel. This impact can be categorized as Direct, Site-Specific, Medium Term, Temporary, High Probability, Reversible and Medium Significant.

b) Mitigation

Land holders will be paid compensation for the loss of their standing crops in accordance with the prevailing market rates as per LAA. The landholders will also be allowed to salvage the agricultural crops and other vegetation from the affected fields.

6.5.18 Conflict over Resources

a) Impact

It is anticipated that local water resources (spring water) will be utilized to meet the camp and construction requirements. This may cause conflicts between the locals and the Contractors. Because the locals are using this spring water for drinking as well as agriculture purpose and they are already facing water shortage for agriculture. This impact can be categorized as Direct, Low, Site-Specific, Short Term, Temporary, Low Probability and Irreversible.

b) Mitigation

The following measures will be carried out to mitigate the impacts of tapping local community water resources, where required:

- In area of Hanzel Bala and Hanzel Paine where the potable water is in short supply; the water will be provided through vehicles;
- The Contractors will be required to maintain close liaison with the local communities to ensure that any potential conflicts relating to the common resource utilization are resolved quickly; and
- Guidelines will be established to minimize the wastage of water during the construction activities and at camp sites.

6.5.19 Public Health

a) Impact

- Local community in the AOI villages such as Hanzel Bala, Hanzel Paine and Harpoon will be affected by noise, dust and vibration during the construction activities, which may have adverse impact on the health of the locals. These impacts are expected to be high in the construction of headrace channel, forebay and power house areas;
- There is one (01) boys primary school in Hanzel Bala which about 100 students are studying while one (01) govt. dispensary fall in the AOI of headrace channel both

institutions will be adversely affected during construction activities due to noise, air pollution and vibration and due to close vicinity of the headrace channel both institution may have to relocate nearby area. During the construction activities, elevated air and noise levels may create short term and long term health issues such as respiratory diseases by air pollution and hearing impairment, hypertension, annoyance, and sleep disturbance by noise pollution for the students and staff as well as local population residing in the, Hanzel Bala, Hanzel Paine and Harpoon.

These impacts are Site-Specific, Temporary, Irreversible, Low Significant and needs to be monitored during the whole construction phase.

b) Mitigation

Water sprinkling, encasement/provision of silencer and mini stacks of generators would be helpful to avoid inconvenience to the locals due to noise, smoke and fugitive dust.

Currently, headrace channel route is buried. However, at detailed design stage maximum effort should be done to avoid disturbance of structures such as houses, schools and dispensary through construction of the tunnel. Special measure and advance technology should be adopted to reduce the noise and vibration impact on the students as well as locals.

6.5.20 Other Socio-economic Impacts

a) Impact

- The movement of construction vehicles from the Gilgit to site and site to quarry areas may create annoyances to the residents and traffic on the road. Transportation of heavy construction equipment and material is likely to affect the Gilgit-Ghizer road. The existing road is single and with narrow turns. Therefore, may be needs widening of road for accessibility to the project site and due to existence of nearby residential areas, locals would face the noise and dust issues. During the development of weir area traffic congestion will be another major impact on the road;
- Conflict between local communities and people arriving in the area for work and / or new opportunities. The local communities are very sensitive about their cultural values;
- Criminal activity may arise as changes occur in the local social culture;
- Theft problems to the nearby community by the Contractor’s staff and vice versa;
- Local community may face accidents/incidents due to construction stage;
- Usage of the Community’s common resources like potable water, fuel wood, etc. by the Contractor workforce may create conflicts between the community and the Contractor;
- Improper arrangement of the disposal of construction materials may create problems for the local residents during the construction stage of the Project;
- Blasting near residential area like Hanzel Bala and Hanzel Paine may create problems for the locals;
- Relocation/disturbance to the existing utilities like electric poles, telephone poles, etc. may affect the routine life and mobility of the community;
- General mobility of the locals especially in the Gilgit-Ghizer road will be disturbed during the construction stage of the Project; and
- Gender issues and hindrance to the mobility of local women due to induction of outsiders by Contractor, who may not understand / respect cultural norms and values.

These impacts are Site-Specific, Temporary, Irreversible, Likely and Medium Significant.

b) Mitigation

- A Traffic Management Plan (TMP) will be prepared by the EPC contractor in consultation with communication and works department Gilgit for smooth flow of traffic on the Gilgit-Ghizer road;

- Good relations with the local communities should be developed. Contractor should provide job opportunities to skilled and unskilled locals and on-the-job training in construction for young people;
- Contractor will restrict his permanent staff to mix with the locals to avoid any social problems by developing code of conduct;
- The Contractor will keep all the copies of Computerized National Identity Card (CNIC) of his employees and will warn the workers not to involve in any theft activities and if anyone would involve in prohibited/criminal activities, the concerned police station will deal with it and he will have to pay heavy penalty;
- Similarly, at the time of employment, Contractor has to take care that the workers should be of good repute. The Contractor camp will be properly fenced and main gate will be locked at night with a security guard to check the theft issues;
- Contractor should arrange first aid kits along with medical officer in the field. Routine medical check-ups of all the field staff including unskilled labour need to be conducted by a qualified doctor;
- Training of workers in construction safety procedures, environmental awareness, equipping all construction workers with PPEs, safety boots, helmets, gloves, and protective masks, and monitoring their proper and sustained usage will be carried out. In case of accidents, contractor will provide free medical treatment to the community;
- Local vendors will be preferred for purchase of camp site goods and services.
- Proper arrangements in the form of alternative routes should be made to ensure that the mobility of locals should not be disturbed;
- The Contractor will take due care in disposal of construction materials as well as solid waste to the proper places, so that the nearby communities will not suffer;
- The Contractor will take care of the local communities water needs and will not exploit, contaminate or damage community's water sources;
- Blasting should be avoided near the settlements like Hanzel Bala and if unavoidable, it should be carried out during the fixed hours (preferably during the mid-day). The timing will be made known to all the people within 500 m from the blasting site in all directions and prior to the blasting thorough inspection should be conducted; and
- In construction camps, amenities of life including clean food, water and sanitation facilities should be provided to these camps. The Contractor should arrange first aid boxes at camps; and
- The Contractor will warn the staff strictly not to indulge in any un-ethical activities and to obey the local norms and cultural restrictions particularly with reference to women.

6.5.21 Indigenous people

No indigenous group fall in the AOI of the proposed Project. Hence there will be no impact on indigenous people.

6.5.22 Gender Issues

a) Impact

In the villages of AOI few houses have no latrine facility therefore; some women living in these areas have to use the open field latrines. The privacy of women in Project AOI may suffer due to the Project activities.

This impact is Site-Specific, Temporary, can be Reversible and Low Significant which needs to be encountered during the construction stage.

b) Mitigation

- The Contractor has to carry out the construction activities in the area in such a way that the open field latrine usage timings by the local community particularly women, should not be affected. The normal timings to use the toilet facilities by the women are early in the morning and at evening so the Contractor will have to take care of these timings;
- Contractor should warn the staff strictly not to involve in any un-ethical activities such as theft, prostitution, harassment of working women as well as college students and to obey the local norms and cultural restrictions particularly with reference to the women; and
- If privacy of the nearby houses will be affected and the Project activities are unavoidable, the management should take steps to not affect the privacy.

The house in the surroundings of the headrace channel may face privacy issues during the construction stage.

6.5.23 Archaeological Resources

a) Impact

One archeological feature named as Hanzel stupa was identified near to the Project at Hanzel Bala village. No direct impact is foreseen on this Stupa as it is located at a reasonable distance from the headrace channel. However, during the construction stage this site may be affected due to heavy vehicles movement on the road, blasting, dust and vibration.

The Stupa is located at a reasonable distance therefore; this impact is Low, Site-Specific, Temporary, and Irreversible.

b) Mitigation

The Project must ensure that construction works do not result in vibration that could damage adjacent structures. Blasting should be done in a controlled manner to avoid the noise and vibration impacts in consultation with the locals and to decide the appropriate time for the controlled blasting. The EPC contractor should also conduct and take guidance from Archeology Department Gilgit during the construction stage. Contractor should be very careful about the excavation of the area. In case of a chance finding during excavation, the Contractor will protect the site and notify the Department of Archaeology & Museums through Water and Power Department, GB.

6.6 EVALUATION OF IMPACTS DURING OPERATIONAL PHASE

The anticipated environmental impacts during the operation are discussed herewith;

6.6.1 Sedimentation

a) Impact

Accumulation of sediment may disturb the efficiency of project components. Sediment load released from the sand trap could have adverse effect and synergetic with low flow of water will put aquatic system under stress. However, it should be kept in mind that during low flows the sediment concentration is very low. Floods and heavy rains carry large sediment loads, which can have a more severe medium impact than the sand trap flushing.

b) Mitigation

A sediments clearing mechanism will be provided in the detail design and should be followed. The river carries, on the average, about 14% sand, 73% silt and 13% clay. Sediment flushing and de-silting arrangements have to be carefully designed by the EPC Contractor. It is recommended that a sediment sampling program during high flow season for estimating bed material load and bed load and its gradation should be initiated based on the technical and economic viability.

6.6.2 Solid waste from Office Building and Other Allied Facilities

a) Impact

The project operation will result into generation of organic as well as in-organic waste. This waste may have significant impact on soil, ambient air, residents living in proximity to the Project, as well as on the aesthetic values if improper systems are adopted. In order to assess the impacts and proper designing of collection, transportation and disposal system, it is imperative to quantify the solid waste generation and assess its characterization.

This impact is Site-specific, Long-term, Reversible, Likely and Medium Significant.

b) Mitigation

Provisions should be made for proper solid waste management, which will involve the following major operations:

- Storage at Source;
- Component Separation at Source;
- Collection of Waste;
- Storage;
- Transportation;
- Resource Recovery for recycle and reuse items; and
- Disposal of Waste (sanitary landfill).

EPC Contractor should make final disposal arrangements in consultation with the concerned government department and should take approvals for final disposal of the waste at the designated disposal site.

A separate solid waste management system for waste from the office building and other allied facilities will be required. During the collection of solid waste, recyclable and reusable waste will be separated for resource recovery and reuse of the generated material.

6.6.3 Soil and River Water Contamination

a) Impact

The accidental oil leakages from the power house may contaminate the soil and water quality of the Gilgit River downstream of the powerhouse. This impact is Site-specific, Temporary, Reversible, Possible, Long Term and Medium Significant.

b) Mitigation

Proper drainage and dewatering system is recommended for Hanzel Hydropower Project. A drainage pump of appropriate capacity will be specified to cope with the leakage of powerhouse. A dewatering pumps will be specified for unit dewatering. Both of these pumps will be installed in drainage and dewatering pit and they will provide redundancy for each other.

6.6.4 Fire Breaking

a) Impact

For the proposed hydropower plant there is also a risk of fire breaking out in powerhouse and switch yard area that may become a serious risk for residents living in allied facilities and/or nearby in the vicinity of the proposed hydropower plant. This impact is Site-specific, Temporary Reversible, Possible, Short-term and Medium Significant.

b) Mitigation

Fire protection and detection systems shall be provided to protect life, property, equipment, and operation of the powerhouse. The detection and fire alarm, fire protection and fire-fighting systems shall include, but not be limited to the following:

- Firefighting water storage, may be combined with raw water tank, depending on local regulations;
- Firefighting pumps;
- Fire water ring main system, including hydrants;
- Fire protection systems; and
- Fire alarm and detection system.

All systems shall be subject to the approval of the insurance company. The systems shall be complete with all necessary piping, pumps, safety valves, mobile equipment, and vehicles. The EPC Contractor shall prepare an Emergency Response Plan (ERP) to cope with the emergency situations. Fire protection system for Generator is recommended.

6.6.5 Air Quality

During operation of the project, the air quality of the area will improve significantly as compared to the air quality of construction phase. There will be less road vehicles in the area, vegetation cover in the area will also increase in general. All these factors will improve the air quality of the area, which will be a positive impact of the project. This impact is Site-specific, Temporary, Irreversible, Unlikely, Medium Significant and needs to be encountered prior to the start of construction stage.

6.6.6 Noise and Vibration

a) Impact

The principal sources of noise and vibration during the operation phase include Intake Structure, Tunnel, Valve House and Powerhouse. The noise levels measured at the project site were within the permissible limits of NEQS but during the operational phase the noise levels may increase. Noise levels above the permissible limits result into various health impacts depending upon the intensity of noise. This impact is Site-specific, Long-term, Reversible, Possible and Low Significant.

b) Mitigation

Best practices should be employed in all noise generating activities. These include the proper maintenance of the pumping equipment and the proper muffling of operating equipment. Plantation of trees and other vegetation will also help to attenuate the noise impacts to the surrounding area.

6.6.7 Flora

a) Impact

Operational stage of the Project will not affect Flora (Trees and agricultural crops) or release any significant pressure detrimental to flora. Low level impact is expected at operational phase on Flora due to the operation and maintenance activities. This impact is Site-specific, Temporary, Short-term, Irreversible, Unlikely and Low Significant.

b) Mitigation

The implementation of plantation plan recommend in compensation for cutting of trees should start working during operational stage, to ensure the ecological balance and to avoid any impact on local Environment.

Large scale planting with suitable indigenous trees, shrubs and ornamental plants in the form of Tree Groves, and Linear plantation will be carried out in accordance with the Tree Plantation Plan to improve aesthetic value and offset the effect of removal of vegetation.

Proper check and balance for above activities is highly recommended. Plantations so, raised must be maintained according to the Silvicultural practices which include proper Irrigation, Cleaning, Pruning, Thinning at prescribed intensity, Silt clearance and Trench-opening, etc. in accordance with the approved practices of Gilgit Forest Department.

Maintenance and security of the forest area should be done for at-least five years in consultation with the forest department. Measures such as fencing, watch guards and fire protection should be considered.

All activities must be done under the technical supervision of Gilgit Forest department.

6.6.8 Fauna

a) Impact

As the project area is part of Hanzel “Community Controlled Hunting Area (CCHA)” and near to Kargah Game Sanctuary (approximately 4000 m Distance), some temporary corridors for wildlife movements may be affected due to headrace channel of 4.983 km (4,983 m) length. The headrace channel may cause disturbances to temporary or expected routes of ibex and Markhor specially babies of above.

No major impact on Wildlife & Livestock in the area is expected through, noise, vibration and any type of normal activity in the Power House, thus will have no effect on productivity.

This impact is Site-specific, Permanent, Irreversible, Possible and Medium Significant.

b) Mitigation

The pathways of locally available wildlife for food, shelter and other normal activities must be compensated with proper alternative routes/pathways & water points at hill side must be provided to minimize the impact & movement of wild animals to Gilgit River. The Passing bridges/crossings and railing on both sides of the channel is recommended to avoid any inconvenience to worthy ibex and Markhor. In proper consultations with Conservator GB Wildlife department permanent water points for available fauna must be provided to conserve local ecosystems & biodiversity.

Strict control must be exercised for stoppage of killing/poaching of available wildlife species by enhancing protection practices and deploying effective watch and ward system.

The precautionary measures described for future shall also be applicable during operation phase as relevant for the conservation of “Endangered”, “Vulnerable” and “Near Threatened” species in the Study Area. The proposed project also have provision in headrace channel construction for crossing bridges, to avoid any inconvenience for wildlife movement.

6.6.9 Aquatic Life

a) Impact

Once the construction phase is completed and water diverted at the site of weir will change the water flow regime from weir to powerhouse. This is a stretch of approximately 4.983 km (4,983

m) from weir to powerhouse. The negative impact will be due to low flow in the stream from weir to location of powerhouse especially during low flow season. A negative impact could also be that the fish population will be fragmented into a population above weir and one below the weir acting as a barrier to migration. This impact is Site-specific, Permanent, Irreversible, Likely and low Significant.

b) Mitigation

The low/lean flow season is March in which flow is recorded as 46 m^3/s and the highest is July i.e. 862.2 m^3/s. For the protection of the fisheries and other aquatic life 10% of average yearly flow is required (Tennat, D.L 1976 In-stream flow regimes for fish, wild life, recreation and related environmental resources). Based on the available data, the minimum flow to be ensured through the weir is more than 10% during the whole year. In case the hydrological records are enhanced, the figure of minimum requirement for maintenance of aquatic ecosystem has to be revised like wise.

Fish traps should be used to stop the fish movement to the intake structure and headrace channel. Fish ladders are highly recommended to compensate the impacts due to diversion of water flow. Without fish ladders, however, many more fish would be prevented from reaching their breeding and feeding grounds. As human action often negatively influences wildlife, it is important to have such structures in order to reduce unwanted consequences.

If any spawning areas are lost due to engineering interventions, they can be well compensated if stretches of stream are stocked annually with increased number of fish. The following measures and intervention including monitoring & evaluation are suggested to conserve and to rehabilitate the effected cold water fisheries resources as these activities will play an important role in replenishment of depleted stock and may also take part in poverty alleviation as well as in providing source of needed food to the marginalized people of the region.

One Biodiversity Fish hatchery is recommended (Biodiversity Fisheries hatchery cost: Chapter 7 EMP) in habitat loss for local available fish fauna. For management and conservation of fisheries, certain conservation, management and monitoring & evaluation staff should be recruited on recommendation of Fisheries Department, GB. Fisheries Department, GB must be consulted at all stages as it is the obligation of the department to manage all natural water resources in GB as per provision of existing Fisheries Act and Rules 1975. Integrated fish resource conservation and management with livelihoods development and establishment of trout farms in private sector for generating livelihood opportunities of the key stockholder communities will also play an important role in conservation of fish fauna.

In the proposed project area one may anticipate that the fish will locate new avenues for breeding. Due to low flow even more micro - macro invertebrates will flourish, thus providing more food for the fish. Creation of pools and puddles (which are now bare minimum) will provide more rest places for fish during extreme rigors of weather.

Proper Waste Management Plan should be prepared as power house will start offering jobs and masses will stay there for power activities. Gilgit River must be given proper protection from such waste of power house employees to avoid impact on the aquatic life.

6.6.10 Gender Issues

a) Impact

At operational stage the induction of outside labor for O&M works may create social and gender issues due to the unawareness of local customs and norms. It will also cause hindrance to the mobility of the local women. Disturbance may occur to the privacy of the local women residing in the nearby villages.

This impact is Site-specific, Long-term, Irreversible, Possible and Low Significant.

b) Mitigation

Project staff should respect the local community's sensitivity towards their customs and traditions. The staff must not involve any un-ethical activities and should obey the local norms and cultural restrictions particularly with reference to women.

6.6.11 Noise

a) Impact

Due to the operation of the power house noise and vibration will be produced which will have impact in the adjoining villages, schools, and surrounding areas. This impact is Site-Specific, Long Term, Reversible and Significance of the Impact Is Medium.

b) Mitigation

To minimize the noise of the proposed power houses pollution barriers should be placed around the boundary of the power houses and continuous monitoring should be done to determine noise levels and ensure that they are within the NEQS limits.

(This Space is Intentionally Left Blank)

CHAPTER 7 – ENVIRONMENTAL MANAGEMENT PLAN

7.1 OBJECTIVES

EMP provides an overall approach for managing and monitoring of the potentially significant environmental and social impacts of the proposed Project and describes the institutional framework and reporting mechanism to implement EMP for the Project. The EMP has been prepared with the following objectives:

- Provide project impacts along with the proposed mitigation measures, and corresponding implementation phase;
- Define the roles and responsibilities of the EPC Contractor related to environment;
- The EPC Contractor to implement and monitor the measures to be taken during construction phase of the project including implementation of the EMP and HSE plan;
- Frame a monitoring mechanism, reporting frequency, auditing mechanism and identifying monitoring parameters to ensure that all the mitigation measures are completely and effectively implemented;
- Define the requirements necessary for documenting compliance with EMP and communicating it to all the concerned regulatory agencies; and
- Provide guidelines to prepare other plans considering the project specific requirements.

7.2 ENVIRONMENTAL COMPLIANCE

The EPC Contractor shall comply with all applicable national and local environmental regulations and guidelines other than listed above.

The EPC Contractor shall (a) establish an operational system for managing environmental impacts, (b) carry out all the monitoring and mitigation measures that will presented in the Initial Environmental Examination (IEE) and Environmental Management Plan (EMP) for the project, and (c) allocate the budget required to ensure that such measures are carried out, and all cost for the implementation of such measures shall be borne by the EPC Contractor. The EPC Contractor shall submit to the Supervisory Consultant monthly environmental reports and quarterly reports on the carrying out of such measures that will also be reviewed by Water and Power Department (WPD), GB and Environmental Protection Agency (EPA), GB.

The EPC Contractor shall within one (01) month of receipt of Notice to Proceed, appoint the designated officials as mentioned in the institutional setup for the implementation of EMP and HSE Plan, and to guide the construction personnel on environmental matters, to communicate and to make liaison with the Supervisory Consultant, Government of GB, relevant department such as Environmental Protection Agency, Directorate of Fisheries Department and Wildlife and Parks Department and with local stakeholders.

7.3 INSTITUTIONAL SETUP

The Water and Power Department (WPD), GB as Project Proponent shall take the responsibility for the land acquisition related measures of the project and also do liaison with the EPC Contractor. It is a pre-requisite that all the land acquisition issues and compensation to Project Affected People (PAP) need to be handled and covered before mobilization of EPC Contractor. While the EPC Contractor will be mainly responsible for the implementation of the mitigation measures that will be suggested in the environmental report and “No Objection Certificate” (NOC) clauses. The EPC Contractor will also responsible for the implementation of EMP and HSE Plan at site. Considering the project nature, it is strongly recommended that Proponent should establish its own environment and social setup. The proposed organizational structure for both construction and operational phases are shown in **Figure 7-1 & 7-2** respectively.

Figure 7-1: Proposed Organization Structure during Construction

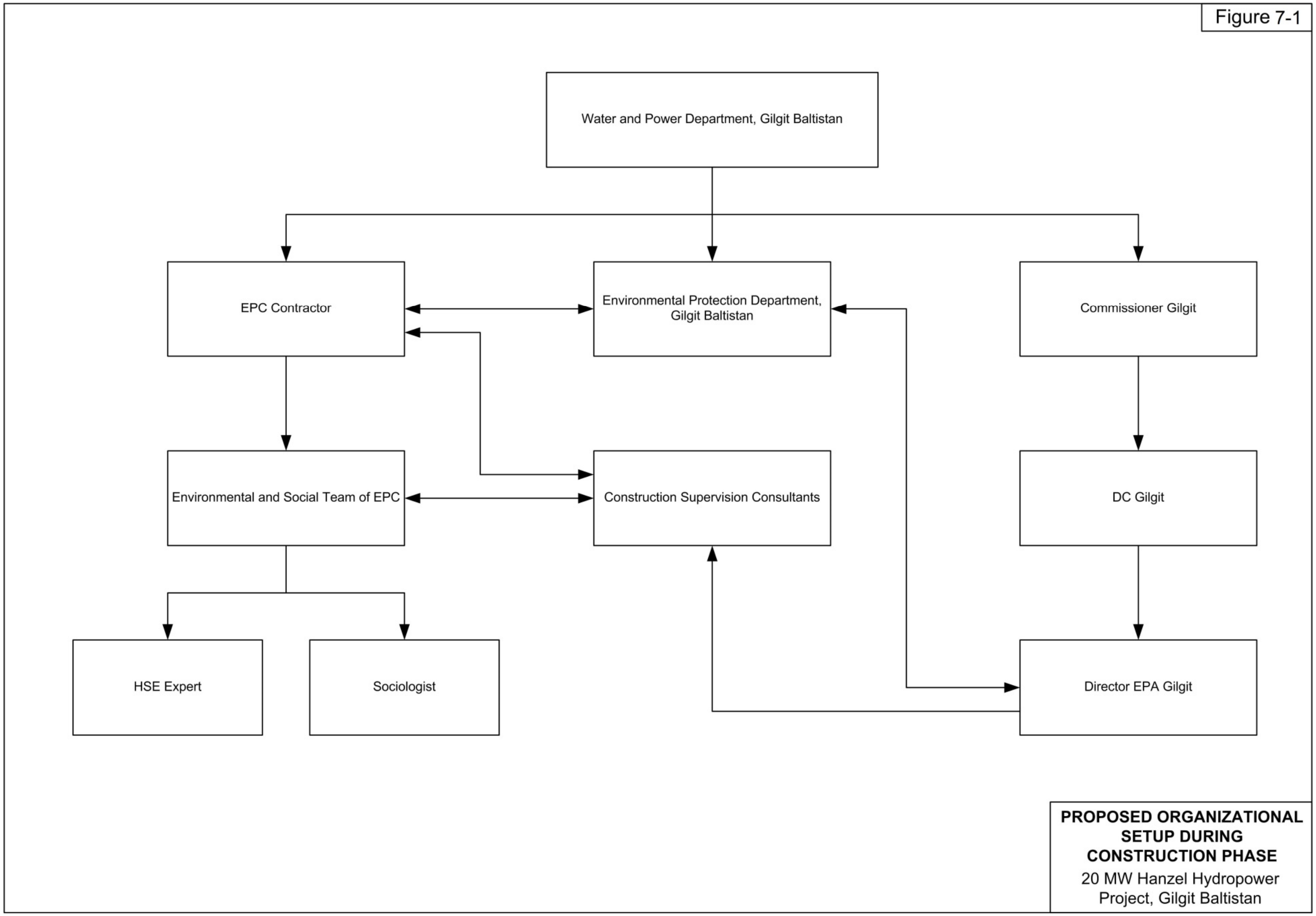
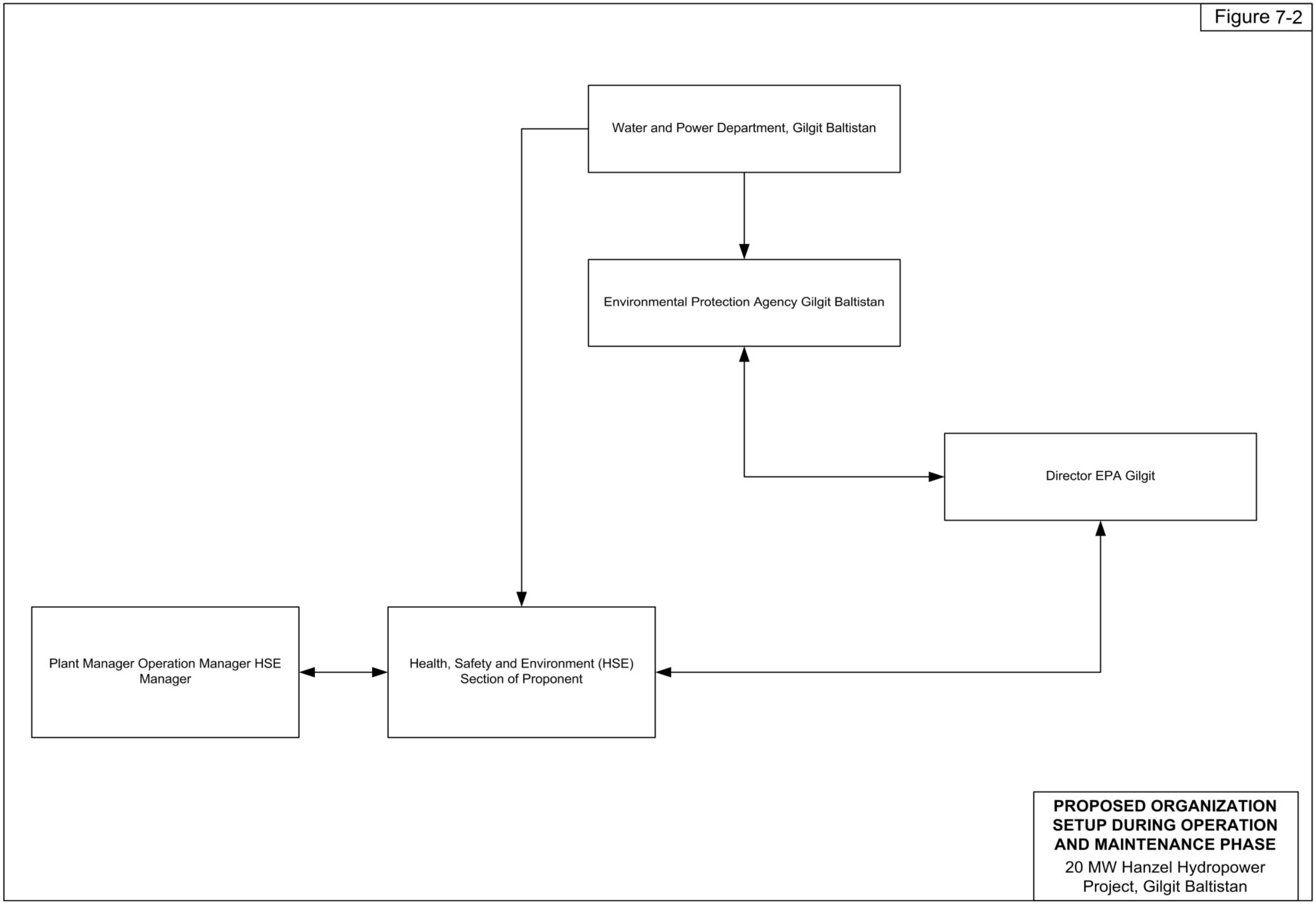


Figure 7-2: Proposed Organization Structure during Operation



This guideline EMP is prepared for the EPC Contractor for reference purpose and needs to be updated as and when detailed information is available or changes in the design and implementation plan occurs. Some of the design and other project information will be made available once the design is finalized or during the Construction activities by the EPC Contractor. Therefore, with the update and availability of the information, this EMP and other relevant documents needs to be updated accordingly by the responsible authorities.

This EMP is being prepared for the EPC Contractor. Some of the design and other project information will be made available once the design is finalized by the EPC Contractor. Therefore, with the update and availability of the information, this EMP and other relevant documents needs to be updated accordingly by the responsible authorities**.**

7.4 ENVIRONMENT AND SOCIAL EXPERTS OF THE EPC CONTRACTOR

The EPC Contractor shall include the below mentioned experts in their existing organizational set-up for Hanzel Hydropower Project to implement the mitigation measures during the design and construction phases of the project including implementation of the EMP and HSE plan. The expense such as salary of the staff, vehicles, workstations, residence will be borne by the EPC Contractor. The table below shows the suggested experts to be the part of the EPC Contractor organizational setup.

Table 7-1: EPC Environment/HSE and Social Experts

Sr. No.	Post	No.	Details
1	HSE Expert	01	Having at least degree in B.Sc. Engineering in Civil or Environment from HEC recognized universities with five (05) years of experience in dealing with environmental issues and HSE specifically hydropower projects.
2	Sociologist	01	Having at least Master's degree in Sociology with five (05) years of experience in dealing with the social issues and land acquisition related issues specifically hydropower projects.

7.5 RESPONSIBILITIES OF EPC CONTRACTOR

The EPC Contractor will be responsible for ensuring the implementation of the mitigation measures and compliance with the PEPA regulations for the construction and operational phase impacts. Following is the list of actions to be performed by the EPC Contractor.

- Ensure the effective implementation of EMP and HSE Plan during construction phase;
- Liaison with other agencies working on different aspects of the environment in the project area. The purpose of liaison with these agencies is to make coordinated effort for monitoring and managing the project activities at different stages. Following are the agencies to liaise with:
- Environmental Protection Department (EPA), GB, Environmental Law compliance, IEE implementation reporting.
- NGOs of the area, Public Health Department, Forestry Department (landscaping, replanting disturbed areas during construction, soil protection), Wildlife Department (protection of wildlife of the area), Fisheries Department (Protection of aquatic fauna), Archaeological Department.
- Ensuring all the sub-contractors to follow the EPA regulations and other requirements stipulated in the construction contracts concerning dust suppression, solid waste disposal, wastewater disposal, air pollution, noise and vibration, biodiversity, traffic management, occupational health and safety, transport, storage and use of explosive materials.

7.6 GRIEVANCE REDRESSAL MECHANISM

The GRM is an institutional arrangement to provide an avenue to address complaints and issues raised by stakeholders. It also provides important feedback on the operational activities of the project. The main purpose of the GRM for this project is to put in place an appropriate mechanism whereby the aggrieved or affected individual(s) or community(s) who believe(s) that he/she has been wronged by any act of the management or connected implementation system, is afforded a fair opportunity to redress his/her grievance.

A “Grievance/Compliant” is defined as any formal communication that expresses dissatisfaction about an action or lack of action, about the standard of service, works or policy, deficiency of service, works or policy of the project management and its implementation mechanism.

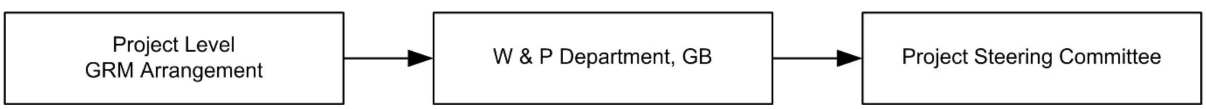
7.6.1 Objectives

The objectives of the Grievance Redress Mechanism are to:

- Develop an organizational framework to address and resolve the grievances of individual(s) or community(s), fairly and equitability;
- Provide enhanced level of satisfaction to the aggrieved;
- Provide easy accessibility to the aggrieved/affected individual or community for an immediate Grievance Redress;
- Ensure that the targeted communities and individuals are treated fairly at all times;
- Identify systemic flaws in the operational functions of the Project and suggest corrective measures; and
- Ensure that the operation of the Project is in line with its conception and transparently to achieve the goals for sustainability of the Project.

7.6.2 Structure of Grievance Redress Mechanism

The Project shall have GRM at Project site level, PMU and Project Steering Committee levels.



A complaint register will be maintained at the work site by the EPC Contractor to document all the complaints received from affected persons/community. The information recorded in the register will include; date of the complaint, description of grievance/issue, particulars of the complaint; and actions to be taken and persons responsible to take the actions.

On receipt of a complaint, the EPC Contractor will register it and forward to field consultant/supervisory consultant. The Supervisory Consultant will review the complaint keeping in view its nature and suggest remedial actions after discussion with the Proponent. The proposed actions will also be shared with the aggrieved person. In case of environmental issues, the decision of Supervisory Consultant will be considered as final decision but in case of any social issue and compensation related issue the decision of Supervisory Consultant will also be forwarded to the Project Director of Hanzel for his review and approval of the actions taken.

The complainant views on remedial actions and suggestions will also be documented in the complaint register. In case, the complainant is not satisfied with the decision taken to resolve the grievances, the affected has the right to appeal to the higher level.

a) Project Level GRM Arrangement

The Project implementation arrangements at local level will include Environment and Social team of EPC represent as Grievance Redress Officers (GROs). It is expected that most of the complaints, grievances and conflicts would be generated at the local level. This would be the most important first Grievance Redress step with a more proactive role. The complaints can be launched through complaint box, in person, via mail or email and telephone. The complaint shall be disposed off within 15 days positively. The decision reached by GROs will be reported to the complainant, and to other stakeholders. Focal person related to GRM may refer the community based issues to arbitration/reconciliation for resolution at village/community level with satisfaction to the parties.

b) Water and Power Department Gilgit Baltistan, PMU Level

Water and Power Department will be implementing the Project. GRO by the Water and Power Department will be appointed to resolve the complaints at this level. He will be assisted by the Environment and Social Team of EPC to resolve complaints with the help of construction Supervision Consultant.

A system of recording and tracking all the complaints will be maintained by the EPC. Supportive evidence in the form of complainant signatures will be required once a decision has been communicated.

Grievances related to the decisions taken by the GRO of Water department shall be forwarded to the next higher forum i.e. Project Steering Committee (PSC). Any such complaint received by Project Steering Committee (PSC) along with the action so taken shall be shared with the Project Director. At this stage try to resolve the complaint by the Project Director based on the previous results and investigation.

c) Project Steering Committee

PSC would serve to resolve the grievances for this Project at the apex level. All the complaints, grievances and conflicts pertaining to the PMU would be resolved at this forum. This would be the final authority to resolve and address the grievances and complaints. This would be the final forum of appeal against the decisions made by the previous levels. Its decision would be final and may also impose penalties and fines on the defaulting parties in accordance with rules. A matter reported to this forum will be decided in not more than one month.

7.6.3 Grievance Redress System and Procedure

- Any grievance in written, verbal or digital form shall be recorded by the receiving office in its Grievances Record System which will be maintained at EPC and Supervisory Consultant;
- A serial number will be assigned to it together with the date of receipt;
- A written acknowledgement to a complainant shall be sent promptly and in any case not more than three (03) working days;
- The acknowledgement shall contain the name and designation of the officer who will deal with the grievance; information that necessary action will be taken within the specified working days from the date of receipt of the grievance by the officer concerned; name, address, email-id and phone number of the authority which the complainant could approach if the matter is not redressed within the specified timeframe or if he is not satisfied with the action taken;

- If the office receiving the grievance/complaint is not the one designated to consider and dispose it, the receiving office shall forward it to the designated office, but after having complied with the requirements at 1 to 3 above; and
- The office designated to consider the matter shall make every effort to ensure that grievances/appeals are considered and disposed off within the stipulated period of fifteen days.

If the grievance redress mechanism fails to satisfy the aggrieved affected person at all levels, he can submit the case to the appropriate court of law.

7.7 COMPLAINT REGISTER

A complaint register will be maintained at the work site by the EPC Contractor to document all the complaints received from affected persons/community. The information recorded in the register will include the followings:

- Date of the complaint;
- Description of grievance/issue;
- Particulars of the complaint; and
- Actions to be taken and persons responsible to take the actions.

On receipt of a complaint, the EPC Contractor will register it and forward to field consultant/supervisory consultant. The Supervisory Consultant will review the complaint keeping in view its nature and suggest remedial actions after discussion with the proponent. The proposed actions will also be shared with the aggrieved person. In case of environmental issues, the decision of Supervisory Consultant will be considered as final decision but in case of any social issue and compensation related issue the decision of Supervisory Consultant will also be forwarded to the Project Director of Hanzel HPP for his review and approval of the actions taken.

The complainant views on remedial actions and suggestions will also be documented in the complaint register. In case, the complainant is not satisfied with the decision taken to resolve the grievances, the affected has the right to appeal to the higher level.

7.8 HSE SECTION OF THE PROPONENT DURING OPERATION

It is strongly recommended that proponent should establish its own environment and social setup during the operation stage. The HSE Section will have a competent Environment & Social Team that will render its duties in close coordination with the Plant Manager.

7.9 MANAGEMENT ACTIVITIES

7.9.1 Internal Auditing

The internal environmental audit will be carried out by Supervisory Consultant. The primary aim of auditing is to assess compliance and effectiveness of the EMP as well as the degree of success of the environmental and social sustainability objectives, and also to assess the effectiveness of the corrective actions. Audit will also suggest remedial measures to overcome the environmental and social problems.

7.9.2 External Auditing

The external environmental audit will be carried out by the independent consultant in order to check the compliance and implementation of the EMP. GB, EPA will check the various parameters with reference to the guidelines provided by GB, Environmental Protection Act, 2015 and the standards specified by National Environmental Quality Standards (NEQS).

7.10 MITIGATION MANAGEMENT MATRIX (MMM)

Environmental protection and enhancement is achieved in various ways. These approaches should begin right at the grass root level and should continue through each phase of the Project. Appropriate environmental management measures are required to be exercised in a cascade order by the Proponent, Engineering, Procurement and Construction (EPC) Contractor during the construction of the project.

In this way, it is envisaged that the Project will achieve maximum ongoing cost-effectiveness, environmental sustainability and social soundness, far beyond if it's implemented at the end of the Project. All phases of the Project have to be managed by adopting the proposed environmental mitigation measures, which, besides the engineering aspects, are given due importance which make a perfect blend with the surrounding ecosystem.

MMM is provided in **Table 7-2** and it identifies the following:

- The impacts and required mitigation measures;
- The person/organization directly responsible for adhering to or executing the required mitigation measures;
- The person/organization responsible for ensuring and monitoring adherence to mitigation measures;
- The parameters which will be monitored to ensure compliance with the mitigation measures; and,

7.11 CONTRACTUAL PROVISIONS

The EPC Contractor will be legally bound for the execution and implementation of EMP, HSE Plan and other site-specific plans during the construction stage of the Project.

7.12 COORDINATION WITH STAKEHOLDERS

Proponent will ensure that coordination with the project primary stakeholders including PAPs and residents of the area, GB, EPA, Irrigation Department, Wildlife and Parks Department, Forest Department, Communication and Works (C&W) Department and other district level departments and EPC Contractor on environmental and social matters as required. EMP is maintained throughout the implementation period (construction and O&M phase) of the project.

(This Space is Intentionally Left Blank)

Table 7-2: Mitigation Management Matrix (MMM)

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
PRE- CONSTRUCTION/DESIGN STAGE				
Land Acquisition	The estimated land required will be 142 acres (57 hectare) based on the project footprint and topographic survey for the project execution, which will be further verified upon the mobilization of the EPC Contractor[16].	The hydropower plant construction mostly involves the government land which will be acquired according to the policy of Govt. of GB. On the other hand, private land is being acquired according to the provision of the LAA 1894. The detailed LAA, 1894 is described in Chapter 6 (Impacts and Mitigation).	EPC Contractor	SC& Proponent
Flora	During the pre-construction phase, activities such as installation of construction camps, construction of temporary roads & mobility of construction staff may damage the local vegetation/trees. As the heavy machinery and camps will be moved and installed, which require significant space due to which available vegetation is expected to be removed.	The camps, mobility of machinery and construction of temporary road should be proper planned and well designed to avoid any loss to local green cover. It is recommended to establish the construction camps where minimum or no vegetation exists. Similarly, the alternate routes for roads and points for camps are recommended where no loss of vegetation is expected. The location of construction camp will be selected so as to have limited environmental effect during construction phase and to reduce the cost and land requirement.	EPC Contractor	SC& Proponent
Fauna	As mobility and installations of machinery and vehicles will take place so heavy noise and habitat loss is expected. The routes of wildlife and other habitats may be affected due to camps and machinery movements & installations.	The standard measures must be adopted to minimize noise due to machinery movements and installations. Wildlife movements and routes must consider during activities and should be avoided to their Maximum level. The alternate routes and points are recommended to avoid any impact on the locally available fauna. Camps shall be located at least 500 m away	EPC Contractor	SC& Proponent

[16] Topographic Survey and GIS Estimation, 2017

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
		from the nearest wildlife area and their source of food as well as water. The camps shall be properly fenced and gated to check the entry of animals in search of eatable goods. Similarly, wastes of the camps shall be properly disposed of to prevent it being eaten by animals, as it may be hazardous to them.		
CONSTRUCTION STAGE				
Water Flow and Requirements	During the construction phase, the Gilgit River water needs to be diverted to get the dry conditions for the construction of the weir and allied structures. The water flow pattern from downstream of weir site will change, water will be diverted towards headrace channel. The variation in flows may affect the downstream aquatic life and community.	If the EPC Contractor constructs a coffer dam partially or fully across the river or erects any other structure in the river bed which can break the supply of perennial river flow for irrigation or drinking purpose to downstream riparian or inhabitants, the Contractor shall ensure a regular supply of perennial river discharge to downstream riparian and inhabitants in accordance with their traditional rights. It should be obligatory for the project to release minimum water flood downstream the weir site throughout the year as environmental flow. Water requirement for downstream residents should be incorporated in the overall design of the project by the EPC Contractor.	EPC Contractor	SC& Proponent
Seismic Impacts	The seismic zones map of Pakistan (**Figure 4-2**) shows the project area on the edge of zone 2 moderate damage. Teleseismic data shows a concentration of seismic activities in three main zones around the project area. • The Hindukush region in the NW • The Daral - Tangier – Haran valley region in the NE, and • The Indus-Kohistan seismic zone in the SE.	All structures to be built must be designed giving maximum allowance to seismic factors. A very careful analysis of the situation will be required during the design stage of the project by the EPC Contractor. The seismic design parameters for the project (50 years lifetime) are recommended as a Maximum Design Earthquake (MDE) of 0.25 g with 10% probability of exceedance with a corresponding return period of 475 years, and an Operation Basis Earthquake (OBE) of 0.15g	EPC Contractor	SC& Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	No change (+/-) in the impact of seismology risk of the area is expected during the project construction phase as none of the project activities is expected to be of such a powerful extent to influence the tectonic risk. However, the seismic potential of the region can disrupt the project construction activities at any time during construction phase of the project. This impact is Local, Temporary, Irreversible, Possible and High Significant.	with 50% probability of exceedance and 75 years return period. The impact on project due to seismicity will shift from high to medium significant level by adopting these mitigations.		
Land Sliding	The construction activities for the proposed project interventions involving cutting of rocks, large scale excavation, dumping of soil and blasting and to create space for the headrace channel and forebay may disturb the stable geological formation of the area. High seismic potential and unstable geological formations are two major causes of land sliding in the area. These affects could promote bank instability and increase land slide in unstable area. Furthermore, due to the project activities, especially blasting of rocks in some areas, the formation will become loose and the risk of landslides will increase in the immediate vicinity of the construction sites, which may be considered as a high adverse impact of the project.	Blasting should be minimized where possible; if inevitable then low intensity explosive material should be used instead of high intensity explosive material. The headrace channel can be covered with RCC slabs at the top at places where the crossing of animal and human is foreseen. An aqueduct can also be provided at nullah/drain crossing. This aspect shall be investigated during the design of the project by the EPC Contractor. Some part of the headrace channel will pass through Amphiobolites where the excavation is difficult and need controlled blasting. Some safety measures along the slope side should be recommended in design to protect against sliding, particularly in rolling areas.	EPC Contractor	SC& Proponent
Topography	Construction activities are not expected to impact the topography of the area significantly except for those areas where physical activities including	The excavated material will require safe disposal by the Contractor. Most of the excavated material could be used in back filling of powerhouse, headrace channel main weir	EPC Contractor	SC& Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	digging and excavation areas, storing or dumping sites for excessive material, storing areas and movement of heavy construction machinery will be carried out. The excavated material will be generated due to the construction of various components of the project like power house, weir, headrace channel, forebay, penstock and tailrace. The area where excavated material is to be dumped will also be negatively impacted.	and making banks and concrete aggregate to be used in construction. A detailed development and operation plan for borrow areas must be prepared by the contractor at the pre development phase (before the starts of extraction of material from each borrow area). Contractor should strictly follow the provisions of approved plan in order to minimize any negative impact associated with the borrow areas. Likewise, excavated material should be dumped at suitable and approved disposal sites.		
Soil Contamination	The construction activities may produce waste containing Carbon based compounds. All the carbon based compounds are toxic to varying degrees. Hydro Carbons (HCs), petrol, diesel etc. are toxic in nature. The insulation on electric wires and cables are made from hydrocarbon compounds, which are toxic. Paints and varnishes are also toxic in nature, which may be used during construction. If proper care is not taken for handling, storing and transportation of these toxic substances, these may cause damage to the health of the workers as well as their spills will contaminate the soil.	The contractor will carefully handle the material quarried during loading, unloading and transportation. The contractor will not leave the borrow pits in an unusable condition such that it could be filled with rain water and cause the problems for the community e.g. breeding place for mosquitoes etc. The contractor will ensure that the selected borrow areas are clearly demarcated, and indicate the maximum allowable depth of the pit before the soil is excavated. Barren or unfertile land will be preferred for use as a borrowing area than agricultural land. Oil leakages, chemicals and other liquids spills should be avoided/minimized by providing appropriate storage places depending on the type of material for storage. Oil and other lubrication material should be stored in water proof tanks especially built for oil storage. These tanks should be built away from the main road and residential areas or safety purposes. Access to these tanks should only be allowed to the authorized personnel. Safety	EPC Contractor	SC& Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
		equipment like fire extinguishers should be placed near these places along with signs for danger and fire. Workers must be familiar with the Material Safety Data Sheets (MSDS) of each chemical used at site. MSDS are provided with each chemical drum. Chemicals will be stored as per the instructions of MSDS. Utmost care should be taken during the handling of these chemicals. Precautions should be taken to prevent spills and all workers should be trained in proper handling, storage and disposal of hazardous or toxic materials.		
Air Quality	Air quality will be affected by the fugitive dust, particulate matter and emissions (such as SO_2, NO_2, CO, etc.) from the construction machinery, vehicular traffic and equipment during the construction phase that will directly and temporarily impact ambient air quality. Emissions may be carried over long distances, depending on wind speed and direction, the temperature of the surrounding air, and atmospheric stability. This will also have negative impact on air quality and aesthetics of the area.	• Crusher and Concrete batching Plants should be installed at a fair distance from Hanzel and Harpoon village. Moreover, it is recommended that crushers should be equipped with dust suppression equipment comprising of scrubber and water sprays. This will significantly reduce the amount of dust released from the crushing plant. Sprinkling of water should be performed during the construction stage wherever there is potential source for dust in the project area; • Spray water on spoil-heaps if there are dust generating materials accumulated during dry periods especially near schools, dispensaries etc.; • Cover all dust generating loads carried in open trucks; • Vehicles and other construction machinery should be properly tuned and maintained, to avoid hazardous level of emissions; • The NEQS applicable to gaseous	EPC Contractor	SC & Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
		emissions and noise levels generated by the construction vehicles, equipment, and machinery should be enforced during the construction of works; • Corrugated steel sheets should be installed around the Project boundary to minimize the dispersion of dust emissions into the nearby areas; • Where necessary, dust emissions must be reduced by a regular sprinkling of water for keeping the dust settled, at least twice a day; and • Avoid overloading trucks and cover trucks to minimize dust and loss of load from trucks during transportation.		
Noise and Vibration	All the above activities will likely include the use of machinery and equipment such as generators, hammers, compressors, etc. and which are expected to be a source of noise and vibration within the Project site and its surroundings. If improperly managed, there is risk of nuisance and health affects to construction workers onsite. It is very unlikely that other nearby surrounding receptors will be affected from noise generating activities given their distance from the Project site.	Apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc.; and comply with the Occupational Safety and Health Administration (OSHA) requirements to ensure that for activities associated with high noise levels, workers are equipped with proper Personal Protective Equipment (e.g. Earmuffs). Low intensity explosive should be used in blasting activities instead of high intensity blasting material.	EPC Contractor	SC & Proponent
Wastewater Generation	Sewage and wastewater will be generated at the construction camps and from construction activities. If the generated sewage is not properly treated	To avoid sewage, untreated wastewater, chemicals and oil spillage from draining into the irrigation channels nearby during construction activities, measures should be	EPC Contractor	SC & Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	or disposed of, this may contaminate the irrigation channels and might affect the groundwater resources apart from soil contamination. Water from dewatering activities (during rainy season) has the potential to contain suspended solids and oil and grease and if disposed of untreated may affect the soil quality. Such contamination of irrigation channel may have highly adverse impacts on agricultural productivity.	taken to contain the chemicals and treat the sewage and untreated wastewater. Contractor should not in any case dispose of these chemicals into the nearby irrigation channels and Gilgit River. Any visible oil and grease should be skimmed off the surface using absorbent pads. According to the National Environmental Quality Standards, BOD of all the surface discharges from domestic wastes should not exceed 80 mg/l. For Sanitary drainage, installation of proper temporary sanitary sewage disposal facilities for the entire site should be considered. These include provision for the construction camp & office and living area. The sanitary sewage facilities should be adequately sized.		
Solid Waste	Considering the labourers (about 200) residing in the construction camp and the locally available labour, an average solid waste generation rate of 0.5 kg/capita/day[17] is adopted for the estimation of solid waste generation. Based on this assumption, a total of about 100 kg of solid waste will be generated from the construction camp daily. The major components of the labour camp waste will be garbage, putrescible waste, rubbish and small portion of ashes and residues. Other type of wastes may include inorganic construction wastes. These wastes will	• None of the solid waste will be disposed-off into the Gilgit River and nullahs; • Solid waste generated during the construction at camp sites should be properly and safely disposed of; • Arrangements should be made for collection of solid waste generated from the construction camp by placing the collection bins in the camp area; • Additional communal containers should be placed near the construction camp which will receive waste from waste bins placed inside construction camp. Waste from these communal containers will be	EPC Contractor	SC & Proponent

[17] Source: The World Bank Report 2012 – What a Waste: A global review of solid waste management. Based on UNEP estimates for waste generation in the Asia Pacific. Average is 0.45 kg/capita/day.

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	be generated due to the construction activities and the materials used for construction. This waste would require proper disposal to minimize land and water contamination.	collected by Solid Waste Management Authority for its disposal; • Containing all stored wastes within construction sites and avoiding littering and runoff; • Optimizing and reducing waste production; • Avoiding mix of different waste and minimizing waste disposal into the drain; • Sorting the waste according to its type and origin; • Storing selected materials in safe place in order to avoid contamination, especially if they will be shipped out for recycling; • Preferring local recycling or reuse before shipping out for recycling before waste disposal; • Properly disposing of all used fuel and lubricant oils in environmentally sound manner, either by recycling or for other use such as fuel for hot mix plant, etc.; and • After construction has finished, removing all machinery and waste from the project area.		
Flammable, Explosive and Hazardous Materials	Explosive materials will be required for rock excavation and penstock installation and other facilities. Other major flammable materials to be used during the construction activities include diesel, furnace oil, petrol, LPG, kerosene oil and machinery fuels. These materials present little risk to the environment, if properly transported stored and used; otherwise they are potentially very dangerous. Improper storage and	Safety procedures should be developed and followed by the contractor and labour strictly while using, handling and storage of these materials and explosives. Contractors should be provided written instructions about the methods and safe practices of using flammable materials and explosives. For safety of construction labour and immediate communities, it is suggested that contractor's staff should be trained about the procedures of blasting, safe use, handling and	EPC Contractor	SC & Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	handling practices for these flammable and explosive materials can pose dangers of fire and blasts in the area. Unsafe disposal of excavated material may not only create the environmental degradation but also a nuisance for the surrounding community. Moreover, borrow areas, if left open, may prove hazardous to human beings, wildlife and livestock of the area.	storage of materials. Emphasis should be to decrease the volume of mucking material by reusing and then the disposal at the marked area in environment friendly way. In order to reduce the volume of disposal material, maximum part of the excavated material can be used in other activities filling of borrow areas and natural depressions in the project area. In order to increase the aesthetics of the area, native grass can be planted by dumping the surplus material in the proposed residential colony with suitable soil cover.		
Health and Safety	Throughout the construction phase there will be generic occupational health and safety risks to workers, as working on construction sites increases the risk of injury or death due to accidents. The following risks are generally associated to construction sites and apply for the construction of the Project and could include: • Slips and falls; • Moving machineries; • Exposure to chemicals, hazardous or flammable materials; and • Taking into account the Project site, construction workers are expected to work in hot weather conditions in summers, and thus are exposed to dehydration, heat exhaustion, and heat stroke.	• Ensuring all occupational health and safety requirements in place; • Understanding the use of personal protection equipment (PPE) and ensuring its use properly; • Installing lights and cautionary signs; • Developing and ensuring implementation of safety and inspection procedures; • Safe handling of toxic materials and other hazardous substances (If used); • Implementing a system of penalties for violation of rules and regulations; • Introduction to health and safety issues in construction sites by the Contractor; • Providing education on basic hygienic practices to minimize spread of tropical diseases, including information on methods of transmission and protection measures for diseases; • Assuring the availability of medical assistance in emergency or nonemergency	EPC Contractor	SC & Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
		situations and availability of other health related assistance such as first aid facilities; and • Identifying in details the hazards which may be associated with the various activities to take place and the various measures to be implemented to reduce such risks. This includes for example safety PPEs for welding and cutting, work at elevated places.		
Traffic Impact	A total of 200 m sections of road around powerhouse and weir site will be affected during the construction period the section of road for crossing of the headrace channel, penstock and spillway that will require to be upgraded or an alternate route during construction period of the project should be constructed to allow the occasional traffic mobility smoothly. There may be chances of accidents due to the increase in traffic volume.	The existing Hanzel road connects two important districts of Gilgit and Ghizer. The EPC Contractor may utilize other alternate road from the nearby settlement after upgradation if find feasible for the smooth flow of traffic on Gilgit-Ghizer road. This will serve as alternate route during construction. However, the EPC contractor will make arrangements to keep it functional during construction and restore it to its original state after the construction activities are over. Furthermore, it is mentioned in Clause no 1.1.2 General Description of Contractor's Scope of Work under Tender Document Contract No ICB-01, Volume -2, Part I – Project Construction Requirements that it will be the EPC contractor responsibility to realign about 550 m existing road.	EPC Contractor	SC & Proponent
Flora	The project will involve destruction of vegetation cover on construction areas particularly headrace channel and powerhouse. About 2,240 trees of small and medium sizes will be removed due to the layout of the project for which compensation will be made to concerned	Cutting of trees shall be avoided, as far as possible so, that negative effects on the process of natural regeneration of species are minimized. A tree plantation program shall be formulated with the recommendations and technical support of Forest Department, GB. As a principal, ten trees shall be planted in	EPC Contractor	SC & Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	parties (local community/forest department.) The direct & indirect assessment, in cutting of total 2,240 trees and plant approximately 1040 trees/plants will be affected at head race channel and 1,200 from penstock, spillway and power house area and at the time of study September 2017. However, no significant tress/Plants were found at weir & forebay immediate sites. Exhaust of noxious gases from movement of heavy machinery and dust will pollute air which will adversely affect health and vigor of plants. During construction activities the Contractor's workers may damage the vegetation and trees (for use as fire-wood to fulfill the camps requirements). Overall, it can be stated that given the relatively small areas affected and the present status of the vegetation in these areas (no forest of other valuable habitat types, no rare or vulnerable species present.).	place of felling of one tree in consideration of mortality. Water and Power Department, GB shall implement the program with the help of Forest Department or through a Contractor over locally available best land and with the consultation of DFO Gilgit. As the land along the slopes generally belongs to the communities/individual owners, the Forest Department in turn shall involve the communities for carrying out plantation. Open fires should be banned in the area to avoid hazards of fire in the area. Clearing of vegetation cannot be avoided at the areas specified for project structures, but damage to the natural vegetation may be minimized by establishing campsites, workshops and batching plants on waste/barren land rather than on forested or agriculturally productive land. However, if such type of land is not available, it shall be ensured that minimum clearing of the vegetation is carried out and minimum damage is caused to trees and undergrowth. Construction vehicles, machinery and equipment will remain confined within their designated areas of movement. The Contractor's staff and labour shall be strictly directed not to damage any vegetation such as trees or bushes. They shall use the paths and roads for movement and shall not be allowed to trespass through farmlands or forested areas. Contractor shall provide gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel shall not be allowed.		
Fauna	During construction phase the existing	Care shall be taken during construction	EPC Contractor	SC &

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	population of mammals and reptiles of the construction areas will be affected due to disturbance arising from construction activities involving excavation, blasting, movement of machinery and vehicular traffic, movement of labour, camping, etc. The existing animals will leave the directly affected areas due to construction activities and human intervention. Some animals particularly reptiles may get killed during the earthworks operations. Moreover, the movements of the mammals and reptiles will be restricted during the construction phase. The Project area is lying under Hanzel CCHA & near (Approximately 4000 m) to Kargah game sanctuary So, rare wildlife movement is possible and disturbance through headrace channel is expected. Birds as well will tend to move away from the construction areas and find shelter and food elsewhere due to the activities mentioned above for fear of being hunted / trapped. Noise generated from blasting and machinery particularly during the night hours will even scare the wildlife residing in habitats located at some distance from the construction areas. Uncontrolled blasting may even disturb the wildlife of the project areas. Food and refuse at the Contractor's camps may attract animals that might in turn be hunted by the workers.	activities for avoiding purposely or chance killing of animals. Hunting, poaching and harassing of wild animals shall be strictly prohibited, and Contractor shall be required to instruct and supervise its labour force accordingly and clear orders should be given in this regard. The Contractor must be held responsible for instructing his work force accordingly and for enforcing this restriction. In addition, this shall have to be controlled by the Wildlife Department. Special measures shall be adopted to minimize impacts on the wild birds, such as avoiding noise generating activities during the critical periods of breeding. Blasting and other noise generating activities shall not be carried out during the night by the work force, clear orders should be given. The Contractor must be held responsible for instructing his work force accordingly and for enforcing this restriction. In addition, this will have to be controlled by the Wildlife Department. The EPC contractor must be bound during design & construction stages and it is highly recommended to provide permanent provision of pathways/bridges & permanent water points for locally available wildlife after and during construction of project. Camps shall be located at least 500 m away from the nearest wild life area and their source of food as well as water. The camps shall be properly fenced and gated to check the entry of animals in search of eatable goods. Similarly, wastes of the camps shall be properly disposed of to prevent it being eaten by animals, as it may be		Proponent

Environmental Components	**Impacts**	**Proposed Mitigation Measures**	**Responsibility**	
			Implementation	**Monitoring**
		hazardous to them. Manpower working at construction site should be aware to protect wildlife. Noise produced by blasting and other construction activities may be kept to acceptable level. Any stray animals found may be handed over to game watcher posted at Hanzel village.		
Aquatic Ecology	The fish fauna is poor due to low temperatures, high turbidity of water, high speed of flows, lack of nutrients in water, low benthic growth and long stretches of gorges through which river flows. Brown trout and rainbow trout are found in cold water and in upper tributaries of Gilgit River. The downstream movement of fish is not restricted due to construction of weir and a lot of water is available downstream of weir, hence impact on fish habitat is insignificant. It is considered that with regard to the already low species population and diversity that exists in the area, this flow will be sufficient to maintain the viability of the aquatic system from the weir site to confluence of Gilgit River and tailrace channel. The impact on aquatic ecology during construction activities will be low adverse.	During the construction of the project by the EPC Contractor, special attention should be given to ensure to plug off the leakages of oil and other chemicals dispersants from turbine and machine engines to avoid hazardous effect on aquatic life. The labour working at construction site should be aware to protect especially edible fish & to avoid fish catching by any means. As according to law of land fish hunt is prohibited with net, cages and by the use of dynamite. The excavated material produced during construction has to be disposed off in a way that it does not enter into the Gilgit River.	EPC Contractor	SC & Proponent
Impact on Built-up Area and Infrastructure	The implementation of the Project will affect the trees, existing water channels, shops, educational institution, dispensary, houses, animal shed during the construction of Project Components. As per project foot print, topographic and	The loss of private built up area and infrastructure should be compensated according to the provisions of the LAA, 1894. Other government infrastructure should be relocated by the concerned department in consultation with the project Proponent. It is	EPC Contractor	SC & Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	GIS surveys, approximately 13 houses, 2 schools, 1 hotel, 13 huts will be affected mainly during the construction of the headrace channel as the houses and other infrastructure are mainly exists on the foothills of the proposed headrace channel.	recommended that school buildings should be constructed before the relocation of these institutions so that the education of the children and health will not get affected. • Compensation will be paid to the affectees for the built-up areas like buildings, huts, animal sheds, electric motor sheds etc. on replacement cost basis and the land on existing agricultural land value; • Payment of three (03) months house-rent will be made to the affectees while they will construct a new abode for their families; • Full market price of any equipment (not shiftable) and cost of reconstruction including labour charges will be paid to the affectees; and • Affectees will be allowed the salvaging of the demolished materials.		
Impact on Agriculture	Based on the social survey the agriculture crops of the tract along the headrace channel in Hanzel Bala will receive significant adverse impact due to various operations such as movement of heavy machinery, blasting and construction of headrace channel.	Land holders will be paid compensation for the loss of their standing crops in accordance with the prevailing market rates as per LAA. The landholders will also be allowed to salvage the agricultural crops and other vegetation from the affected fields.	EPC Contractor	SC & Proponent
Conflict Over Resources	It is anticipated that local water resources (spring water) will be utilized to meet the camp and construction requirements. This may cause conflicts between the locals and the Contractors. Because the locals are using this spring water for drinking as well as agriculture purpose and they are already facing water shortage for agriculture.	The following measures will be carried out to mitigate the impacts of tapping local community water resources, where required: In area of Hanzel Bala and Hanzel Paine where the potable water is in short supply; the water will be provided through vehicles; • The Contractors will be required to maintain close liaison with the local communities to ensure that any potential conflicts relating to the common resource	EPC Contractor	SC & Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
		utilization are resolved quickly; and • Guidelines will be established to minimize the wastage of water during the construction activities and at camp sites.		
Impact on Public Health	Local community in the AOI villages such as Hanzel Bala, Hanzel Paine and Harpoon will be affected by noise, dust and vibration during the construction activities, which may have adverse impact on the health of the locals. These impacts are expected to be high in the construction of headrace channel, forebay and power house areas; There is one boys primary school in Hanzel Bala which about 100 students are studying while one (01) govt. dispensary fall in the AOI of headrace channel both institutions will be adversely affected during construction activities due to noise, air pollution and vibration and due to close vicinity of the headrace channel both institution may have to relocate nearby area. During the construction activities, elevated air and noise levels may create short term and long term health issues such as respiratory diseases by air pollution and hearing, hypertension, impairment, annoyance, and sleep disturbance by noise pollution for the students and staff as well as local population residing in the, Hanzel Bala, Hanzel Paine and Harpoon.	Water sprinkling, encasement/provision of silencer and mini stacks of generators would be helpful to avoid inconvenience to the locals due to noise, smoke and fugitive dust. Currently, headrace channel is buried. However, at design stage maximum effort should be done to avoid disturbance of structures such as houses, schools and dispensary through construction of the tunnel. Special measure and advance technology should be adopted to reduce the noise and vibration impact on the students as well as locals.	EPC Contractor	SC & Proponent
Other Socio-Economic Impact	• The movement of construction vehicles from the Gilgit to site and	• A Traffic Management Plan (TMP) will be prepared by the EPC contractor in	EPC Contractor	SC& Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	site to quarry areas may create annoyances to the residents and traffic on the road. Transportation of heavy construction equipment and material is likely to affect the Gilgit-Ghizer road. The existing road is single and with narrow turns. Therefore, may be needs widening of road for accessibility to the project site and due to existence of nearby residential areas, locals would face the noise and dust issues. During the development of weir area traffic congestion will be another major impact on the road; • Conflict between local communities and people arriving in the area for work and / or new opportunities. The local communities are very sensitive about their cultural values; • Criminal activities may arise as changes occur in the local social culture; • Theft problems to the nearby community by the Contractor's staff and vice versa; • Local community may face accidents/incidents due to construction stage; • Usage of the Community's common resources like potable water, fuel wood, etc. by the Contractor workforce may create conflicts between the community and the Contractor;	consultation with communication and works department Gilgit for smooth flow of traffic on the Gilgit Ghizer road; • Good relations with the local communities should be developed. Contractor should provide job opportunities to skilled and unskilled locals and on-the-job training in construction for young people; • Contractor will restrict his permanent staff to mix with the locals to avoid any social problems by developing code of conduct; • The Contractor will keep all the copies of Computerized National Identity Card (CNIC) of his employees and will warn the workers not to involve in any theft activities and if anyone would involve in prohibited/criminal activities, the concerned police station will deal with it and he will have to pay heavy penalty; • Similarly, at the time of employment, Contractor has to take care that the workers should be of good repute. The Contractor camp will be properly fenced and main gate will be locked at night with a security guard to check the theft issues; • Contractor should arrange first aid kits along with medical officer in the field. Routine medical check-ups of all the field staff including unskilled labour need to be conducted by a qualified doctor; • Training of workers in construction safety procedures, environmental awareness, equipping all construction workers with PPEs, safety boots, helmets, gloves, and protective masks, and monitoring their		

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	• Improper arrangement of the disposal of construction materials may create problems for the local residents during the construction stage of the Project; • Blasting near residential area like Hanzel Bala and Hanzel Paine may create problems for the locals; • Relocation/disturbance to the existing utilities like electric poles, telephone poles, etc. may affect the routine life and mobility of the community; • General mobility of the locals especially in the Gilgit- Ghizer road will be disturbed during the construction stage of the Project; and • Gender issues and hindrance to the mobility of local women due to induction of outsiders by Contractor, who may not understand / respect cultural norms and values.	proper and sustained usage will be carried out. In case of accidents, contractor will provide free medical treatment to the community; • Local vendors will be preferred for purchase of camp site goods and services. • Proper arrangements in the form of alternative routes should be made to ensure that the mobility of locals should not be disturbed; • The Contractor will take due care in disposal of construction materials as well as solid waste to the proper places, so that the nearby communities will not suffer; • The Contractor will take care of the local communities water needs and will not exploit, contaminate or damage community's water sources; • Blasting should be avoided near the settlements like Hanzel Bala and if unavoidable, it should be carried out during the fixed hours (preferably during the mid-day). The timing will be made known to all the people within 500 m from the blasting site in all directions and prior to the blasting thorough inspection should be conducted; and In construction camps, amenities of life including clean food, water and sanitation facilities should be provided to these camps. The Contractor should arrange first aid boxes at camps; and The Contractor will warn the staff strictly not to indulge in any un-ethical activities and to obey the local norms and cultural		

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
		restrictions particularly with reference to women.		
Gender Issues	In the villages of AOI few houses have no latrine facility therefore; some women living in these areas have to use the open field latrines. The privacy of women in Project AOI may suffer due to the Project activities. The house in the surroundings of the headrace channel route may face privacy issues during the construction stage.	• The Contractor has to carry out the construction activities in the area in such a way that the open field latrine usage timings by the local community particularly women, should not be affected. The normal timings to use the toilet facilities by the women are early in the morning and at evening so the Contractor will have to take care of these timings; • Contractor should warn the staff strictly not to involve in any un-ethical activities such as theft, prostitution, harassment of working women as well as college students and to obey the local norms and cultural restrictions particularly with reference to the women; and • If privacy of the nearby houses will be affected and the Project activities are unavoidable, the management should take steps to not affect the privacy.	EPC Contractor	SC& Proponent
Impact on Archeology	One archeological feature named as Hanzel stupa was identified near to the Project at Hanzel Bala village. No direct impact is foreseen on this Stupa as it is located at a reasonable distance from the headrace channel. However, during the construction stage this site may be affected due to heavy vehicles movement on the road, blasting, dust and vibration. The Stupa is located at a reasonable distance therefore; this impact is low, site-specific, temporary, and irreversible.	The Project must ensure that construction works do not result in vibration that could damage adjacent structures. Blasting should be done in a controlled manner to avoid the noise and vibration impacts in consultation with the locals and to decide the appropriate time for the controlled blasting. The EPC contractor should also conduct and take guidance from Archeology Department Gilgit during the construction stage. Contractor should be very careful about the excavation of the area. In case of a chance finding during excavation, the Contractor will protect the site and notify the	EPC Contractor	SC& Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
		Department of Archaeology & Museums through Water and Power Department.		
OPERATIONAL STAGE				
Sedimentation	Accumulation of sediment may disturb the efficiency of project components. Sediment load released from the sand trap could have adverse effect and synergetic with low flow of water will put aquatic system under stress. However, it should be kept in mind that during low flows the sediment concentration is very low. Floods and heavy rains carry large sediment loads, which can have a more severe impact than the sand trap flushing.	A sediments clearing mechanism will be provided in the detail design and should be followed. The river carries, on the average, about 14% sand, 73% silt and 13% clay. Sediment flushing and de-silting arrangements have to be carefully designed by the EPC Contractor. It is recommended that a sediment sampling program during high flow season for estimating bed material load and bed load and its gradation are initiated based on the technical and economic viability.	EPC Contractor	SC& Proponent
Solid waste from office building and other allied facilities	The project operation will result into generation of organic as well as in-organic waste. This waste may have significant impact on soil, ambient air, residents living in proximity to the Project, as well as on the aesthetic values if improper systems are adopted. In order to assess the impacts and proper designing of collection, transportation and disposal system, it is imperative to quantify the solid waste generation and assess its characterization.	Provisions should be made for proper solid waste management, which will involve the following major operations: • Storage at Source; • Component Separation at Source; • Collection of Waste; • Storage; • Transportation; • Resource Recovery for recycle and reuse items; and • Disposal of Waste (sanitary landfill). Proponent should make final disposal arrangements in consultation with the concerned government department and should take approvals for final disposal of the waste at the designated disposal site. A separate solid waste management system for waste from the office building and other allied facilities will be required. During the	EPC Contractor	SC& Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
		collection of solid waste, recyclable and reusable waste will be separated for resource recovery and reuse of the generated material.		
Fire Breaking	For the proposed hydropower plant there is also a risk of fire breaking out in powerhouse and switch yard area that may become a serious risk for residents living in allied facilities and/or nearby in the vicinity of the proposed hydropower Plant. This impact will be medium adverse.	Fire protection and detection systems shall be provided to protect life, property, equipment, and operation of the powerhouse. The detection and fire alarm, fire protection and fire-fighting systems shall include, but not be limited to the following: • Firefighting water storage, may be combined with raw water tank, depending on local regulations; • Firefighting pumps; • Fire water ring main system, including hydrants; • Fire protection systems; and • Fire alarm and detection system. All systems shall be subject to the approval of the insurance company. The systems shall be complete with all necessary piping, pumps, safety valves, mobile equipment, and vehicles. Water spray system for Generator fire protection is recommended. The EPC Contractor shall prepare an Emergency Response Plan (ERP) to cope with the emergency situations.	EPC Contractor	SC& Proponent
Noise and Vibration	The principal sources of noise and vibration during the operation phase include Intake structure, tunnel, valve house and powerhouse. The noise levels measured at the project site were within the permissible limits of NEQS but during the operational phase the noise levels may increase. Noise levels above the permissible limits result into various	Best practices should be employed in all noise generating activities. These include the proper maintenance of the pumping equipment and the proper muffling of operating equipment. Plantation of trees and other vegetation will also help to attenuate the noise impacts to the surrounding area.	EPC Contractor	SC& Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	health impacts depending upon the intensity of noise. The impacts will be in the category of low to medium adverse.			
Flora	During Operational stage the Project will not affect Flora (Trees and agricultural crops) or release any significant pressure detrimental to flora. Low level impact is expected at operational phase on flora due to the O&M activities.	The implementation of plantation plan recommend in compensation for cutting of trees should start working during operational stage, to ensure the ecological balance and to avoid any impact on local Environment. Large scale planting with suitable indigenous trees, shrubs and ornamental plants in the form of Tree Groves, and Linear plantation will be carried out in accordance with the Tree Plantation Plan to improve aesthetic value and offset the effect of removal of vegetation. Proper check and balance for above activities is highly recommended. Plantations so, raised must be maintained according to the Silvicultural practices which include proper Irrigation, Cleaning, Pruning, Thinning at prescribed intensity, Silt clearance and Trench-opening, etc. in accordance with the approved practices of Gilgit Forest Department. Maintenance and security of the forest area should be done for at-least five years in consultation with the forest department. Measures such as fencing, watch guards and fire protection should be considered. All activities must be done under the technical supervision of GB, Forest Department.	EPC Contractor	SC& Proponent
Fauna	As the project area is part of Hanzel "Community Controlled Hunting Area (CCHA)" and near to Kargah Game Sanctuary (approximately 4000 m Distance), some temporary corridors for wildlife movements may be affected due	The pathways of locally available wildlife for food, shelter and other normal activities must be compensated with proper alternative routes/pathways & water points at hill side must be provided to minimize the impact & movement of wild animals to Gilgit River. The	EPC Contractor	SC& Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
	to headrace channel of 4.983 km (4,983 m) length. The headrace channel may cause disturbances to temporary or expected routes of Iibex and Markhor specially babies of above. No major impact on Wildlife & Livestock in the area is expected through, noise, vibration and any type of normal activity in the Power House, thus will have no effect on productivity.	passing bridges/crossings and railing on both sides of the channel is recommended to avoid any inconvenience to worthy ibex and Markhor. In proper consultations with Conservator GB Wildlife department permanent water points for available fauna must be provided to conserve local ecosystems & biodiversity. Strict control must be exercised for stoppage of killing/poaching of available wildlife species by enhancing protection practices and deploying effective watch and ward system. The precautionary measures described for future shall also be applicable during operation phase as relevant for the conservation of “Endangered”, “Vulnerable” and “Near Threatened” species in the Study Area. The proposed project also have provision in headrace channel construction for crossing bridges, to avoid any inconvenience for wildlife movement.		
Aquatic Life	Once the construction phase is completed and water diverted at the site of weir will change the water flow regime from weir to powerhouse. This is a stretch of approximately 4.983 km (4,983 m) from weir to powerhouse. The negative impact will be due to low flow in the stream from weir to location of powerhouse especially during low flow season. A negative impact could also be that the fish population will be fragmented into a population above weir and one below the weir acting as a barrier to migration. The expected impact is considered to be Medium Significant.	The low/lean flow season is March in which flow is recorded as 46 m^3/s and the highest is July i.e. 862.2 m^3/s. For the protection of the fisheries and other aquatic life 10% of average yearly flow is required (Tennat, D.L 1976 In-stream flow regimes for fish, wild life, recreation and related environmental resources). Based on the available data, the minimum flow to be ensured through the weir is more than 10% during the whole year. In case the hydrological records are enhanced, the figure of minimum requirement for maintenance of aquatic ecosystem has to be revised like wise. Fish traps should be used to stop the fish movement to the intake structure and	EPC Contractor	SC& Proponent

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
		headrace/power channel. Fish ladders are highly recommended to compensate the impacts due to diversion of water flow. Without fish ladders, however, many more fish would be prevented from reaching their breeding and feeding grounds. As human action often negatively influences wildlife, it is important to have such structures in order to reduce unwanted consequences. If any spawning areas are lost due to engineering interventions, they can be well compensated if stretches of stream are stocked annually with increased number of fish. One Biodiversity Fish hatchery is recommended in habitat loss for local available fish. For management and conservation of fisheries, certain conservation and management staff should be recruited on recommendation of Fisheries Department, GB. Fisheries Department, GB must be consulted at all stages as it is the obligation of the department to manage all natural water resources in GB as per provision of existing Fisheries Act and Rules 1975. In the proposed project area one may anticipate that the fish will locate new avenues for breeding. Due to low flow even more micro - macro invertebrates will flourish, thus providing more food for the fish. Creation of pools and puddles (which are now bare minimum) will provide more rest places for fish during extreme rigors of weather. Proper waste Management Plan should be prepared as power house will start offering jobs and masses will stay there for power activities. Gilgit River must be given proper		

Environmental Components	Impacts	Proposed Mitigation Measures	Responsibility	
			Implementation	Monitoring
		protection from such waste of power house employees to avoid impact on the aquatic life.		
Noise	Due to the operation of the power house noise and vibration will be produced which will have impact in the adjoining villages, schools, and surrounding areas.	To minimize the noise of the proposed power houses pollution barriers should be placed around the boundary of the power houses and continuous monitoring should be done to determine noise levels and ensure that they are within the NEQS limits.	EPC Contractor	SC & Proponent

(This Space is Left Intentionally Blank)

7.13 ENVIRONMENTAL MONITORING PLAN

Environmental monitoring provides timely and useful information to the project management and implementation agencies. Conceptually, “monitoring” means to check and balance, on a regular basis, the status of the project activities and realization of various developmental targets during construction, operation and maintenance. It helps in timely identification/analysis and removal of the bottlenecks and expedites actions. Certain environmental parameters (physical, chemical and ecological) are selected and quantitative analysis is carried out. The results of analysis are compared with the guidelines; standards and pre-project condition to investigate whether the EMP and its implementation are effective for the mitigation of impacts or not.

(This Space is Intentionally Left Blank)

Table 7-3: Environmental Monitoring Plan

Description of Components	Associated Impacts	Monitoring Tasks/ Parameters	Methodology	Monitoring Location	Frequency of Measurement	Responsibility
Water flows/Compensation flow	Effect on aquatic life	Water flows	Flow Measurement	Downstream of weir site	Monthly	EPC Contractor
Disposal of excavated Material/ Borrow areas	Hazardous to human being and wild life, Aesthetic Nuisance	Dumping at designated sites, Reuse of excavated material in order to reduce the volume of dumping material	Visual observations	Areas identified for disposal by the EPC Contractor	Weekly	EPC Contractor
Soil Erosion/ Contamination	Slope instability Limit the future use of land	Inspection of pre-identified sensitive points including borrow areas	Checklist, Visual Observations	Construction sites, storage and workshop areas	Weekly	EPC Contractor
Landslides	Instability of geological formation	Inspection of sensitive points/Appearance of cracks	Visual Observations	Construction sites	Quarterly	EPC Contractor
Explosive materials	Danger to fire and blast in the area	Presence of proper storage area, Emergency plan Display of safety signs, Trainings of workers	Checklists, Visual Observations	Storage areas	Bi-annually	EPC Contractor
Occupational health and safety	Health and Safety hazards to the workers	Display of safety signs, Provision of PPEs to the workers, Trainings	Checklist, visual Observations	Construction and storage sites	During construction activities	EPC Contractor
Flora	Damage to the visual quality and beauty of the area	Types and species to be uprooted, presence and implementation of Tree Plantation Plan	Tree Plantation Plan to be followed	Project area	Tree cutting will be completed prior to start the construction activities while tree plantation will be continuous activity	EPC Contractor

Description of Components	Associated Impacts	Monitoring Tasks/ Parameters	Methodology	Monitoring Location	Frequency of Measurement	Responsibility
Women	Privacy	No. of complaints	Observations, complaint register	Project area	Continuous activity	EPC Contractor
Public grievance	Dissatisfaction of PAPs	No. of complaints Actions on public complaints	Complaint Register	Throughout construction	Daily	EPC Contractor
Employment	Job opportunities for locals	Compliance with agreed contract	Checklist	Project area	Continuous activity	EPC Contractor

(This Space is Intentionally Left Blank)

7.14 INSTRUMENTAL MONITORING

During the IEE process, environmental monitoring will be carried out by an EPA approved laboratory to establish baseline conditions. The main purpose to conduct the monitoring is to get the results of various parameters of water, air & noise and to compare them with monitored parameters during the construction as well as EPC Contractor can compare these with the National Environmental Quality Standards (NEQS). The monitoring during the construction phase will be carried out by EPC Contractor by hiring EPA approved laboratory. The **Table 7-4** shows the parameters, location, frequency and estimated points for the instrumental monitoring during the preconstruction and construction phase.

Table 7-4: Proposed Instrumental Monitoring Protocol

Project Phase	Parameters	Location	Frequency	Estimated Points
(A) AIR QUALITY				
Design /Pre-Construction	SO_2, NO_x, PM_{10}, $PM_{2.5}$, CO, CO_2 and VOC, and (Ambient Air Quality)	▪ Proposed construction Areas. ▪ Nearby Villages (Hanzel) ▪ At the access Road.	Once before the start of construction	5 Nos.
Construction	SO_2, NO_x, PM_{10}, $PM_{2.5}$, CO, CO_2, and VOC. (Ambient Air Quality)	▪ Active construction Areas. ▪ Nearby Villages (Hanzel Bala, Hanzel Paine, Harpoon) ▪ At the access Road. ▪ Workers Camp Area ▪ Near Concrete mixing plant. ▪ Excavated areas.	Quarterly	5 Nos.
Operation	SO_2, NO_x, PM_{10}, $PM_{2.5}$, CO, CO_2, and VOC. (Ambient Air Quality	▪ Nearby Villages (Hanzel Bala, Hanzel Paine, Harpoon ▪ O&M staff colonies ▪ Weir Site ▪ Power House Site	Bi-annually	5 Nos.
(B) WATER QUALITY				
Design/Pre-Construction (Drinking Water)	Colour, pH, Odor, Taste, Turbidity, TDS, TSS, Heavy Metals, Phosphate, NH_3, Arsenic, Sulphate, Sulphide, Coliforms, other Heavy Metals and Fecal Coliforms.	▪ From drinking water source in the nearby Villages (Hanzel Bala, Hanzel Paine, Harpoon) ▪ Spring Water from existing water tank	Once before the start of construction	5 Nos.
Construction (Drinking Water)	Colour, pH, Odor, Taste, Turbidity, TDS, TSS, Heavy Metals, Phosphate, NH_3, Arsenic, Sulphate, Sulphide,	▪ Camp Area (Drinking Water Source). ▪ From drinking water source in the nearby Villages (Hanzel Bala, Hanzel Paine, Harpoon), Spring Water, Existing	Quarterly	5 Nos.

Project Phase	Parameters	Location	Frequency	Estimated Points
	Coliforms, Other Heavy Metals and Faecal Coliforms	water tank in Barbuch		
Operation (Drinking Water)	Colour, pH, Odor, Taste, Turbidity, TDS, TSS, Heavy Metals, Phosphate, NH_3, Arsenic, Sulphate, Sulphide, Coliforms, Other Heavy Metals and Faecal Coliforms	▪ Drinking Water from O&M staff colonies/offices, ▪ Spring Water near Barbuch, ▪ Tap water from Hanzel Village	Bi-annually	5 Nos.
Pre-Construction (Surface Water)	Colour, pH, TSS, TDS, Turbidity, DO, BOD_5, (COD), Total Toxic Metals etc.	▪ Upstream and Downstream of the Weir. ▪ Downstream of the Power House. ▪ Existing water Channels supplying water to the locals.	Once before the start of construction	5 Nos.
Construction (Surface Water)	Colour, pH, TSS, TDS, Turbidity, DO, BOD_5, COD, Total Toxic Metals etc.	▪ Upstream and Downstream of the Weir. ▪ Downstream of the Power House. ▪ Existing water Channels supplying water to the locals.	Quarterly	5 Nos.
Operation (Surface Water)	Colour, pH, TSS, TDS, Turbidity, DO, BOD_5, COD, Total Toxic Metals etc.	▪ Upstream and Downstream of the Weir. ▪ Downstream of the Power House. ▪ Headrace Channel.	Bi-annually	5 Nos.
Pre-Construction (Wastewater)	NEQS 32 Parameters.	▪ Upstream and Downstream of the Weir. ▪ Downstream of the Power House. ▪ Existing water Channels supplying water to the locals.	Once before the start of construction	5 Nos.
Construction (Wastewater)	NEQS 32 Parameters.	▪ Composite discharge from the construction camps ▪ Wastewater pond/Collection Point in Hanzel.	Quarterly	3 Nos.
Operation (Wastewater)	NEQS 32 Parameters	▪ Composite discharge from the O&M staff colonies/offices, ▪ Any Discharge from Power House facility.	Bi-annually	3 Nos.

Project Phase	Parameters	Location	Frequency	Estimated Points
(C) NOISE				
Pre-Construction	Noise levels on dB(A) scale	▪ Nearby Villages (Hanzel Bala, Hanzel Paine, Harpoon) ▪ At the access Road. ▪ Workers Camp Area, ▪ Excavated areas.	Once before the start of construction	5 Nos.
Construction	Noise levels on dB(A) scale.	▪ At the blasting areas. ▪ Nearby Villages (Hanzel Bala, Hanzel Paine, Harpoon) ▪ Construction Camp Site. ▪ At the access Road. ▪ Near batching / asphalt plant.	Quarterly	5 Nos.
Operation	Noise levels on dB(A) scale.	▪ Power House Facility ▪ Weir Site ▪ O&M Staff Colony/ Offices ▪ Nearby Villages (Hanzel Bala, Hanzel Paine, Harpoon)	Bi-annually	5 Nos.
(D) SOIL				
Pre-Construction	Oil and grease, Total Toxic Metals, Nitrate and Phosphate.	▪ Camp site location. ▪ Proposed chemical Storage tank and pit sites.	Once before start of construction	5 Nos.
Construction	Oil and grease, Total Toxic Metals, Nitrate and Phosphate.	▪ At access road, fuel and chemical storage sites, camp site.	Quarterly	5 Nos.
Operation	Oil and grease, Total Toxic Metals, Nitrate and Phosphate.	▪ Near Power House Site, and chemical storage sites, O&M staff colony/office.	Bi-annually	5 Nos.

7.14.1 Implementation of Monitoring

i) EPC Contractor

Physical implementation of the EMP is the sole responsibility of EPC Contractor during the construction of the project. Contractor will be responsible for in-house monitoring to ensure that the construction activities are being carried out as specified in the EMP. However, EPC Contractor's presence later in the operation phase is dependent upon the agreement between Proponent and EPC Contractor.

ii) Proponent

Proponent will be responsible to check the environmental monitoring activities (during construction phase only) being carried out by the Contractor and will perform the following activities;

- Check whether monitoring of the environmental aspects of project during construction phase is being properly carried out and to ensure that the environmental requirements of the contract and the mitigation measures proposed in the EMP are implemented;
- Undertake routine visual monitoring of construction activities, waste disposal, storm
- water drainage management, noise levels, exhaust gases etc.;
- Review the monitoring reports that would be prepared by the Contractor and make
- recommendations (if any); and
- To submit a monitoring report to Proponent and actions taken for rectification.

iii) Auditing

The internal audit of the plant at operational phase will be carried out by the Plant Manager who will be assisted by HSE Manager. It is recommended. Audit will also suggest remedial measures to overcome the environmental and social problems.

7.15 TRAINING AND AWARENESS

Environmental and social trainings will help to ensure that requirements of Environmental Management Plan are understood by the project team. Training program will be finalized during detailed design stage. The EPC Contractor will mainly be responsible for providing and evaluating the training program for effective implementation of EMP and HSE Plan.

Trainings will be provided to construction workers, skilled and unskilled persons engaged with the project. These trainings will continue to be conducted during the whole construction phase of the project. The below **Table 7-5** shows the scope of training program.

Table 7-5: Scope of Training Program

Sr. No.	Scope	Responsibility	Staff/Participants	Schedule
1	• General awareness about the project and project area; • Environmental and social aspects of the project; • Mitigation measures; • Environmental Management Plan.	EPC Contractor	GB W&P Department staff (Project Supervisors and management staff), contractors staff	At the end of the detailed design stage (Prior to start The project activities)
2	• General awareness about the project and project area; • Environmental and social aspects of the project; • Community issues.	EPC Contractor	Project team	Prior to start of the project activities
3	• Environmental Management Plan • Implementation mechanism • Liquid and solid waste disposal • Cultural values • PPEs • Health and safety	EPC Contractor	Construction Workers	Prior to start of the project activities

Sr. No.	Scope	Responsibility	Staff/Participants	Schedule
	Issues.			
4	• Road safety principles • Speed limits • Waste disposal practices.	EPC Contractor	Drivers, Construction Workers	Prior to start of the project activities

7.16 MONTHLY / QUARTERLY REPORTING AND DOCUMENTATION

Monthly as well as quarterly meetings will be held during the construction phase at proposed Project site office. The purpose of these meetings will be to discuss the activities of the last quarter, non-compliances and their remedial measures. The nominee from Client, Contractors and Supervisory Consultant should attend the meeting. The meeting will be recorded in the form of a quarterly Environmental Compliance Report (ECR) to be prepared by Contractor and reviewed by Supervisory Consultant. The report will include but not limited to:

- Summary of project activities during last quarter;
- Personnel attended the meeting;
- Summary of compliance monitoring and evaluation activities; and
- Non-compliances observed and mitigation measures taken or required along with the role and responsibilities and pictorial records.

A tentative format of the monthly/quarterly reports is as follow:

- List of Figures;
- List of Tables;
- List of Annexes;
- Part I: Introduction;
- Part II: Status of Institutional Arrangements during the reporting period;
- Part III: Construction Stage Activities in the Reporting Month;
- Part IV: Status of Site Specific Development Plans and its Implementation;
- Part V: Status of Mitigation Implementation during the reporting period;
- Part VI: Status of NOC Implementation during the reporting period;
- Part VII: Environmental Monitoring, Sampling and Testing;
- Part VIII: Major Non Compliance during the reporting period;
- Part IX: Corrective Actions Taken on Non-Compliance of the Previous Month;
- Part X: Stakeholder Consultations;
- Part XI: Conclusions and Recommendations; and
- Part XII: Photographic Records.

7.17 SITE SPECIFIC PLANS

The site-specific plans will also require to be prepared by the EPC Contractor based on its final design. EPC contractor will get approval from GB EPA before commencement of the below mentioned activities. All the listed activities are part of scope of works of EPC Contractor and included in the EPC Tender Documents (Project Construction Requirements). As far allocation of financial resources is concerned, the cost for development of these activities is deemed to be covered in the bid of EPC Contractor and all the cost for development of these activities shall be solely borne by the EPC Contractor. The subsequent sections outline the guidelines to prepare environmental management site specific plans by the EPC Contractor before start of the construction works.

7.17.1 Management / Rehabilitation Plan for Quarry / Borrow Areas

Objective: To manage the borrow worksite (quarry / borrow areas) to avoid the environmental damage

Activity: Development and operation of quarry / borrow areas

Management Guidelines

The EPC Contractor will develop a Borrow and Quarry area management plan prior to start the extraction of material from each borrow pit or quarry by using these guidelines.

- Site layout and boundaries with the following provisions:
- Name, location and ownership of the borrow or quarry area;
- Existing land use of the area;
- Estimates of the resources to be extracted;
- Stockpiling location;
- Dust and noise consideration; and
- Sequence of operation.

Site operating procedures

- Pit wall suitability in case of quarry;
- Wild life interaction;
- Avoid interference of borrow areas with the natural or designed drainage system;
- Reuse the leftover excavated material e.g., backfilling the pits and queries. If this is not possible, then excavation slopes will be smoothed and depression will be filled in such a way that it looks more or less like the original ground surface;
- Where the agricultural land is unavoidable, the top 30 cm of the plough layer should be stock piled for redressing the land after the required borrow material has been removed;
- Avoid soil erosion by planting indigenous grass in case of low embankments;
- Protect high embankments i.e. over 2 m by stone pitching or riprap across the embankment as appropriate; and
- Landscape the pits that cannot be fully rehabilitated in order to avoid creating hazards to the people and livestock.

Service the machinery and equipment on routine maintenance schedule to ensure proper operation and thus minimize the emission and noise.

7.17.2 Waste Management

Objective: To reduce the amount of waste by adopting waste management practices

Activity: General Waste

Management Guidelines

- Segregate the waste streams (construction debris, food waste, reusable waste);
- Develop waste management plan for each segregates stream;
- Disposal of each stream in environmental friendly manner;
- Adopt 3R approach to minimize the production of waste;
- Conduct trainings of staff engaged in waste collection and disposal regarding waste management practices;
- Maintain the temporary collection waste at the construction site;
- Emphasize good housekeeping; and
- Use refuse containers at each work site.

Activity: Hazardous waste

Management Guidelines

- Ensure the availability of MSDS for hazardous chemicals on the site; and
- Retain the waste oils, lubricants, greasy and oily rags, or other materials subject to spontaneous combustion in labelled containers used for that purpose exclusively and dispose properly at frequent intervals.

7.17.3 Fuel and Hazardous Material Management

Objective: To reduce/eliminate the adverse impacts of hazardous materials on surroundings

Activity: hazardous material/fuel handling and storage

Management Guidelines

- Store the fuel tanks in an area where it cannot be hit by vehicles or other equipment. The storage area should be located at the appropriate distance:
- Mark the storage site with "HAZARDOUS MATERIAL STORAGE SITE" where drum and containers are put;
- Place the fire extinguishers near the fuel storage areas and be of a suitable type and size to permit the evacuation;
- Don't permit the smoking near storage area and post the "No Smoking" signs;
- Don't permit the smoking during any fuelling operation;
- Store the hazardous material on concrete floor covered with plastic sheet;
- Floor should be sloped to safe collection area in case spill occurs;
- Containers must be closed except when adding or removing material;
- Use auto shut down valves for fuel transfer pipes;
- Designate the specific site for refueling;
- Dispose the non-recycled waste to EPA designated disposal site;
- Ensure the provision and use of PPE while handling of hazardous materials;
- Ensure that all containers and chemical filled drums are in good condition;
- Regular check of any leakages to identify the problem prior to occur; and
- Conduct trainings of staff regarding proper storage and handling of chemicals and other hazardous goods.

7.17.4 Spill Management

Objective: Allow response person to prepare for and safely respond to spill incidents

Activity: Spill Control

Management Guidelines

The impacts of spills can be minimized by establishing a predetermined line of response and action plan. Spill contingency plan should include the following;

Introduction: project description, topography e.g. slope of land, scope of the plan, site name and location, type and amount of hazardous materials stored on-site, the storage capacity and the type and number of storage containers, all nearby surface water bodies etc.

Description of response: identify response personnel, flowchart showing the communication lines and the response duties of each member of the response team.

Action plan: potential impacts related to the spill and procedures to be taken in response to a spill. Following procedures should be developed in detail;

- Procedures for initial action;

- Spill reporting procedures;
- Procedures for cleaning up the spill;
- Procedures for transferring, storing, and managing spill-related wastes; and
- Procedures for restoring affected areas.

Resources inventory: spill response equipment

Description of training programs

Plan should be updated monthly to reflect changes such as fuel storage locations, arrival of new hazardous materials on site and new personnel and contact information.

7.17.5 Health, Safety and Working Environment Plan

Objective: Promote health and safety of construction labor at the work place

Activity: Construction site, Construction Camps, offices

Management Guidelines

Ensure the provisions of following facilities:

- Safe drinking water supply;
- Sufficient ventilation facilities;
- Security fence;
- Proper sanitary facilities;
- Proper sewerage system;
- Wastewater treatment facility;
- Solid waste collection system;
- First aid facilities;
- Training of workers;
- Develop and implement safety standards for all the workers and at workplace and visitors which should not be less than those laid down on the international standards;
- Periodic inspections and procedures for correction and control;
- Potential risks and hazards assessment in the workplace, and eliminating or controlling them;
- Provision of personnel protection equipment's to the workers;
- Trainings of employees in health and safety, basic sanitation and specific hazards at the work place; and
- Development and implement driving safety rules.

Activity: Occupational Accidents

Management Guidelines

- Identify potential hazards to the workers;
- Provision of first aid facility at site and ambulance facility during emergency to be transported to nearest hospital;
- Document the accidents and diseases;
- Health screening of workers to assess the physical fitness; and
- Provide sufficient light system at active construction areas

Activity: Water and Sanitation Facility

Management Guidelines

- Provide sanitary facilities at the construction site. Location should be at a fair distance from surface waters; and

- Provide safe drinking water supply to the workers

7.17.6 Noise and Vibration Management

Objective: To maintain the acceptable tranquil environment for living in and around the construction site

Activity: Construction activities/Blasting/Construction Machinery noise

Management Guidelines

- Use well maintained construction machinery;
- Use buffers around generators and static noise generating machinery;
- Avoid use of needless horns and alarms;
- Use low intensity explosive material instead of high intensity explosive material;
- Prefer increased number of blasts with low intensity explosive material rather than high intensity single blast to avoid the noise impacts;
- Install temporary noise control barriers where appropriate;
- Monitor noise levels and analyze the results as required;
- Schedule the loading and unloading trucks; and
- Avoid to perform the noisiest activities at time near residential areas.

7.17.7 Air Quality Management

Objective: To maintain the ambient air quality as per standards

Activity: Construction activities/Movement of construction Vehicles

Management Guidelines

- Impose maximum speed limit on all internal access roads by use of speed bumps and appropriate road signage;
- Undertake maintenance and repairing of generators and construction machinery to avoid hazardous emissions;
- Performed sprinkling of water wherever there is potential source for dust in the project area;
- Install crusher and concrete batching plants at a fair distance from village Hanzel Bala, Hanzel Paine and Harpoon;
- Equip the crushers with dust suppression equipment comprising of scrubber and water sprays to reduce the amount of dust released from the plant;
- Provide water supply system for controlling dust from the borrow area;
- Conduct monitoring near sensitive points;
- Use closed conveyer system to transport the material to batching plant; and
- Pave the access roads in the construction area.

7.18 CHANGE MANAGEMENT PLAN (CMP)

If some changes in the operation of Project or the EMP may be required, a CMP manages such changes. The management of changes is discussed under two separate headings, i.e. additions to the EMP and changes to the operation and the EMP.

7.18.1 Additions to the EMP

The EMP has been developed based on the best possible information available at the time of the study. However, it is possible that during the conduct of the proposed operation, additional mitigation measures based on the findings of environmental monitoring during the construction and operation may have to be included in the EMP. In such cases following actions will be taken for changes during the construction phase:

- A meeting will be held between Proponent, EPC Contractor and the Supervisory Consultant. During the meeting, the proposed addition to the EMP will be discussed and agreed upon by all parties;
- Based on the discussion during the meeting, a change report will be produced by EPC Contractor, which will include the additional EMP clause and the reasons for the addition;
- The report will be signed by all parties and finalized at the site office. A copy of the report will be sent to Proponent, EPC Contractor and Supervisory Consultant;
- All relevant project personnel will be given information about the addition/change; and
- During the operation phase, all actions would mainly be the responsibility of Plant Management.

7.18.2 Changes to the Operation and EMP

The change management system recognizes three orders of changes:

a) First Order

A first order change is one that leads to a significant departure from the project described or the impacts assessed and consequently require a reassessment of the environmental impacts associated with the change. Action required in this case will be that the environmental impacts of the proposed change to be reassessed by Supervisory Consultant and forward to the EPA by Proponent.

Examples of such change include:

- Deviations from the minimum requirements for Effects Monitoring specified in the EMP; and
- Changes in the design/alignment, documentation, communication, or stakeholders' consultation program such as if the overall objective of documenting compliance with the EMP and its communication to Proponent, Supervisory Consultant and the EPC Contractor or interested stakeholders at regular intervals is not being met.

b) Second Order

A second order change is one that does not result into change in the project description or impacts that are significantly different from those in the EMP. Action required for such changes will be that Supervisory Consultant will reassess the impact of the activity on the environment and specify additional mitigation measures, if required, and report the changes to Proponent.

c) Third Order

A third order change is one that does not result in impacts above those already assessed in the EMP, rather these may be made on-site to minimize the impact of an activity such as relocation of certain areas of construction camp to minimize effects on the environment. The only action required for such changes will be to record the change.

7.19 CRITERIA FOR ESTABLISHMENT OF CONSTRUCTION CAMPS

The location of construction camps is not finalized as yet. The EPC Contractor should consider the below mentioned criteria with respect to environmental other than the technical considerations while selecting sites for establishment of construction camps during the construction phase.

- Water should be easily available for the camps;
- Camps location should be selected in such a way that it must be at a considerable distance from the river, water body, any wetland and existing built-up area;

- Camps should be located in the area that is safe from flooding hazard;
- Land selected for the camps preferably should be a government property;
- Land selected for the camps must not be interfere community infrastructure, sensitive wildlife habitat and should be preferably on barren land; and
- There should be no resettlement issue for the location of camps.

7.20 CHANCE FIND PROCEDURE

In case of any chance find procedure, the EPC Contractor will immediately report through supervision consultant to Archaeology Department of GB and take further suitable action to preserve those antiques or sensitive remains. Representative of the Director will visit the site and observed the significance of the antique, arte fact and Cultural (religious) properties and significance of the project. The report will be prepared by representative and will be given to the Director. The documentation will be completed and if required suitable action will be taken to preserved those antiques and sensitive remains.

In case any arte fact, antiques and sensitive remains are discovered, chance find procedures should be adopted by construction contractor workers as follows:

- Stop the construction activities in the areas of chance find procedure;
- Delineate the discovered site or area;
- Consult with the local community and Archaeological Department;
- The suggestion of the local communities and the concerned authorities will be incorporated during taking the preventive measures to conserved the antique, arte fact and Cultural (religious) properties;
- Secure the site to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive remain, a night guard shall be arranged until the responsible local authorities take over; and
- After stopping work, The EPC Contractor must immediately report the discovery to the Supervisory Consultant.

7.21 LAND ACQUISITION

Client (WPDGB) will acquire land for the construction of project structures such as headrace channel, penstock, and powerhouse complex etc. Similarly, a section of the main road which needs relocations as well as any temporary access roads land also needs to be acquired. Land for the construction of the Project components will be acquired by the Project proponents as per the provisions of the LAA. The process has been initiated to acquire the land well before the start of the construction activities.

As a standard procedure Section-4 has be notified. Moreover, Secretary Law GB, authorize Deputy Commissioner/Collector to start the land acquisition at the project zone.

The estimated land required will be 142 acres (57 hectare) based on the project footprint and topographic and GIS surveys for the project execution, which will be further verified upon the mobilization of the EPC Contractor. The land that will be required for the weir, spillway, headrace channel, forebay, penstock, powerhouse, contractor's camps, access roads, bridges and operator's colony is about 15 acres (6 hectare)[18].

Land acquisition details will be updated when fully acquired by the Client.

[18] Topographic Survey and GIS Estimation, 2017

7.22 TREE PLANTATION PLAN

The total number of estimated 2,240 trees needs to be removed during the Project implementation phase. The Plantation/Reforestation of suitable species to be carried out in the affected areas shall not only improve the water quality, but will also improve the overall environment/ecology of the area. The loss of vegetation in the Project AOI, after construction of the Power House, will be compensated by Plantation/Reforestation measures carried out in the disturbed area before operational phase.

The site of 20 MW Hanzel Hydropower Project is located on the right Bank of Gilgit River a tributary of Indus River at about 17 km (17,000 m) from Gilgit town. Based on Google imageries & experts observations different areas in the proposed project area were identified having comparatively good tree density. The selected area has about 2,240 trees.

The area can be afforested and vegetation cover can be improved by adopting standard afforestation technique of digging pits, as the site is suitable for this type of afforestation. Afforestation/Plantation shall be carried out on the suitable area as sufficient barren land is available in immediate vicinity of the site. The adjacent area to the project site shall be taken up in order to increase the grazing capacity of the area as on submersion of the livestock, which used to graze here shall be shifted to surrounding areas.

The total recommended 22,400 plants can be raised in at an average rate of 500 plants / acre. These plants can be raised in area at an average 10'*10' rate of spacing while technically observing site quality and capacity in the light of plantation objectives. The ratio of 1 is to 10 is considered for the potential area, remaining trees will be planted at later stage, under the supervision of Forest Department, to improve the local Ecology.

Pits should be dug, in the blank, areas at a spacing of 10' x 10'. (Spacing may vary from specie to specie and Plantation site). The pits should be of 2' dia at the top and 1' dia at the bottom with a depth of 1-3/4" ft (May vary according to site, soil profile & structure). The earth taken out of the pits will be deposited below each pit in a crescent shape, so as to form a ridge with a clear berm of 9 inches in front. The consecutive crescents will be joined to catch the maximum quantity of moisture. Line to line distance of 10' may be reduced on steeper slopes planting should be carried out in the pits and sowing on the berms, before or immediately after the first shower of rain. Number of pits in the area should be nearly 500 per acre. The choice of species for area is given in **Table 7-6**. It's worth mentioning that species and site should be selected according the recommendations of DFO, Gilgit.

Table 7-6: Recommended Species for Afforestation

Sr. No.	Local Name	Scientific Name
1	Bhaid (Willow)	*Salix tetrasperma*
2	Thoth(Mulberry)	*Morrus alba*
3	Ilenthus	*Ilenthus spp*
4	Khail	*Pinusroxburghii*
5	Poplar	*Populus alba*
6	Kikar	*Acacia nilotica*
7	Palosa/Phulahi	*Acacia modesta*

7.23 MONITORING AND REPORTING

Monitoring will be carried out to check the implementation and effectiveness of EMP and HSE based on data collection and analysis. The frequency of reporting will depend upon the scope of the project activities. Results of internal monitoring of mentioned parameters will be documented in periodic reports to assess the progress.

The information will be collected directly from field through periodic surveys and submitted to the Project director for his feedback and actions. Monthly environmental reports will be prepared by the EPC contractor and reviewed by the Supervisory Consultant and summarized in "quarterly monitoring reports" for onward submission to the proponent and subsequently submitted to GB, EPA by the proponent.

GB, EPA is the regulatory authority for issuance of NOC for this proposed project. As part of its mandate, protection of environment (water, air and noise) is their responsibility. Therefore, the agency will undertake an audit (as and when required) of the activities of the project (both phases) with respect to the protocols as defined in EMP.

7.24 ENVIRONMENTAL COST

The environmental mitigation and monitoring cost including instrumental monitoring for air and noise during construction and operation, water sampling and testing, tree plantation. The land acquisition cost will be updated during the detail design stage.

7.24.1 Environmental Monitoring Cost

An annually estimated cost for instrumentation monitoring for all the three phases of the Project is given in **Table 7-7**.

Table 7-7: Environmental Monitoring Cost

Project Phase	Environmental Monitoring Cost
Pre-Construction (once)	Rs. 600,000/-
Construction (annually)	Rs. 2,900,000/-
Operation (annually)	Rs. 1,600,000/-

7.24.2 Plantation Cost

The cost of raising 500 Plants in the disturbed area has been estimated Rs. 295,500/- including price of plants, earthwork, procurement of manures, continued supply of water to young plants throughout the year and its maintenance for five (05) years. Total cost for raising 22,400 plants is estimated as Break-up of Expenditure 13,238,400/-(13.2 Millions).

The cost of raising 500 Plants in the disturbed area has been estimated Rs. 295,500/- including price of plants, earthwork, procurement of manures, continued supply of water to young plants throughout the year and its maintenance for five (05) years. Total cost for raising 3,000 plants in six (06) acres is estimated as Break-up of Expenditure Rs. 1,773,000/-.

Cost of raising 500 plants in one acre and their maintenance for 5 years, keeping the rate of daily wages as Rs. 500 per Man per day is described in **Table 7-8** to **7-11** respectively.

Table 7-8: Estimated Cost of Plantation of 500 Plants for First Year.

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	Layout	1 Acre	2 MD/Acre	1000
2.	Digging of Pits 2.5 ft. each 2.5x500 = 1250 cft.	1250 cft.	10 MD/Acre	5000
3.	Cost of Plants including 20% Restocking	600 No.	Rs.20/-plant	12,000
4.	Cost of planting of plants	600 No.	Rs. 5/- plant	3,000
5.	Carriage of plants from private nursery to site including loading/unloading	600 No.	Rs. 1/- plant	600
6.	Cost of Manure and Bhall (silt) including	500 Pits	Lump Sump	5,000

	carriage			
7.	H/watering 30 times 500x30	15,000 no.	10MD/1000	75,000
8.	Weeding twice 500x2	1000 no.	5 MD/100	2,500
9.	Reopening of Pits twice (500x2)/cft/pit	1000 cft.	5 MD/100	2,500
10.	Miscellaneous			400
			Total	**1,07,000**

Table 7-9: Estimated Cost of Plantation of 20% (100) Plants and maintenance for Second Year

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	Cost of Plants 20% Restocking	100 No.	Rs.20/- per plant	2,000
2.	Cost of planting	100 No.	Rs. 5/- per plant	500
3.	Carriage of plants	100 No.	Rs. 1/- per plant	100
4.	H/watering 30 times	15,000 no.	10 MD/ 1000	75,000
5.	Reopening of Pits twice (500x2)	1000 cft.	5 MD/1000	2,500
6.	Weeding twice 500x2	1000 no.	5 MD/1000	2,500
7.	Miscellaneous			400
			Total	**83,000**

Table 7-10: Estimated Cost of Plantation of 10% (50) Plants and maintenance for Third Year

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	Cost of Plants 10% Restocking 50 No.	50 No.	Rs.20/- per plant	1000
2.	Cost of planting	50 No.	Rs. 5/- per plant	250
3.	Carriage of plants	50 No.	Rs. 1/- per plant	50
4.	H/watering 20 times	10,000 no.	10 MD/1000	50,000
5.	Reopening of Pits twice (500x2)	1000	5 MD/ 1000	1,500
6.	Miscellaneous			700
			Total	**53,500**

Table 7-11: Estimated Cost of Maintaining Plants for Fourth Year

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	H/watering 20 times	10,000 no.	10 MD/per 1000	50,000
2.	Pruning and cleaning of plants	500 no.	5 MD	1,500
3.	Unforeseen			500
			Total	**52000**

Total Cost for Raising 500 Plants Including Maintenance:	Rs.	295,500/-
Cost for Raising 01 Plant	Rs.	591/-
Total Cost for Raising 22,400 Plants .	Rs.	13,238,400/- (13.2 Million)

7.24.3 Fish Hatchery Cost

The proposed Fish Hatchery cost for the proposed project is given in **Table 7-12**:

Table 7-12: Fish Hatchery Cost

Sr. No.	Item	Estimated Cost
1	Establishment of fish hatchery cum farm for stock replenishment of depleted stock.	Rs. 1,000,000/-
2	Support for establishment of trout farms in private sector for generating livelihood opportunities of the key	Rs. 2,000,000/-

Sr. No.	Item	Estimated Cost
	stockholder communities of the project site.	
3	Integrated fish resource conservation and management with livelihoods development.	Rs. 2,000,000/-
4	Project Management Unit. (Pay and allowances of staff)	Rs. 3,000,000/-
5	Monitoring & evaluation, Printing & publication of the project activities.	Rs. 500,000/-
6	Operational charges.	Rs. 2,000,000/-
7	Purchase of physical Assets.	Rs. 500,000/-

Note*(The cost estimates given in the cost table are Approximate/Tentative. The final cost estimates shall be provided by the Fisheries Department, GB as per prevalent rates. It also does not include any contingencies etc.).*

7.24.4 Summary of Environmental Cost

Table 7-13 presents a summary of all the tentative environmental cost.

Table 7-13: Summary of Tentative Environmental Cost

Activities	Estimated Environmental Cost (Rs.)
(A) ENVIRONMENTAL MONITORING COST	
Pre-Construction (Once)	Rs. 600,000/- (0.6 Million)
Construction (34 months)[19]	Rs. 82,166,66/- (8.21 Million)
Operation (annually)	Rs. 1,600,000/- (1.6 Million)
(B) COST FOR TRAINING AND AUDITING[20]	
Training on EMP and HSE	Rs. 13,600,000 (13.6 Million)
Environmental Audit Cost	Rs. 6,600,000 (6.6 Million)
(B) TREE PLANTATION	
Cost of Plantation	. Rs 13,238,400/- (13.2 Million)
(**C) FISH HATCHERY COST**	
Cost of Fish Hatchery	Rs. 11,000,000/- (11 Million)
(**D) OTHER COST FOR ENVIRONMENTAL MANAGEMENT & IMPROVEMENT**	
Cost for Environmental Improvement	Rs. 14,000,000/- (14 Million)

7.25 CONTRACTUAL PROVISIONS FOR HEALTH, SAFETY AND ENVIRONMENT

The World Bank Standard Procurement Document Request for bids works (without prequalification) January 2017 is the recommended document; the bidder shall comply the provisions related with Health, Safety and Environment (HSE). However, following special HSE Sub-Clauses/provisions shall be included in the contract:

A description of the proposed work to be performed, a program for its execution and sufficient Environmental, Health and Safety (EHS) information to enable an evaluation of EHS risks and impacts;

- The EPC Contractor will be bound to implement all measures/actions to mitigate the adverse impact as mentioned in the IEE/EMP and NOC terms and conditions into true spirit;
- Implementation of the approved HSE manual including all SOPs and procedures during the contract period;
- The approved EMP shall be reviewed, periodically (but not less than every six (6) months), and updated in a timely manner, as required, by the EPC Contractor to ensure

[19] Rs. 2,900,000/annum

[20] Salary Cost and Other Miscellaneous Expenditures

that it contains measures appropriate to the Work activities to be undertaken. The updated EMP shall be subject to prior approval by the Engineer;

- The EPC Contractor shall provide immediate notification to the Engineer of incidents in the following categories. Full details of such incidents shall be provided to the Engineer within the timeframe agreed with the Engineer;
- Confirmed or likely violation of any local law or applicable international agreement; any fatality or serious (lost time) injury;
- Significant adverse effects or damage to private property (e.g. vehicle accident, damage from fly rock, working beyond the boundary);
- Major pollution of drinking water aquifer or damage or destruction of rare or endangered habitat (including protected areas) or species and;
- Any allegation of sexual harassment or sexual misbehavior, child abuse, defilement, or other violations involving children.

(This Space is Intentionally Left Blank)

CHAPTER 8 – CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the conclusion drawn and provides recommendations based on these conclusions.

8.1 CONCLUSIONS

The proposed Project is essentially a Run of the River 20 MW Hydropower Project. The site is located in Mauza Hanzel, Bala and Hanzel Paine, Gilgit District that is a right bank tributary of Indus River. The project is located about 17 km (17,000 m) from Gilgit Town. Gilgit Town is headquartering of the GB and the biggest city in the whole area respectively. The Project site is accessible through Karakoram Highway (KKH) which starts from Havelian in Abbotabad District. Hanzel is lying over Gilgit Gupis good quality newly constructed road. For evacuation of generated power from Hanzel, Single circuit 132 kV transmission line is selected.

This IEE report has been prepared in accordance with the requirements of the Gilgit-Baltistan Environmental Protection Act, 2015 (Amended 2012); Pak-EPA Regulations, 2000 for review of IEE and EIA; Pakistan EIA procedures; and Sectoral guidelines for environmental reports.

The site alternatives were analyzed to assess the better approach, maximum weir head and evacuation of power from project site. Other alternatives discussed in IEE report include the technological, power generation options.

Departmental and local (villages) level stakeholder consultations were carried out in order to record the concerns and observations of the stakeholders, especially the affected people. The major positive impacts of the Project are:

- Hydropower is a clean and renewable source of energy and avoids contributions to pollution loads, hence it is environment friendly.
- Getting experience on the project will develop human resource.
- Increased business activity and employment opportunities will have positive impacts on the local economy.
- The provision of electricity in the area will bring prosperity and improve the living standards of the local people.
- Improvement in civic and social services and increase in business and tourism are anticipated.
- Construction of new roads will improve access and mobility in the project area.
- There is potential for reclaiming of land on the deposition area. In addition, land leased for construction period will be developed and returned to original owner during operation phase for agricultural use.
- There is possibility for developing a recreational spot by improving and managing the project area and hence increase in tourist and income for locals.

The potentially significant adverse environment and social impacts of the proposed Project are:

- The estimated land required will be 142 acres (57 hectare) based on the project footprint and topographic survey for the project execution, which will be further verified upon the mobilization of the EPC Contractor. As per project foot print, topographic and GIS surveys, approximately 13 houses, 2 schools, 1 hotel, 13 huts will be affected mainly during the construction of the headrace channel as the houses and other infrastructure are mainly exists on the foothills of the proposed headrace channel. The loss of private built up area and infrastructure should be compensated according to the provisions of the LAA, 1894.

- During the pre-construction phase, installation of construction camps, construction of temporary roads & mobility of construction staff may damage the local vegetation/trees;
- The water flow pattern from downstream of weir site will be diverted towards headrace channel. The variation in flows may affect the downstream aquatic life and community. It should be obligatory for the project to release minimum water flood downstream the weir site throughout the year;
- The cutting of rocks, large scale excavation, dumping of soil and blasting and to create space for the headrace channel and forebay may disturb the stable geological formation of the area. Blasting should be minimized where possible. The headrace channel can be covered with RCC slabs at the top at places where the crossing of animal and human is foreseen. An aqueduct can also be provided at nullah/drain crossing;
- A total of 200 m sections of road around powerhouse and weir site will be affected. Approximately 550 m of the existing Gilgt-Ghizer road will be realigned at lateral intake, and sedimentation basin will be the responsibility of the EPC contractor during construction[21]. The EPC contractor should make arrangements to keep it functional during construction and restore it to its original state after the construction activities are over;
- About 2,240 trees of small and medium sizes will be removed due the layout of the project. The tree plantation plan should be implemented to compensate the tree cutting.
- Hunting, poaching and harassing of wild animals shall be strictly prohibited to avoid the impact on local fauna;
- The excavated material produced during construction has to be disposed off in a way that it does not enter the Gilgit River to avoid any impact on the aquatic life;
- The Project must ensure that construction works do not result in vibration that could affect the Hanzel Stupa. The EPC contractor should also conduct and take guidance from Archeology Department Gilgit during the construction stage;
- A sediments clearing mechanism will be provided in the detail design and should be followed to mitigate the impact from sedimentation;
- The pathways of locally available wildlife for food, Shelter and other normal activities must be compensated with proper alternative routes/pathways. The Passing bridges/crossings and railing on both sides of the channel is recommended to avoid any inconvenience to worthy Ibex and Markhor;
- The low/lean flow season is March in which flow is recorded as 46.8 m^3/s and the highest in July i.e. 862.2 m^3/s. It may be observed that the planned diversion of 38 m^3/s of water (including 2 m^3/sec of flushing discharge) is available for 98.6% of time. Based on the available data, the minimum flow to be ensured through the weir is more than 10% during the whole year; and
- Fish traps should be used to stop the fish movement to the intake structure and headrace channel. Fish ladders are highly recommended to compensate the impacts due to diversion of water flow. If any spawning areas are lost due to engineering interventions, they can be well compensated if stretches of stream are stocked annually with increased number of fish. Fisheries Department, GB must be consulted at all stages as it is the obligation of the department to manage all natural water resources in GB as per provision of existing Fisheries Act and Rules 1975.

An EMP has been developed as part of the report which provides a detailed mitigation matrix that covers impacts, mitigation measures, roles and responsibilities and timings to avoid, minimize or mitigate the adverse impacts and justify the friendly nature of the Project.

[21] Tender Document Contract No ICB-01, Volume -2A, Part I – Project Construction Requirements

8.2 RECOMMENDATIONS

Following are the set of major recommendations and way forward:

- EMP should be made a part of all bidding/tender documents;
- EPC Contractor should be bound to completely implement relevant mitigation measures set out in the EMP to ensure environmental sustainability. Also the cost related to these mitigation measures has to be borne by the EPC Contractor;
- PAPs must be compensated for their lost land, property or any other asset as per existing market rates. This step will reduce any future social impacts or political strains due to Project implementation. Livelihood assistance should also be provided to PAPs;
- The Proponent should do more consultation with the primary stakeholders to take them into confidence and to satisfy their all concerns regarding project; and
- EPC Contractor should prepare evacuation plan; emergency preparedness and response plan; waste management plan, traffic management plan, HSE plan, borrow and quarry management plan, site restoration plan and other plans mentioned in the EMP. These plans should be communicated with the Supervisory Consultant, GB EPA and Proponent for their review and approval.

(This Space is Intentionally Left Blank)

ANNEXES

ANNEX 1: FIELD VISIT REPORT

ANNEX I- FIELD VISIT FINDINGS

1.0 INTRODUCTION

During the Inception Stage of the proposed project, the environmental team conducted two days (06^{th}-07^{th} April 2017) reconnaissance of the project area including weir site, power channel route, forebay, penstock, power house site and the adjacent villages such as Hanzel Bala, Hanzel Paine, Harpoon and Saeeda Abad Villages.

Preliminary consultation with the local communities and concerned Government Departments such as Environmental Protection Agency (EPA), GB Wildlife Department, Fisheries Department and Forest Department were also carried out as part of the visit. The reconnaissance provides an overview of the project areas of the proposed project. These findings will be firmed up during the updation of the IEE Study when the design will be finalized. The brief highlights of the reconnaissance are presented below.

2.0 FINDINGS OF THE RECONNAISSANCE

- The Hanzel Hydropower Project is located on Gilgit River. Gilgit River is a right bank tributary of Indus River. The proposed project is located at 11.5 km from Gilgit Town. Hanzel is located along Gilgit Gupis, a newly- constructed road that connect Hanzel Bala, Hanzel Paine and Harpoon Villages in the Project area. Gilgit Airport is the nearest air facility to the project area. However, project site is accessible through Gilti Chitral Road.
- The project area is characterized by rugged mountainous topography with barren rock exposures along with glacial deposits. As per discussion with the locals and feasibility review, Gilgit River is mainly fed by snow melt water and glacier. Springs located within the valley also contribute to enhance the water discharge of the river.
- The major surface water source from weir to power house site is the Gilgit River, few small springs and Nullah's were also present. Drinking water is also being supplied by the Public Health Department, Government of Northern Area. Piped network is available for supply of good quality water which is either being pumped from ground or obtained from natural stream. In project area local people mostly use spring water for drinking which is being provided through lined water channels.
- Solid waste was found to be stored in the forms of heaps at Hanzel Road side. However, Gilgit Baltistan (GB) Waste Management Company is operational for the proper management of solid waste in GB.
- The areas lack proper sewerage system with only some open drains constructed in the vicinity for the discharge of wastewater. In general, villages are discharging its sewage through small open drains. These drains discharge the sewage into the depression area near each village.
- Visual air quality observed is clear, however it will be verified by conducting the limited instrumental monitoring at site. The non-point sources of air pollution in area include cars, trucks and loaders that provide supplies in GB. Major sources of noise observed at site were vehicular traffic.
- The project area, is mountainous with sparse vegetation. Among trees Mulberry (*Morus*), fir (*Abies*) and Kikar (*Vachellia nilotica) are* found mainly at the Power House Site which needs to be removed for the construction of power house and allied facilities. Bushes of various kinds have their natural growth, which provide fire wood to the people. Based on the rough estimate, about 1,000 trees of small and medium sizes will be removed at power house site for which compensation will be made to the locals.

- The agriculture was observed at the downstream site of the Weir. The locals grow crops such as maize, wheat and fodder to meet their home-based needs.
- No fish pond was observed at the project site during the visit. However, as per local information obtained during field visit and consultation with the fisheries department of GB Trout fish is found in Gilgit River along with other than indigenous fish species. The fisheries department grant commercial fishing license to the locals in 2000 rupees per month. However, this fishing license is not issued for Trout fish as mentioned by the official of the fisheries department.
- Avifauna observed was Doves and Crows. Wildlife department and locals informed about the presence of Markhor, Urial and Ibex in the surrounding areas at higher elevations. After discussion with the Wildlife Department, the "Hanzel" is declared as the community controlled hunting area under conservancy name "Kargah Gilgit" in May 2013 under Gilgit Baltistan Wildlife Preservation Act 1975. This issue will be further examined during the detail investigations.
- The nearby villages at the Weir site is Saeeda Abad and Harpoon, while the downstream area up to the power house site, the main villages are Hanzel Bala and Hanzel Paine.
- Most of the locals in the AOI are involved in the agriculture activities however, the dominant occupation in the project area is labour. The main castes of the visited villages are Kashmiri, Gujjar, Yashkon and Syed and the major languages being spoken by most of the locals in the area is *"Shina" followed by "Balti"* and "*Burushaski".*
- During the site visit, it is observed that few hotels and a petrol pump is located close to the power channel at the foothills and may get affected during the construction activities. Similarly, a house is being constructed at the forebay area which will be affected during the commencement of the civil works. Most of the houses in the area are made of boulders and wood blocks. This aspect will be further investigated after the completion of the Topographic Survey and availability of project foot print on ground.
- The amount and distribution of land to be acquired for the project components will be confirmed after the availability of the final project design.
- It was observed by the team that apparently, there are no security issues. But as far as specific activities are concerned or safeguards of foreign experts, SOP's of the concerned agencies needs to be followed strictly.

ANNEX 2: NATIONAL ENVIRONMENTAL QUALITY STANDARDS (NEQS)

REGISTERED No. M - 302 / L.-7646

The Gazette of Pakistan

EXTRAORDINARY
PUBLISHED BY AUTHORITY

ISLAMABAD, FRIDAY, NOVEMBER 26, 2010

PART II

Statutory Notifications (S. R. O.)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT

NOTIFICATIONS

Islamabad, the 18th October, 2010

S. R. O. 1062(I)/2010.—In exercise of the powers conferred under clause (c) of sub-section (I) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Environmental Quality Standards for Ambient Air.

National Environmental Quality Standards for Ambient Air

Pollutants	Time-weighted average	Concentration in Ambient Air: Effective from 1st July, 2010	Concentration in Ambient Air: Effective from 1st January 2013	Method of measurement
Sulphur Dioxide (SO_2)	Annual Average* 24 hours**	80 $\mu g/m^3$ 120 $\mu g/m^3$	80 $\mu g/m^3$ 120 $\mu g/m^3$	-Ultraviolet Fluorescence method
Oxides of Nitrogen as (NO)	Annual Average* 24 hours**	40 $\mu g/m^3$ 40 $\mu g/m^3$	40 $\mu g/m^3$ 40 $\mu g/m^3$	- Gas Phase Chemiluminescence

[2944(2010)/Ex. Gaz.] *Price: Rs. 5.00*

Pollutants	Time-weighted average	Concentration in Ambient Air: Effective from 1st July, 2010	Concentration in Ambient Air: Effective from 1st January 2013	Method of measurement
Oxides of Nitrogen as (NO_2)	Annual Average*	40 $\mu g/m^3$	40 $\mu g/m^3$	- Gas Phase Chemiluminescence
	24 hours**	80 $\mu g/m^3$	80 $\mu g/m^3$	
O^3	1 hour	180 $\mu g/m^3$	130 $\mu g/m^3$	-Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	400 $\mu g/m^3$	360 $\mu g/m^3$	- High Volume Sampling, (Average flow rate not less than 1.1 m3/minute).
	24 hours**	550 $\mu g/m^3$	500 $\mu g/m^3$	
Respirable Particulate Matter. PM_{10}	Annual Average*	200 $\mu g/m^3$	120 $\mu g/m^3$	-β Ray absorption method
	24 hours**	250 $\mu g/m^3$	150 $\mu g/m^3$	
Respirable Particulate Matter. $PM_{2.5}$	Annual Average*	25 $\mu g/m^3$	15 $\mu g/m^3$	-β Ray absorption method
	24 hours**	40 $\mu g/m^3$	35 $\mu g/m^3$	
	1 hour	25 $\mu g/m^3$	15 $\mu g/m^3$	
Lead Pb	Annual Average*	1.5 $\mu g/m^3$	1 $\mu g/m^3$	- ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	2 $\mu g/m^3$	1.5 $\mu g/m^3$	
Carbon Monoxide (CO)	8 hours**	5 mg/m^3	5 mg/m^3	- Non Dispersive Infra Red (NDIR) method
	1 hour	10 mg/m^3	10 mg/m^3	

*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly /8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

S. R. O. 1063(I)/2010.— In exercise of the powers conferred under clause (c) of sub-section (1) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Standards for Drinking Water Quality.

National Standards for Drinking Water Quality

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Bacterial			
All water intended for drinking (e.Coli or Thermotolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water in the distribution system (E. coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period.	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12 month period.	Most Asian countries also follow WHO standards
Physical			
Colour	$\leq$ 15 TCU	$\leq$ 15 TCU	
Taste	Non objectionable/Acceptable	Non objectionable/Acceptable	
Odour	Non objectionable/Acceptable	Non objectionable/Acceptable	
Turbidity	〈 5 NTU	〈 5 NTU	
Total hardness as $CaCO_3$	< 500 mg/l	----	
TDS	〈 1000	〈 1000	
pH	6.5 – 8.5	6.5 – 8.5	
Chemical			
Essential Inorganic	*mg/Litre*	*mg/Litre*	
Aluminium (Al) mg/l	$\leq$ 0.2	0.2	

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Antimony (Sb)	≤ 0.005 (P)	0.02	
Arsenic (As)	≤ 0.05 (P)	0.01	Standard for Pakistan similar to most Asian developing countries
Barium (Ba)	0.7	0.7	
Boron (B)	0.3	0.3	
Cadmium (Cd)	0.01	0.003	Standard for Pakistan similar to most Asian developing countries
Chloride (Cl)	< 250	250	
Chromium (Cr)	≤ 0.05	0.05	
Copper (Cu)	2	2	
Toxic Inorganic	***mg/Litre***	***mg/Litre***	
Cyanide (CN)	≤ 0.05	0.07	Standard for Pakistan similar to Asian developing countries
Fluoride (F)*	≤ 1.5	1.5	
Lead (Pb)	≤ 0.05	0.01	Standard for Pakistan similar to most Asian developing countries
Manganese (Mn)	≤ 0.5	0.5	
Mercury (Hg)	≤ 0.001	0.001	
Nickel (Ni)	≤ 0.02	0.02	
Nitrate (NO_3)*	≤ 50	50	
Nitrite (NO_2)*	≤ 3 (P)	3	
Selenium (Se)	0.01(P)	0.01	
Residual chlorine	0.2-0.5 at consumer end 0.5-1.5 at source	—	
Zinc (Zn)	5.0	3	Standard for Pakistan similar to most Asian developing countries

* indicates priority health related inorganic constituents which need regular monitoring.

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Organic			
Pesticides mg/L		PSQCA No. 4639-2004, Page No. 4 Table No. 3 Serial No. 20-58 may be consulted.***	Annex II
Phenolic compounds (as Phenols) mg/L		$\leq$ 0.002	
Polynuclear aromatic hydrocarbons (as PAH) g/L		0.01 (By GC/MS method)	
Radioactive			
Alpha Emitters bq/L or pCi	0.1	0.1	
Beta emitters	1	1	

*** PSQCA: Pakistan Standards Quality Control Authority.

Proviso:

The existing drinking water treatment infrastructure is not adequate to comply with WHO guidelines. The Arsenic concentrations in South Punjab and in some parts of Sindh have been found high then Revised WHO guidelines. It will take some time to control arsenic through treatment process. Lead concentration in the proposed standards is higher than WHO Guidelines. As the piping system for supply of drinking water in urban centres are generally old and will take significant resources and time to get them replaced. In the recent past, Lead was completely phased out from petroleum products to cut down Lead entering into environment. These steps will enable to achieve WHO guidelines for Arsenic, Lead, Cadmium and Zinc. However, for bottled water, WHO limits for Arsenic, Lead, Cadmium and Zinc will be applicable and PSQCA Standards for all the remaining parameters.

S. R. O. 1064(I)/2010.—In exercise of the powers conferred under clause (c) of sub-section (1) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Environmental Quality Standards for Noise.

National Environmental Quality Standards for Noise

S. No.	Category of Area / Zone	Effective from 1st July, 2010		Effective from 1st July, 2012	
		Limit in dB(A) Leq *			
		Day Time	Night Time	Day Time	Night Time
1.	Residential area (A)	65	50	55	45
2.	Commercial area (B)	70	60	65	55
3.	Industrial area (C)	80	75	75	65
4.	Silence Zone (D)	55	45	50	45

Note: 1. Day time hours: 6.00 a. m to 10.00 p. m.

2. Night time hours: 10.00 p. m. to 6.00 a.m.

3. Silence zone: Zones which are declared as such by the competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.

4. Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.

*dB(A) Leq: Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

[No. F. 1(12)/2010-11-General.]

MUHAMMAD KHALIL AWAN,
Section Officer (PEPC).

PRINTED BY THE MANAGER, PRINTING CORPORATION OF PAKISTAN PRESS, ISLAMABAD.
PUBLISHED BY THE DEPUTY CONTROLLER, STATIONERY AND FORMS, UNIVERSITY ROAD, KARACHI.

REGISTERED No. M-302
L. 7646

The Gazette of Pakistan

EXTRAORDINARY
PUBLISHED BY AUTHORITY

===

ISLAMABD, THURSDAY, AUGUST 10, 2000

===

PART-II

Statutory Notification (S.R.O)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT, LOCAL GOVERNMENT AND
RURAL DEVELOPMENT

NOTIFICATION

Islamabad, the 8th August 2000

S.R.O. 549 (I)/2000.___ In exercise of the powers conferred under clause (c) of sub-section (1) of section of 6 of the Pakistan environmental Protection Act. 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to direct that the following further amendments shall be made in its Notification No. S.R.O. 742(I)/93, dated the 24th August, 1993, namely: ___

In the aforesaid Notification, in paragraph 2._____

[4138(2000)/Ex.GAZ]

Price : Rs. 5.00

(1) for Annex, I the following shall be substituted, namely:_____

Annex-I

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MUNICIPAL AND LIQUID INDUSTRIAL EFFLUENTS (mg/I, UNLESS OTHERWISE DEFINED)

S. No.	Parameter	Existing Standards	Revised Standards Into Inland Waters	Into Sewage Treatment (5)	Into Sea ( )
1	2	3	4	5	6
1.	Temperature or Temperature Increase *	40^0C	$\leq 3^oC$	$\leq 3^oC$	$\leq 3^oC$
2.	pH value (H^+) .	6-10	6-9	6-9	6-9
3.	Biochemical Oxygen Demand $(BOD)_5$ at 20^0C (1)	80	80	250	80**
4.	Chemical Oxygen Demand (COD) (1)	150	150	400	400
5.	Total Suspended Solids (TSS)	150	200	400	200
6.	Total Dissolved Solids (TDS)	3500	3500	3500	3500
7.	Oil and Grease	10	10	10	10
8.	Phenolic compounds (as phenol)	0.1	0.1	0.3	0.3
9.	Chloride (as $C1^-$)	1000	1000	1000	SC***
10.	Fluoride (as F^-)	20	10	10	10
11.	Cyanide (as CN^-) total ..	2	1.0	1.0	1.0
12.	An-ionic detergents (as MBAS) (2)	20	20	20	20
13.	Sulphate (SO_4^{2-})	600	600	1000	SC***
14.	Sulphide (S^{2-})	1.0	1.0	1.0	1.0
15.	Ammonia (NH_3)	40	40	40	40
16.	Pesticides (3)	0.15	0.15	0.15	0.15

1	2	3	4	5	6
17.	Cadmium [(4)]	0.1	0.1	0.1	0.1
18.	Chromium (trivalent and hexavalent [(4)].. ..	1.0	1.0	1.0	1.0
19.	Cooper [(4)]	1.0	1.0	1.0	1.0
20.	Lead [(4)]	0.5	0.5	0.5	0.5
21.	Mercury [(4)]	0.01	0.01	0.01	0.01
22.	Selenium [(4)]	0.5	0.5	0.5	0.5
23.	Nickel [(4)]	1.0	1.0	1.0	1.0
24.	Silver [(4)]	1.0	1.0	1.0	1.0
25.	Total toxic metals	2.0	2.0	2.0	2.0
26.	Zinc	5.0	5.0	5.0	5.0
27.	Arsenic [(4)]	1.0	1.0	1.0	1.0
28.	Barium [(4)]	1.5	1.5	1.5	1.5
29.	Iron	2.0	8.0	8.0	8.0
30.	Manganese	1.5	1.5	1.5	1.5
31.	Boron [(4)]	6.0	6.0	6.0	6.0
32.	Chlorine	1.0	1.0	1.0	1.0

Explanations:

1. Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.

2. Methylene Blue Active Substances; assuming surfactant as biodegradable.

3. Pesticides include herbicides, fungicides, and insecticides.

4. Subject to total toxic metals discharge should not exceed level given at S. N. 25.

5. Applicable only when and where sewage treatment is operational and BOD_5=80mg/I is achieved by the sewage treatment system.

6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.

* The effluent should not result in temperature increase of more than 3^0C at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not defined, use 100 meters from the point of discharge.

** The value for industry is 200 mg/I

*** Discharge concentration at or below sea concentration (SC).

Note:______ 1. Dilution of liquid effluents to bring them to the NEQS limiting values is not permissible through fresh water mixing with the effluent before discharging into the environment.

2. The concentration of pollutants in water being used will be substracted from the effluent for calculating the NEQS limits" and

(2) for Annex-II the following shall be substituted, namely:____

Annex-II

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR INDUSTRIAL GASEOUS EMISSION (mg/Nm^3, UNLESS OTHERWISE DEFINED)."

S. No.	Parameter	Source of Emission	Existing Standards	Revised Standards
1	2	3	4	5
1.	Smoke	Smoke opacity not to exceed	40% or 2 Ringlemann Scale	40% or 2 Ringlemann Scale or equivalent smoke number
2.	Particulate malter	(a) Boilers and Furnaces		
	(1)	(i) Oil fired	300	300
		(ii) Coal fired	500	500
		(iii) Cement Kilns	200	300
		(b) Grinding, crushing, Clinker coolers and Related processes, Metallurgical Processes, converter, blast furnaces and cupolas.	500	500
3.	Hydrogen Chloride	Any	400	400

1	2	3	4	5
4.	Chlorine	Any	150	150
5.	Hydrogen Fluoride	Any	150	150
6.	Hydrogen Sulphide	Any	10	10
7.	Sulphur Oxides (2) (3)	Sulfuric acid/Sulphonic acid plants		
		Other Plants except power Plants operating on oil and coal	400	1700
8.	Carbon Monoxide	Any	800	800
9.	Lead	Any	50	50
10.	Mercury	Any	10	10
11.	Cadmium	Any	20	20
12.	Arsenic	Any	20	20
13.	Copper	Any	50	50
14.	Antimony	Any	20	20
15.	Zinc	Any	200	200
16.	Oxides of Nitrogen	Nitric acid manufacturing unit.	400	3000
	(3)	Other plants except power plants operating on oil or coal:		
		Gas fired	400	400
		Oil fired	-	600
		Coal fired	-	1200

Explanations:-

1. Based on the assumption that the size of the particulate is 10 micron or more.

2. Based on 1 percent Sulphur content in fuel oil. Higher content of Sulphur will case standards to be pro-rated.

3. In respect of emissions of Sulphur dioxide and Nitrogen oxides, the power plants operating on oil and coal as fuel shall in addition to National Environmental Quality Standards (NEQS) specified above, comply with the following standards:-

A. **Sulphur Dioxide**

Sulphur Dioxide Background levels Micro-gram per cubic meter (ug/m^3) Standards.

Background Air Quality (SO_2 Basis)	Annual Average	Max. 24-hours Interval	Criterion I Max. SO_2 Emission (Tons per Day Per Plant)	Criterion II Max. Allowable ground level increment to ambient (ug/m^3) (One year Average)
Unpolluted	<50	<200	500	50
Moderately Polluted*				
Low	50	200	500	50
High	100	400	100	10
Very Polluted**	>100	>400	100	10

* For intermediate values between 50 and 100 ug/m^3 linear interpolations should be used.

** No projects with Sulphur dioxide emissions will be recommended.

B. Nitrogen Oxide

Ambient air concentrations of Nitrogen oxides, expressed as NO_x should not be exceed the following:-

Annual Arithmetic Mean 100ug/m^3
(0.05 ppm)

Emission level for stationary source discharge before missing with the atmosphere, should be maintained as follows:-

For fuel fired steam generators as Nanogram (10^0-gram) per joule of heat input:

Liquid fossil fuel	..	..	..	130
Solid fossil fuel ..	..	..		300
Lignite fossil fuel	..	..	..	260

Note:- Dilution of gaseous emissions to bring them to the NEQS limiting value is not permissible through excess air mixing blowing before emitting into the environment.

[File No. 14(3)/98-TO-PEPC.]

HAFIZ ABDULAH AWAN
DEPUTY SECRETARY (ADMN)

PRINTED BY THE MANAGER, PRINTING CORPORATION OF PAKISTAN, PRESS ISLAMABAD. PUBLISHED BY THE MANAGER OF PUBLICATIONS, KARACHI.

REGISTERED No. M-302

The Gazette of Pakistan

EXTRAORDINARY

PUBLISHED BY AUTHORITY

KARACHI, TUESDAY, AUGUST 18, 2009

PART II

Statutory Notifications containing Rules and Orders issued by all Ministries and Divisions of the Government of Pakistan and their Attached and Subordinate Offices and the Supreme Court of Pakistan

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT

NOTIFICATION

Karachi, the 16th May, 2009

S.R.O. 72 (KE)/2009:

In exercise of the powers conferred under clause (c) of sub-section (1) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, in anticipatioin of approval of the Pakistan Environmental Protection Council, is pleased to direct that the following further amendments shall be made in its Notification No. S.R.O. 742(I)/93, dated the 24th August, 1993, namely :-

In the aforesaid Notification, in paragraph 2.

(1) Annex-III shall be replaced with the following Annex-III (amended):-

Price : Rs. 3.00

Annex-III (Amended)

NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MOTOR VEHICLE EXHAUST AND NOISE

(i) For Inuse Vehicles

S. No.	Parameter	Standards (maximum permissible limit)	Measuring method	Applicability
1	2	3	4	5
1.	Smoke	40% or 2 on the Ringlemann Scale during engine acceleration mode.	To be compared with Ringlemann Chart at a distance of 6 metres or more.	Immediate effect
2.	Carbon Monoxide.	6%	Under idling conditions : Non-dispersive infrared detection through gas analyzer.	
3.	Noise	85 db (A).	Sound-meter at 7.5 meters from the source.	

For new Vehicles

EMISSION STANDARDS FOR DIESEL VEHICLES

(a) For Passenger Cars and Light Commercial Vehicles (g/Km)

Type of Vehicle	Category/Class	Tiers	CO	HC+ NOx	PM	Measuring Method	Applicability
1	2	3	4	5	6	7	8
Passenger Cars.	M 1: with reference mass (RW) upto 2500 kg. Cars with RW over 2500 kg. to meet NI category standards.	Pak-II, IDI	1.0	0.7	0.08	NEDC (ECE 15+ EUDCL)	i. All imported and local manufactured diesel vehicles with effect from 01-07-2012.
		Pak-II DI	1.0	0.9	0.10		

1	2	3	4	5	6	7	8
Light Commercial Vehicles	NI-I(RW<1250 kg).	Pak-II, IDI	1.0	0.70	0.08		
		Pak-II, DI	1.0	0.90	0.10		
	NI-II(1250 kg < RW <1700 kg)	Pak.II IDI	1.25	1.0	0.12		
		Pak-II, DI	1.25	1.3	0.14		
	NI-III(RW > 1700 kg)	Pak.II, IDI	1.50	1.2	0.17		
		Pak-II, DI	1.50	1.6	0.20		

Parameter	Standards (maximum permissible limit)	Measuring method
	85 db (A)	Sound - meter at 7.5 metres from the source.

(b) For Heavy Duty Diesel Engines and Large Goods Vehicles (g/Kwh)

Type of Vehicle	Category/ Class	Tiers	CO	HC	NOx	PM	Measuring Method	Applicability
1	2	3	4		6	7	8	9
Heavy Duty Diesel Engines	Trucks and Buses	Pak-II	4.0	1.1	7.0	0.15	ECE-R-49	All imported and local manufactured diesel vehicles with the effect 1-7-2012
Large goods Vehicles	N2(2000 and up	Pak-II	4.0	7.0	1.10	0.15	EDC	

Parameter	Standards (maximum permissible limit)	Measuring method
Noise	85 db (A)	Sound - meter at 7.5 metres from the source.

EMISSION STANDARDS FOR PETROL VEHICLES (g/km)

Type of Vehicle	Category/ Class	Tiers	CO	HC+ NOx	Measuring Method	Applica-bility
1	2	3	4	5	6	7
Passenger Cars	M 1: With reference mass (RW) upto 2500 kg. Cars with RW over 2500 kg. to meet N1category standards.	Pak-II	2.20	0.5	NEDC (ECE 15 + EUDCL)	All imported and new moddels* locally manufactured petrol vehicles with effect from 1st July, 2009**
Light Commercial Vehicles	N1-I(RW<1250) kg)	Pak-II	2.20	0.5		
	N1-II(1250 kg>RW) <1700 kg)	Pak-II	4.0	0.65		
	N1-III(RW>1700 kg)	Pak-II	5.0	0.08		
Motor Rickshaws & Motor Cycles	2,4 strokes <150cc	Pak-II	5.5	1.5	ECER 40	
	2,4 strokes >150 cc	Pak-II	5.5	1.3		

Parameter	Standards (maximum permissible limit)	Measuring method
Noise	85 db (A)	Sound - metre at 7.5 metres from the source.

Explanations:

DI: Direct Injection.
IDI: Indirect Injection.
EUDCL: Extra Urban Driving Cycle.
NEDC: New European Driving Cycle.
ECE: Urban Driving Cycle.
M: Vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.
N: Motor vehicles with at least four wheels designed and constructed for the carriage of goods.

* New model means both model and engine type change.

** The existing models of petrol driven vehicles locally manufactured will immediately switch over to Pak-II emission standards but not later than 30th June, 2012.

[No. F.17(12)/2005-DD-VI]

M. FAHIM RIAZ KHAN,
Director (A/L/E).

PRINTED BY THE MANAGER, PRINTING CORPORATION OF PAKISTAN PRESS, KARACHI.
PUBLISHED BY THE DEPUTY CONTROLLER, STATIONERY AND FORMS, KARACHI.

ANNEX 3: CLIMATIC DATA

ANNEX- 3

Monthly Maximum Temperatures (ºC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1984	9.3	10.5	19.9	23.9	26.6	36.8	35.4	38.4	29.3	25.1	15.9	10.5	23.5
1985	8.5	14.5	21.2	25.8	27.6	33.6	38.4	34.9	32.1	25	17.9	10.5	24.2
1986	9	11.7	15.6	22.4	27.1	33	35.9	32.2	31.2	27.3	17.4	9	22.7
1987	9.6	13.6	18.8	23.9	26.6	31.7	34.2	36.2	33.4	21.3	18.3	12.4	23.3
1988	10.3	12.5	16.5	26	32.4	34.6	37.6	34.7	33.4	24.2	20.5	12.8	24.6
1989	9.1	11	17.5	23.1	25.1	33	32.8	31.3	31.9	26.7	17	12.3	22.6
1990	11.5	10.5	17.5	23.2	34.2	34.7	38.6	37.6	34	25.5	19.8	12.3	24.9
1991	8.2	12	17.2	23.4	25.3	34.1	34.5	36.1	32.6	24.6	18.6	12.6	23.3
1992	9.3	11.1	15	23	28.5	34.6	36	35.5	29.9	24.7	19.2	13.1	23.3
1993	9.3	15.2	16.8	27	30.1	33.4	33.7	34.6	33.6	25.8	17.7	13.5	24.2
1994	9.8	10.9	18.8	22.1	29.8	34.1	38.2	38.2	30.7	25.2	19.7	10.8	24
1995	7.7	12.5	18.3	22.4	29.3	33.6	36.9	36.5	32.5	25	20.1	9.9	23.7
1996	8.9	13.5	17.9	24.3	23.2	32.3	35.5	35.8	35.5	24.6	19	12	23.5
1997	12	14.7	17.7	26.4	28.6	34.3	39.7	35.5	32.9	25.2	17.9	12.3	24.8
1998	9.8	13	18.7	26	28.9	31	38.2	36.5	33	28.5	21.9	14.9	25
1999	11.1	13	18.4	23.4	30.7	35.1	37.8	34.3	34.1	26.6	17.9	14.6	24.8
2000	10.6	13.3	19.3	26.5	34.9	35.2	34.6	35.3	32.9	27.8	19.9	12.9	25.3
2001	12.6	16.4	21.6	26.7	34.8	35.9	37.2	35.5	31.1	28.2	18	13	25.9
2002	11.2	14.1	21.3	24	30.7	34.5	35	36.1	30.3	28.5	20.9	13.3	25
2003	13.4	13.5	17.6	25.2	26.3	35.3	38.2	35	30.9	26	18.4	12	24.3
2004	11.3	15.6	23.4	24.9	30.1	33.2	34.7	34	33	24.1	20.6	13	24.8
2005	9	10.8	20	22.9	27.4	35.3	35.8	35.9	33.5	27.1	18.3	11.5	24
2006	8.5	16.9	20.3	24.9	34	32.3	36.8	32.5	30.1	27.2	19	11.2	24.5
2007	12.4	16	17.8	29.1	32	35.2	33.7	33.9	31	25.5	20.9	12.6	25
2008	7.8	12.5	23	25.6	32.5	37.6	36.5	35.5	30.3	27.4	19.2	11.5	25
2009	9.5	12.7	18.5	22.7	31.1	32.1	36.1	36.8	31	25.1	18.7	12.5	23.9
2010	13.9	12.5	22.1	24.4	26.5	30.9	33.2	31.2	29.3	28.1	22.8	14.6	24.1
2011	11.9	11.6	20	25.6	33.2	36.6	34.2	35.3	29.5	25.9	19.6	13.9	24.8
2012	10.5	12.1	17.9	24.9	27.1	32.4	37.1	34.8	28.3	24.6	20.5	13	23.6
2013	10.6	13.8	21.7	25.6	28	36.4	39	33.9	31.6	28.4	18.1	13.2	25

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

Monthly Minimum Temperatures (ºC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1984	-3.9	-0.9	6.4	9.2	12.5	16.1	19.2	20.4	11.9	5.8	1.5	-3.1	7.9
1985	-1.4	-1.3	5.7	9.9	12	14.4	20	19	12.6	6.9	1.3	-0.2	8.2
1986	-3.3	1.3	4.6	9	11.2	14.4	18.7	17.2	12.1	4.9	1.9	-0.7	7.6
1987	-4.6	0.6	6.2	8.8	9.9	13.5	16	17.3	12.7	7.5	-0.2	-2.8	7.1
1988	0.2	0.6	5.2	8.6	11.6	13.4	19.1	17.1	12.6	6.3	-0.5	-1.8	7.7
1989	-3.7	-1.4	6.1	6.9	9.9	13.3	16.4	14.5	11.3	4.8	1.3	0.4	6.7
1990	-1.1	2	3.8	7.6	11.9	15.8	18.5	16.3	12.4	4.8	-0.9	-2.1	7.4
1991	-3.1	1.9	6.1	8.1	11.2	13.5	16	14.7	11.7	4.8	-0.3	1.8	7.2
1992	-0.5	1.6	4.5	9.2	11.5	13.5	17.5	16.6	12.3	5.8	0.2	-2	7.5
1993	-3.6	1.1	4	8.8	12.3	13.8	16.5	15.9	12.2	5.3	1.3	-2	7.1
1994	-1.1	0.8	7.3	7.5	12.5	14.3	19.1	19.6	12.3	5.9	0.6	-1.8	8.1
1995	-5.5	-0.8	5	9.6	12.3	14.7	17.6	17.7	12.5	7.3	-1.1	-2.4	7.2
1996	-3.6	1.4	6.1	8.4	9.3	13.3	13.9	18.7	12.3	5.6	-1.5	-5.7	6.5
1997	-4.3	-2.4	4.5	9.2	11.4	15.5	18.2	15.5	12.9	7.4	1.5	-0.9	7.4
1998	-2.3	1.8	5.1	9.3	13	15.1	17.9	16.3	12.4	7.7	-0.8	-4.5	7.6
1999	-0.9	2.4	6.7	9.8	12.1	13.3	17.3	16.8	12.8	4.4	0.9	-6.8	7.4
2000	-4	-2.2	2.6	7.8	11.9	14.5	16.7	14	9.4	4.6	-0.2	-1.3	6.2
2001	-5.6	0	3.6	9.4	12.8	15.2	18.6	14.7	9.3	3.9	-0.7	-1.1	6.7
2002	-4.6	0.3	5.1	9	11.2	14.6	15.7	15.8	8.7	6.1	1.1	-1.5	6.8
2003	-3.2	0.2	5.3	8.9	9.5	13.6	17.3	18.5	13.1	4.5	0.5	-1.6	7.2
2004	0	1.1	6.9	9.8	11.3	14.8	16.4	16.3	11.2	6.7	1.3	0.3	8
2005	0	0.9	7.5	8	10.9	14	17.5	16.1	11.8	4.9	-1.1	-6	7
2006	-2.3	4.1	5.9	7.7	12.8	14.4	18.8	18.3	12.6	7.4	2.1	-2.5	8.3
2007	-4.8	2.5	5.1	10.7	13.5	15.9	16.6	17.3	13.6	5.2	-0.8	-3	7.6
2008	-3	-1.7	6	10.1	12.8	18.1	17.9	17.5	11.4	7.1	1	-1.5	8
2009	0.1	2.5	6.1	9.3	11.5	14.3	16	17	12.2	6.5	-0.4	0	7.9
2010	-1.9	1.9	7.3	10.3	12.4	13.9	16.7	17.8	13.3	5.9	-0.8	-5.9	7.6
2011	-4.3	1	5.8	8.5	12.8	15.8	18.1	18	14.1	8	3.3	-3.1	8.2
2012	-3.7	0.2	5.3	10.1	11.6	14.3	17.3	19	15	6.4	0.9	-1.7	**7.9**
2013	-4.8	1.6	6.3	10.3	12.1	16.7	18.8	18.4	12.5	7.8	0.5	-2	**8.2**

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

Mean Monthly Rainfall (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1984	0	0	8.1	3.5	57.6	6	4.3	7	14.4	0	3.2	0.6	104.7
1985	2.3	1.2	1.8	9.8	37.8	0	11.3	11.3	0	0.2	0.2	25.1	101
1986	0	9.9	14	24.2	6.8	5.8	12.3	26.8	4.8	0	14.7	14.3	133.6
1987	0	0	5.7	45.3	14.8	16	13	0	2.2	102.4	0	0	199.4
1988	0	8.2	26.7	10	0.5	22.6	38.1	15.6	5	4.7	0	4.8	136.2
1989	0.8	2.3	2	3.3	68.8	2	35.7	40.5	2	TR	2.2	TR	159.6
1990	6	5.5	6.6	17.9	TR	4.2	10.9	12.4	0	3.7	0	22.1	89.3
1991	0.7	10.8	21.3	10.6	30.1	8.2	17.1	5.7	13.4	0.5	0	0	118.4
1992	6.7	1.5	10.8	9.1	0.5	TR	0.3	2.4	61.3	1.7	TR	0	94.3
1993	TR	0.2	0	TR	16.1	3	43.5	1.9	2.1	0.4	27.4	0	94.6
1994	3.2	8.8	18.6	4.5	32.5	8.8	13.6	2	11.4	3.2	0.6	12	119.2
1995	0.1	3.6	1	25.7	18.6	9.8	22.5	5.6	7.1	4.8	2	7.5	108.3
1996	20.1	6	40.1	41.1	72.8	48	13.2	4.2	TR	5.7	0	0.5	251.7
1997	0	TR	12.1	2.1	2	3.9	12.5	88.1	0.1	3.4	0.8	3.7	128.7
1998	6	8.6	6.8	58.9	44.8	17.6	3.1	7.3	14.3	0.5	0	0	167.9
1999	1.6	34.5	6.8	89.7	15.8	3.5	12	18.5	11.6	4.1	8.7	0	206.8
2000	4.9	TR	1.7	13.3	0.7	18.7	22.4	16.6	12.9	2	0	4	97.2
2001	0	0.5	12.9	6.2	1.8	20.6	12.7	14	1.3	0.6	15	2.4	88
2002	0.5	9.3	2.9	31.2	9.4	18	16.4	20.8	3.7	0	0	0.2	112.4
2003	TR	33.4	18.5	23.8	87.2	6.9	15.4	9.4	17.6	8.4	0.3	4.7	225.6
2004	0.4	6.9	6	45.2	13.3	14.8	4.8	10.4	2.3	6.5	TR	36.5	147.1
2005	11.2	14.1	12.4	58.9	32.6	2.7	9.3	2.1	2.1	TR	4	0.4	149.8
2006	15.4	6	2.1	23	1.5	11.1	8.1	39	11.9	4.7	4	5.8	132.6
2007	0	1.3	11.9	15.2	12	18.8	12.5	6.3	6.3	0	0	0	84.3
2008	2.9	TR	TR	8.3	75.8	15.6	3.5	10.9	8.3	12.9	1	31.5	170.7
2009	32.2	4.7	6.1	42.9	3.1	21.6	2.5	1.4	16.8	1.2	TR	8.6	141.1
2010	TR	13.3	20.7	24.6	60.7	23.2	52.9	60.1	10.4	1	0	0.6	267.5
2011	4.7	35.5	10.6	5.8	16.6	19.8	14.5	11.1	32.7	4.9	0.2	2.3	158.7
2012	TR	2.6	36.9	11.3	18.4	9.3	1.1	11.3	49	0.2	2.2	5.1	147.4
2013	3.1	3.6	3.2	5.6	50	7.1	3.4	47.6	14.4	1.5	14	0	153.5

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

Mean Wind at Synoptic Hours (1200 UTC) in Knots

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1984	0.2	1.5	2.2	5.2	2.8	2.4	1.8	2	1.8	1	0.1	0.1	1.8
1985	0.4	1	2.5	3.4	2.6	2	3.5	1.5	1.5	0.9	0.6	0.5	1.7
1986	0.3	1.2	2.9	3.1	4.4	3.4	2.8	2.4	2.1	0.3	0.5	0.2	2
1987	0.5	2	3	3.3	3.5	2.9	4.5	1.8	2	1.3	0.4	0.5	2.1
1988	0.7	1.8	3.8	3	2.6	0.8	1.3	1.9	1	1.3	0.1	0.7	1.6
1989	1	2.3	2.6	3.3	1.9	4.6	1.5	1.4	1.6	1.5	1.2	0.7	2
1990	1.1	0.9	2.9	2.4	1.7	2.4	1.3	2.5	0.9	0.4	0.4	0.8	1.5
1991	0.5	1.9	2.3	4.1	2.6	1.8	3.1	3	2.1	1.3	0.6	0.7	2
1992	0.6	2.1	2.3	2.7	4.1	0.3	2.9	1.6	1.3	1	0.3	0.2	1.6
1993	0.7	1.8	2.5	2.7	3.7	2.3	1.8	1.9	0.8	1.6	0.3	0.5	1.7
1994	1.7	2.1	2.7	3.5	2.8	3.4	1.9	1.7	1.7	0.7	0.2	0.3	1.9
1995	0.4	1.4	2.8	2.2	2.4	1.6	1	3.1	2.4	0.7	0.1	0.1	1.5
1996	0.3	1.8	2	2.7	1.8	2.1	1.9	1.5	0.9	0.4	0.1	0.1	1.3
1997	0.2	0.6	2.3	1.9	3.1	4	0.6	2.4	2.4	1.2	0.4	0	1.6
1998	0.1	0.7	3.2	2.7	2.3	3.2	1.8	1.8	1.7	0.4	0	0	1.5
1999	0.5	1.3	2.6	2.1	3.4	3.3	3.5	3.1	1.7	0.6	0.3	0	1.9
2000	0.7	2.1	3.5	3.8	5	2.3	2.4	5.3	2.8	1.6	0.6	0.1	2.5
2001	0.1	2.6	4.2	4.2	4.1	2.1	2.7	3.1	2.6	1.1	0.1	0.3	2.3
2002	0.6	0.8	2.2	2.4	2.9	2.8	5	1.9	3.1	0.6	0	0.5	1.9
2003	0.3	1.1	3.1	2	4.3	4.8	3.2	2.2	1.7	0.6	0.3	0.1	2
2004	0.5	2.4	3.4	3.9	2.2	3.5	3.7	3.1	1.3	1.8	0.6	0	2.2
2005	0.6	1.1	2	2.1	4.7	3.9	3.2	2.9	2.2	1.4	0.5	0.1	2.1
2006	0.3	1.4	2.3	4	5.9	6.7	4.2	2.9	2	1.1	0.3	0.1	2.6
2007	0.1	1.2	3.7	1.5	6.3	5.5	3.2	3	3.1	1.3	0	0	2.4
2008	0.5	0.7	3.9	3.6	5.4	4.3	4.7	4.6	2.2	0.6	0.5	0.1	2.6
2009	0.5	1.6	3.4	2	5.7	3.8	4.6	2.8	1.3	1.7	0.1	0.3	2.3
2010	0.5	0.7	1.8	2.1	1.9	2.2	2.6	0.7	2.6	1.3	0	0	1.4
2011	0	2.6	3.7	3.5	3.9	5.4	3.9	2.8	2.5	0.5	0.3	0	2.4
2012	0.6	2.7	4	7.5	5.9	6.9	4.6	4	1.9	1.7	0.2	0	3.3
2013	0.1	1.6	2.4	5.3	3.1	3.7	3.8	2.6	3.1	1.3	0	0.1	2.3

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

Mean Wind Direction at Synoptic Hours (0000 UTC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1984	S23E	S45E	S67E	W	N77W	S6E	S40E	S23W	S45E	W	W	W
1985	S67W	N72W	S31W	E	S34E	W	S56E	S37W	E	S67W	S18W	S45W
1986	S66W	S73W	N10W	W	S83W	S	S45W	N	S45W	CALM	S	N23E
1987	S73W	W	S38E	S45E	S75E	W	S45W	W	N45E	W	S38W	S73W
1988	N87W	N80W	N56W	S68W	S70W	CALM	S52W	N84W	S62W	S74W	S66W	N23W
1989	S45W	W	N87W	S70W	N74W	S29E	S63W	W	W	S18E	W	N82W
1990	S28W	S45W	N45W	S45E	S45W	S76W	S56E	S20E	S68E	N	S45W	S67E
1991	S75W	N82W	N78W	N45E	W	S18E	N75E	S45W	S60W	S23W	CALM	S23W
1992	S3E	N85W	S45W	S69W	N67W	S64W	S78E	S9E	S66W	S45W	CALM	CALM
1993	S58W	N15E	S66W	S12W	N75W	N38W	S55W	S18W	S45W	S60W	S23W	S34W
1994	S74W	S82W	S68W	S23W	S11W	S45W	S45W	S23E	S45E	W	W	N76E
1995	CALM	S	W	S45W	N23W	N45W	S45W	S	S23E	N45W	CALM	S28W
1996	W	N50W	S41E	S27E	S5E	S45W	W	N23E	E	N77W	CALM	N45W
1997	W	S72E	N36E	S45E	S45W	N45W	S45E	S	S45W	CALM	E	CALM
1998	E	W	N66W	W	S41E	S57W	S45E	CALM	S27W	S66W	CALM	CALM
1999	W	W	N24W	W	S23W	S45E	S41E	S56E	W	W	W	W
2000	W	S85W	S71W	S45W	E	S38W	S45W	CALM	S38W	CALM	W	W
2001	S	S75W	N	N45E	E	W	CALM	E	E	W	CALM	CALM
2002	CALM	CALM	S	E	N45E	W	W	CALM	S60W	CALM	W	CALM
2003	CALM	N45E	S	W	CALM	N60E	CALM	S66W	W	N45W	CALM	CALM
2004	W	S76W	S77W	W	S45W	E	S45E	CALM	S23E	S45W	CALM	W
2005	W	CALM	S	N45W	E	W	CALM	S60W	CALM	W	CALM	CALM
2006	CALM	CALM	N14E	CALM	W	CALM	S80W	N45W	S75W	W	CALM	N45E
2007	CALM	W	CALM	N82W	S65W	N45W	W	S55W	N45W	S45E	CALM	CALM
2008	S68W	S68W	N63W	S16E	CALM	CALM	S75E	CALM	CALM	W	S45E	S57W
2009	S83W	W	S72W	CALM	E	S75E	N62E	E	S67W	W	CALM	S82W
2010	W	CALM	E	N45W	E	CALM	CALM	CALM	S62W	CALM	CALM	CALM
2011	CALM	CALM	W	S45E	W	N68E	E	S62E	N79W	CALM	W	CALM
2012	W	S45W	W	S45W	E	S23E	S45E	W	W	W	W	S63W
2013	S	S45E	S45W	E	E	E	CALM	CALM	CALM	CALM	CALM	CALM

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

Mean Wind Direction at Synoptic Hours (1200 UTC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1984	S38W	S11E	S56W	S2W	S50E	S56E	S66E	S	S32E	S64W	S45W	S45W
1985	S53W	S37W	S66W	S26E	S57E	S54E	S74E	S76E	E	S22E	N80W	S76E
1986	S27E	S63W	S9E	S4E	S50E	S65E	S77E	S	S37E	S45W	S66W	N23E
1987	S	S47E	S10E	S72E	S32E	S49E	S24W	E	S56E	CALM	S	S27W
1988	S64W	S19E	S29W	S	S45E	S49E	S62E	S76E	S5W	S16E	S45E	S84W
1989	S55W	S20W	S34W	S57W	S43E	S43E	S35E	S66E	S38E	S41E	S45E	S18W
1990	S42E	S45W	S	S21W	S56E	S53E	S49E	S28E	S66E	S68W	S66E	S50E
1991	W	S55W	N88W	S34W	N45E	S3W	S60E	S57E	S41W	S52W	S52W	S31E
1992	S79W	S87W	N85W	S69W	S45E	S52E	E	S	S53E	S53W	S23W	S23E
1993	S73E	N87E	S10E	S2W	S38E	S9E	S77E	S2E	S70E	S28W	S27W	S67W
1994	N83E	S22W	S4W	S7E	S64E	S45E	S43E	S32E	S67W	S58W	N45W	N73E
1995	S45E	S40E	S80E	S36E	S61W	S60W	S65E	S71E	S6W	S11W	S45W	E
1996	S45E	S47W	S21E	S20E	S83E	S63E	S82E	S24E	S31W	CALM	W	E
1997	S60E	S22E	E	S12E	S45E	S83E	S45E	S42E	S60E	S77E	CALM	CALM
1998	W	S41W	S10W	S81E	S51E	S28E	N71E	S66E	S64E	N79W	CALM	CALM
1999	S23E	N50W	S79W	S82W	S76E	S89E	S64E	S81E	S45E	S45E	S	CALM
2000	W	S15E	S70W	S80E	N83E	S85E	N25E	S83E	N73E	S23E	W	S
2001	E	S40E	S42E	S85E	S69E	E	N81E	S60E	S21E	E	E	E
2002	S58E	E	S75E	S74E	S76E	S45E	S31W	S63E	S80E	N79E	CALM	E
2003	S60E	S34W	S61W	S87W	S83E	S72E	S67E	S38E	S45E	S23W	S45W	W
2004	E	N84W	S54W	S19E	S62E	S44E	S57E	S85E	S60W	S45W	CALM	W
2005	W	S65W	S43W	S85W	S69E	S64E	S84E	S50E	N37W	S14W	S22W	S45W
2006	S27W	N45W	S23W	S20E	S59E	S42E	S18E	E	S68E	W	E	W
2007	W	W	S72W	S	S47E	S66E	S75E	S05W	S45E	S36E	CALM	CALM
2008	S36E	S36W	S33W	S75E	S76E	S80E	S73E	S76E	S68E	E	E	W
2009	S68W	S80W	S76W	S06W	S67E	N82W	S86E	S77E	S62W	W	N23E	W
2010	W	W	S52W	W	E	S83E	S76E	E	W	E	CALM	CALM
2011	CALM	N13W	S62W	E	S76E	N87E	S12W	S36W	S82W	W	S45E	CALM
2012	S45W	S76E	S87W	S78E	S86E	S62E	S82E	E	S63E	S11E	N45W	CALM
2013	W	S03W	S03E	S32E	S45E	S86E	N85E	W	N83E	S75E	CALM	W

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

Relative Humidity at 0000 UTC (%)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1984	83	74	56	67	74	----	67	69	80	74	81	79	----
1985	76	65	53	68	73	65	63	73	79	74	77	79	70.4
1986	79	64	64	76	72	78	75	84	84	86	82	79	76.9
1987	87	73	71	74	87	80	78	87	82	93	84	83	81.6
1988	80	76	81	76	81	83	77	81	82	89	80	79	80.4
1989	83	74	63	71	86	74	84	86	84	88	82	68	78.6
1990	85	70	67	79	70	73	70	75	85	84	85	85	77.3
1991	84	74	70	76	87	74	79	81	85	88	85	82	80.4
1992	85	59	72	74	79	74	73	76	88	84	85	86	77.9
1993	81	77	60	61	79	80	80	83	85	79	88	86	78.3
1994	84	80	66	76	77	83	81	76	82	86	84	94	80.8
1995	93	78	70	73	78	53	76	83	78	91	81	87	78.4
1996	88	70	70	75	91	81	84	75	76	83	80	83	79.7
1997	82	70	68	69	69	69	73	80	84	85	88	80	76.4
1998	85	69	61	73	79	78	68	78	87	82	84	84	77.3
1999	82	77	63	69	73	72	69	83	82	84	80	83	76.4
2000	82	59	52	72	66	64	78	85	80	83	78	80	73.3
2001	80	65	59	69	65	71	63	80	78	77	89	82	73.2
2002	87	78	58	78	71	72	78	82	82	87	81	82	78
2003	80	82	75	78	84	74	73	76	88	88	84	84	80.5
2004	79	65	65	82	79	80	80	76	83	85	82	81	78.1
2005	79	83	69	79	82	80	80	73	87	85	86	88	80.9
2006	85	78	64	75	71	75	69	85	86	85	89	85	78.9
2007	82	70	65	62	73	76	84	77	81	79	84	83	76.3
2008	80	68	65	66	76	70	76	77	86	86	87	83	76.7
2009	81	67	66	75	76	74	75	74	78	82	84	81	76.1
2010	81	75	71	79	84	82	78	87	82	85	85	81	80.8
2011	85	81	66	71	77	71	75	76	83	85	83	82	77.9
2012	75	70	64	71	78	72	73	70	78	80	80	76	73.9
2013	79	74	63	68	77	65	67	82	84	79	86	83	75.6

Source: Data obtained from Environmental Protection Agency, Gilgit Baltistan

ANNEX 4: ENVIRONMENTAL MONITORING AND TESTING REPORT

ENVIRONMENTAL MONITORING, SAMPLING AND TESTING REPORT

Of

20MW Hanzel Hydropower Project

04 November, 2017

Prepared By: Green Crescent Environmental Consultants Pvt. Ltd.

Contact Details of GCEC-Pakistan	
Country Manager:	Mr. Rashid Maqbool.
Telephone:	+92-42-35761300
Fax:	+92-42-35761301
Email:	country.manager@gcee.pk
Address	112 C/E-1, Hali Road, Gulberg III, Lahore

Reviewed By:

Manager Operations
GCEC-Pakistan

Approved By:

Country Manager
GCEC-Pakistan

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURES

SECTION 1: COMPANY INTRODUCTION

Water and Power Department Northern Areas, Gilgit-Baltistan has planned 20MW Hanzel Hydropower Project, is a run-of-river hydropower project located on the Gilgit River, a main tributary of Indus River about 11 km from Gilgit city, Northern Areas, Pakistan. Diversion weir is located near Harpoon village has three parts, fixed and lateral intake/low level flushing section. Low level flushing section is equipped with two gates of same size. Fixed weir and low level flushing section and water diverted to gated intake to connecting channel to fore bay and then to power channel. Total length of power channel is 5.1 km and rated head is 62.8 m and discharge 38 m^3/s with installed capacity of 20 MW energy studies were made and annual energy delivery to the grid is 171.48 GWh per year.

The main purpose of the Environmental monitoring in 20MW Hanzel Hydropower Project limited, Gilgit Baltistan was to determine the current condition of environment and its compliance with Environmental Quality Standards. National Engineering Services Pakistan (Pvt.) Limited (NESPAK) hired the services of GCEC Pakistan (Pvt.) Ltd. to conduct the Environmental monitoring. A comprehensive Environmental monitoring was conducted at mutually agreed sampling points. The Environmental monitoring includes the monitoring of Ambient Air Quality, Meteorological Data, Noise Level and Sampling & Analysis of Drinking, Surface and Waste Water from mutually agreed sampling points. This report is prepared on the basis of monitoring conducted at these points according to the instructions provided by client. Field survey was carried out on 17th to 22nd Sep 2017.

1.1 STUDY OBJECTIVES

Environmental Monitoring Sampling and Testing of 20MW Hanzel Hydropower Project limited, Gilgit Baltistan is primarily conducted to;

- To assess the current conditions of the environment in the surroundings of project site.
- To develop the strategies for the protection and betterment of environment.
- The monitoring and testing outcomes will help us to configure a clear picture of environmental changes/deterioration of the environment transpired by this Hydro Power Project during its construction stage and as well as in operational phase.

1.2 SCOPE OF SERVICES

Scope of services covered following main components:

- Surface Water Sampling Testing & Analysis
- Drinking Water Sampling Testing & Analysis
- Waste Water Sampling Testing & Analysis
- Ambient Air Quality Monitoring

- Background Noise Level Monitoring
- Metrological Data Monitoring

1.3 MONITORING & TESTING TEAM

Monitoring team of Green Crescent Environmental Consultants involved in the monitoring and sampling is given in below table:

Table 1-1: Monitoring & Testing Team

Sr. No.	Name of The Employee	Designation	Qualification	Experience
Monitoring Team				
1.	Mr. Anosh Raza	Executive Field Officer	MS (Environmental Sciences)	2 Years
2.	Mr. Umar Usama	Executive Field Officer	BS (Environmental Sciences)	1 Year
3.	Mr. Waseem	Executive Field Officer	MS (Environmental Sciences)	1.5 Years
Testing Team				
4.	Mr. Usman Raza	Lab Manager	MS (Chemistry)	5 Years
5.	Mr. Shahzaib	Chemist	BS (Chemistry)	1.5 Years
6.	Miss. Amna Batool	Microbiologist	MS (Microbiology)	2 Years

SECTION 2: MONITORING SCHEDULE

Detailed Environmental monitoring was conducted at the mutually agreed sites of 20MW Hanzel Hydropower Project. The monitoring and sampling was conducted on 17th to 22nd Sep 2017. Monitoring and sampling schedule is presented in Table 2-1, while location maps are presented next to the Table 2-1.

Table 2-1: Monitoring Schedule

Sr. #	Intervention Date	Activity	Monitoring Location
1.	**22-09-2017**	Surface Water Sampling	1. Upstream of the Weir (Harpoon) 2. Downstream of the Weir (Hanzel Bala) 3. Spring Water Near Barbuch 4. Spring Water Collection Tank 5. Downstream of the Power House (Hanzel Paine) Near Girls High School
		Drinking Water Sampling	6. Drinking Water Sample from Tap Near Hanzel Stupa
		Waste Water Sampling	7. Pit Near Baseen (Before Hunzel Bala)
2.	**17-09-2017 to 18-09-2017**	• Ambient Air Quality Monitoring • VOC's Monitoring • Noise Level Monitoring • Meteorological Monitoring	Hanzel Paine
3.	**18-09-2017 to 19-09-2017**	• Ambient Air Quality Monitoring • VOC's Monitoring • Noise Level Monitoring • Meteorological Monitoring	Hanzel Bala
4.	**19-09-2017 to 20-09-2017**	• Ambient Air Quality Monitoring • VOC's Monitoring • Noise Level Monitoring • Meteorological Monitoring	Before Weir Site Near Harpon Village
5.	**20-09-2017 to 21-09-2017**	• Ambient Air Quality Monitoring • VOC's Monitoring • Noise Level Monitoring • Meteorological Monitoring	After Weir Site Near Barbuch
6.	**21-09-2017 to 22-09-2017**	• Ambient Air Quality Monitoring • VOC's Monitoring • Noise Level Monitoring • Meteorological Monitoring	Near Girls School in Haznel Paine

SECTION 3: PROEJCT LOCATION

This is a run-of-river hydropower project located in Hanzal at Gilgit River, Gilgit-Baltistan, and Province of Pakistan. The project location has been shown in below mentioned figure.

Figure 3-1: Project Location Map

SECTION 4: METHODOLOGY

Following is a brief description of the methodology adopted for this Environmental Monitoring, including Ambient Air, Metrological data and Water Analysis:

4.1 Onsite Monitoring

Among the environmental parameters selected by the client;

- Ambient Air
- Temperature and pH of water samples

Were monitored onsite using portable digital instruments were used for ambient air monitoring including metrological monitoring and noise level monitoring while temperature and pH of the water samples were monitored manually using thermometer and pH strips. A brief description of each digital instrument used for onsite monitoring is given below;

4.1.1 Vantage Pro2, Davis

The Wireless Vantage Pro2 Weather Station consists of a console unit and an innovative integrated sensor suite that includes a rain collector with self-emptying bucket, temperature and humidity sensors and an anemometer. The sensor suite is housed inside a radiation shield, protecting the sensors against solar radiation and additional sources of reflected and/or radiated heat. It provides accurate weather data in a sophisticated yet easy-to-read format. With Wireless Vantage Pro2 Weather Station we can continuously measure metrological parameters including;

- Temperature
- Wind Direction
- Wind Velocity
- Humidity
- Atmospheric Pressure

Wireless weather station Vantage Pro2 was used for the assessment of these parameters according to standard operating procedures and obtained results are presented in **Annex-2** of this report.

4.1.2 Model 407730 Digital Sound Level Meter, Extech

It is a measuring instrument used to assess sound levels by measuring sound pressure. Often referred to as a sound pressure level (SPL) meter, decibel (dB) meter, noise meter or noise dosimeter, a sound level meter uses a microphone to capture sound. The sound is then evaluated within the device and acoustic measurement values are displayed. The most common unit of acoustic measurement for sound is the decibel (dB). Hourly noise level monitoring was done for 24 hours' point at each selected location.

Noise level using portable digital sound meter was monitored at client's mutually agreed sampling points. Noise level measurement was performed according to standard operating procedures and obtained results are presented in **Annex-1** & **Annex-2** respectively of this report.

4.1.3 AQM 65 Ambient Air Monitoring Station, Aeroqual

The AQM 65 is a fully integrated air monitoring station that delivers 'near reference' levels of performance. The size of a large suitcase it can measure up to 20 different gaseous and particulate pollutants and environmental parameters simultaneously. With the AQM 65 we measured air pollutants including;

- Nitrogen oxide (NO)
- Nitrogen dioxide (NO_2)
- Carbon monoxide (CO)
- Sulphur dioxide (SO_2)
- Volatile organic compounds (VOC)
- Carbon dioxide (CO_2)
- Ozone (O_3)

These measurements were performed according to standard operating procedures and obtained results are presented in **Annex-2** respectively in the report.

4.1.4 DF-1E Low Volume Air Sampler, F & J

The Model DF-1E portable air sampling system with a digital flow meter is a low-volume air sampler consisting of an oil-less, carbon vane vacuum pump, with a mechanical constant air flow regulator for use where a nearly constant air flow is desirable. Filters are mounted on the pump facing, air passes through the filter leaving the particulate matters on the filter surface. The regulator holds a constant pressure drop across an in-line orifice by varying the flow through a bypass valve into the pump. This system allows the pump to work at a minimum pressure drop at all times, permitting it to run cooler, thus extending its service life. DF-1E Low Volume Air Sampler was used to monitor

- Particulate matter (PM_{10})
- Particulate matter ($PM_{2.5}$)

4.2 Water Sample Collection and Preservation

Water samples were collected from mutually agreed sampling points according to the SOPs based on American Public Health Association (APHA) for water sampling and analysis. Decontaminated glass bottles were used to collect the samples. To prevent air bubbles from being trapped in the bottles, they were filled to the brim. The lids of the sampling bottles were then replaced tightly. The bottles were then labeled and chain of custody forms were filled out and signed to keep track of the collected samples. Collected samples were than preserved in appropriate containers as per APHA Preservation Guidelines. A shipping container containing ice packs with maintained temperature was used for transporting the samples from sampling location to GCEC Lahore Branch for testing.

Grab Sampling method was adopted for surface and waste water collection. Grab samples are collected at one location and at one point in time. By contrast, composite samples consist of multiple grab samples taken over an area or time period. Reason behind adaptation of grab sampling method for this monitoring was; Composite sampling method is adopted where pollution content in the monitoring body keeps on changing like at such a point where industrial discharge enters in any water body and pollution content keeps on changing, while for sampling location like any canal or river body where no industrial discharge is being added grab sampling method is adopted.

4.3 Sample Tagging and Chain of Custody

In GCEC Lahore Branch, samples and chain of custody form were handed over by Field Monitoring to the Coordination Staff for in-house tagging and logging according to the company's policy and handed over to the Laboratory Staff for further physical, chemical and microbiological testing. A brief description of each sampling type and further proceedings are also discussed in following section.

4.3.1 Drinking Water Testing & Analysis

Drinking water samples were tested and analyzed against selected physical, chemical and microbiological parameters using American Public Health Association's (APHA) Standard Method. Analysis Methods and Results are presented in **Annexure-1** & **Annexure-2** respectively in this report.

4.3.2 Surface Water Testing & Analysis

Surface water samples were tested and analyzed against selected physical and chemical parameters using American Public Health Association's (APHA) Standard Method. Analysis Methods and Results are presented in **Annexure-1** & **Annexure-2** respectively in this report.

4.3.3 Waste Water Testing & Analysis

Waste water samples were tested and analyzed against selected physical and chemical parameters using American Public Health Association's (APHA) and United States Environmental Protection Agency's (UAEPA) Standard Procedures. Analysis Methods and Results are presented in **Annexure-1** & **Annexure-2** respectively in this report.

SECTION 5: RESULTS AND DISCUSSIONS

This section of the report presents the Environmental testing results of noise-level monitoring, ambient air quality, meteorological data, and drinking water and waste water analysis.

5.1 Background Noise Level Monitoring

The Noise monitoring activity was carried at the project site and at the surrounding areas of project site. Monitoring schedule is presented in Table 2-1. The Monitoring results are given in **Annexure-2**.

5.1.1 *Discussion on Results*

Noise level Monitoring was conducted at 5 locations on 24 hour basis. The monitoring results of all the sites are within the prescribed limits of National Environmental Quality Standards. All of monitoring points falls in commercial area category of NEQS set for noise level i.e. 65.0 dB (B) for Day Time and 55.0 dB (B) for Night Time.

Day and Night Time average for each monitoring point is presented in tables below.

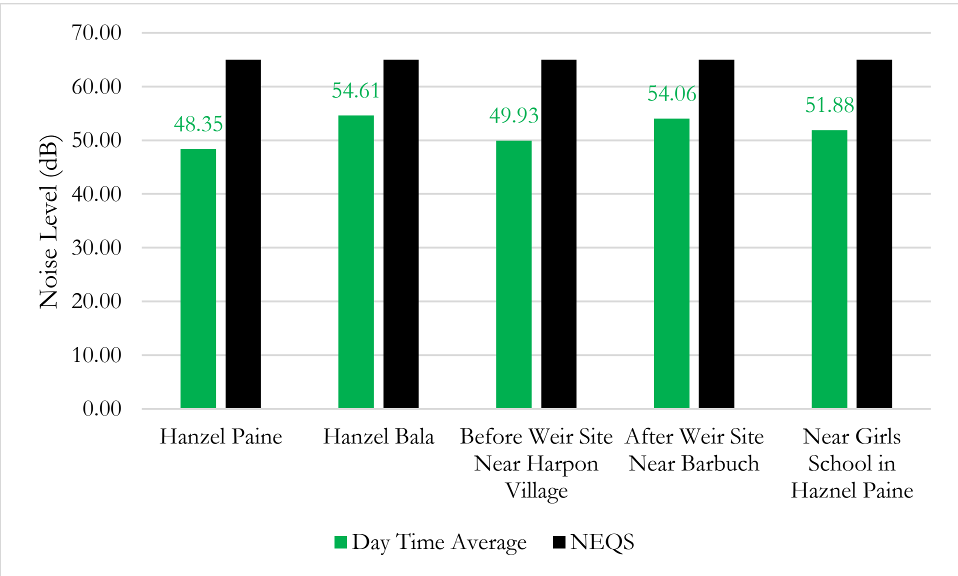


Figure 5-1: Day Time Average Noise Level Values Compared with Respective NEQS (17th to 22nd Sep 2017)

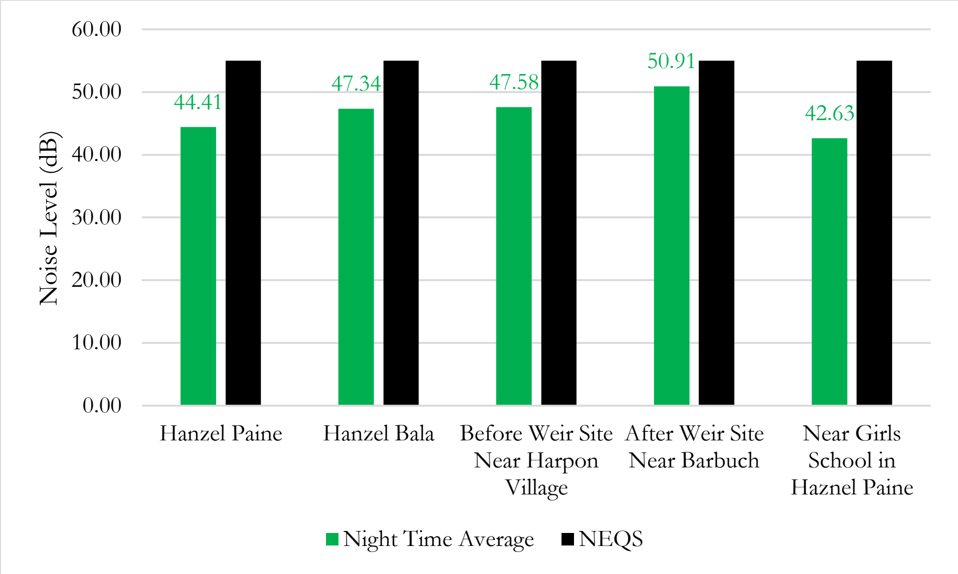


Figure 5-2: Night Time Average Noise Level Values Compared with Respective NEQS (17th to 22nd Sep 2017)

5.2 Ambient Air Quality Monitoring

The activity for monitoring the ambient air conditions was carried out at the project site and its vicinity for 24 hours, starting from 17th to 22nd Sep 2017. Monitoring location are shown in in the Figure 5-3. To assess the current quality of ambient air Carbon Monoxide, Carbon Dioxide, Oxides of Nitrogen, Sulphur Dioxide, Ozone, Particulate Matter and Volatile Organic Compounds were monitored. The table below represents the summary of results that were obtained during the monitoring period. Summary of monitoring results is presented in Table 5-1.

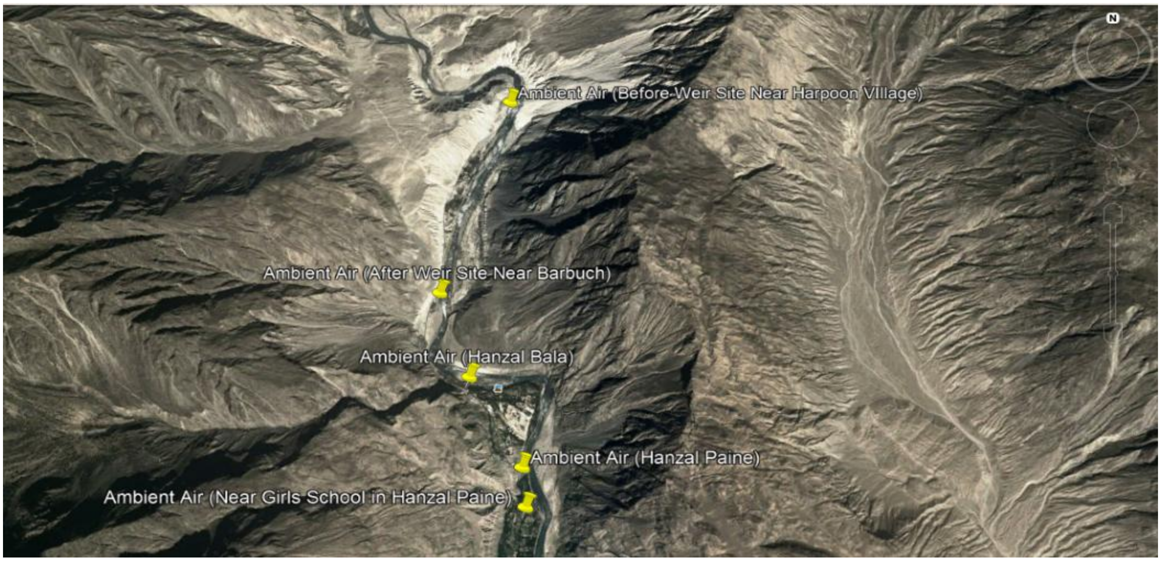


Figure 5-3: Map Showing Locations of Ambient Air Monitoring Points (17th to 22nd Sep 2017)

5.2.1 Discussion of NOx Measurements

The readings of NO, NO_2 and NOx for the project site and its surroundings comply with the National Environmental Quality Standard i.e., 40 µg/m³, 80 µg/m³ and 120 µg/m³ respectively. Sum of NO and

NO_2 is termed as NOx. NOx results found at all of monitoring locations were within the NEQS limits. Monitoring results, compared with NEQs, are graphically presented in figure below and in Summary Table 5-1.

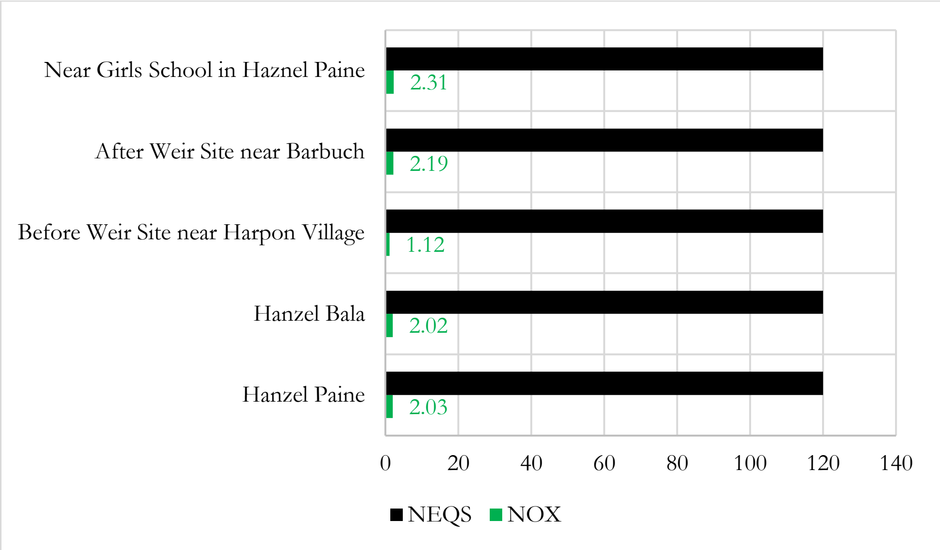


Figure 5-4: Daily Average NOx Measurements Compared with Respective NEQS (17th to 22nd Sep 2017)

5.2.2 Discussion of SO_2 Measurements

The SO_2 readings for the monitoring locations is presented in the summary table which depicts that all the monitoring results are within the prescribed limits of NEQS i.e. 120 µg/m³. SO_2 results found at all of monitoring locations were within the NEQS limits. Monitoring results, compared with NEQs, are graphically presented in figure below and in Summary Table 5-1.

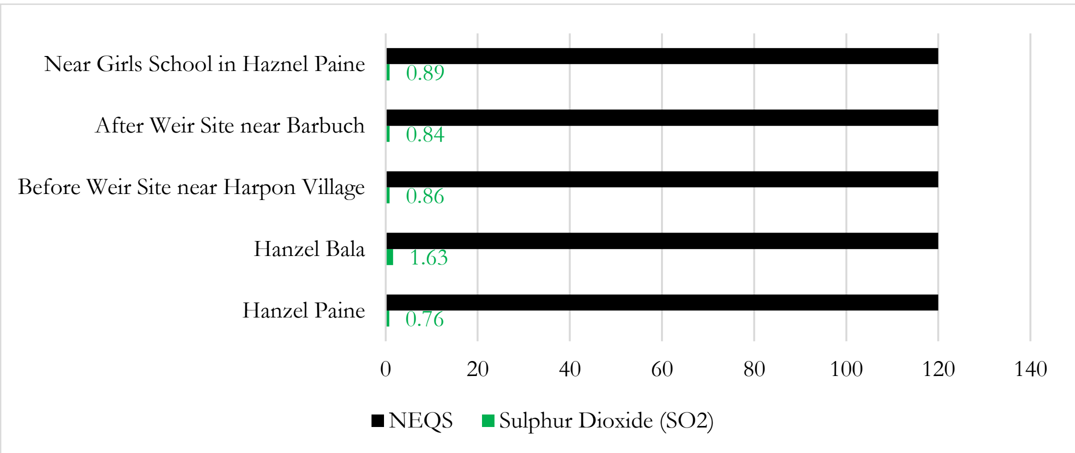


Figure 5-5: Daily Average SO2 Measurements Compared with Respective NEQS (17th to 22nd Sep 2017)

5.2.3 Discussion of CO Measurements

The above summary table shows that readings of CO for all the sites are within the permissible limit of NEQS i.e., 5.0 mg/m³. CO results found at all of monitoring locations were within the NEQS limits.

Monitoring results, compared with NEQs, are graphically presented in figure below and in Summary Table 5-1.

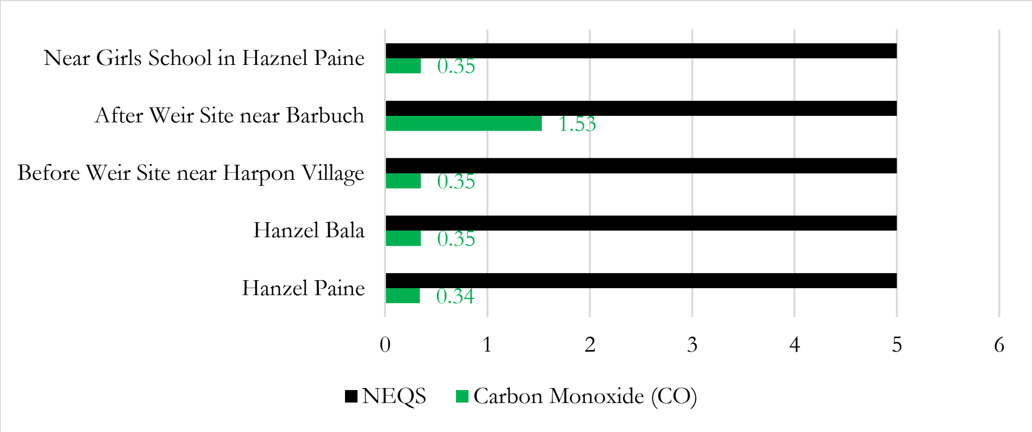


Figure 5-6: Daily Average CO Measurements Compared with Respective NEQS (17th to 22nd Sep 2017)

5.2.4 Discussion on Suspended Particulate Matter (SPM)

The readings of PM_{10}, $PM_{2.5}$ and SPM for the project site and its surroundings comply with the National Environmental Quality Standard i.e., 150 µg/m³, 35 µg/m³ and 185 µg/m³ respectively. Suspended Particulate Matter (SPM) is the sum of PM_{10} and $PM_{2.5}$. SPM along with PM_{10} an $PM_{2.5}$ results found at all of monitoring locations were within the NEQS limits. Monitoring results, compared with NEQs, are graphically presented in figure below and in Summary Table 5-1.

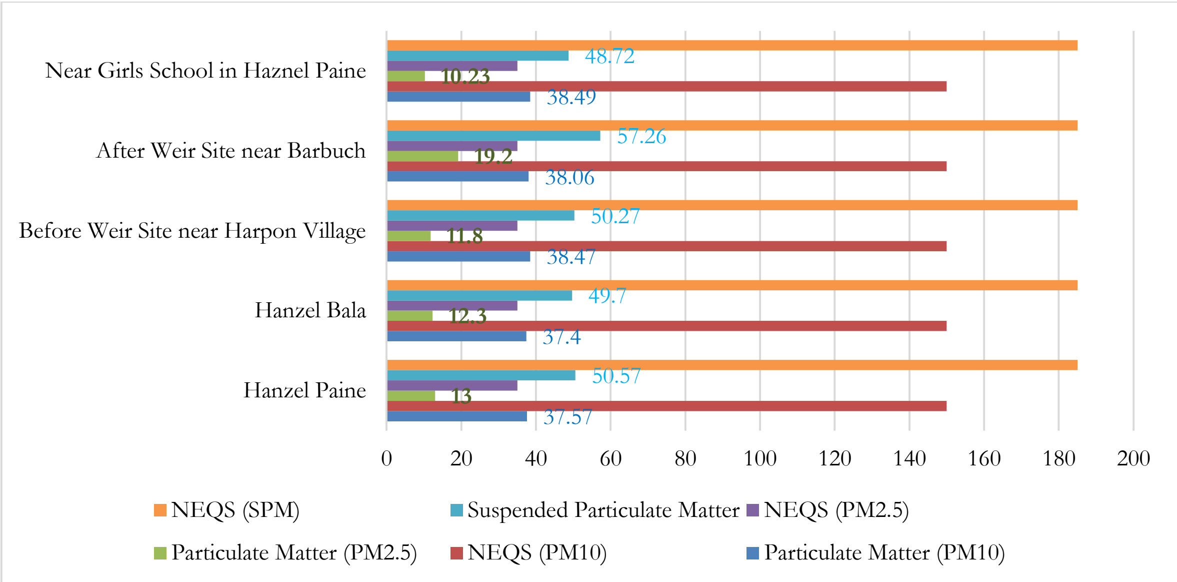


Figure 5-7: Daily Average SPM Measurements Compared with Respective NEQS (17th to 22nd Sep 2017)

5.2.5 Discussion of Ozone Measurements

The values for ozone (O_3) recorded for averaging period of 1 hour was within the NEQS set for ozone i.e., 130 µg/m³. Monitoring results, compared with NEQs, are graphically presented in figure below and in Summary Table 5-1.

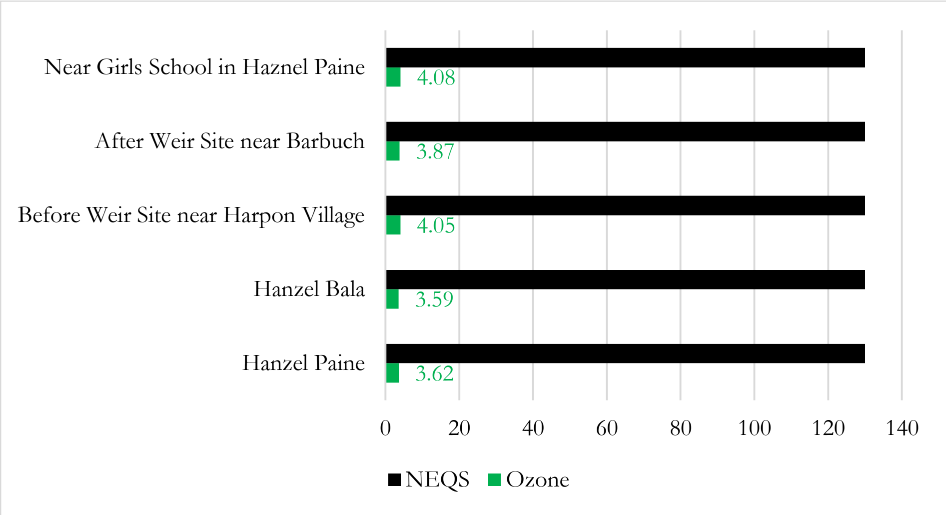


Figure 5-8: Daily 1 hour O3 Measurements Compared with Respective NEQS (17th to 22nd Sep 2017)

5.2.6 Discussion of VOC Measurements

VOC's Monitoring was conducted at the site and the surrounding areas. Monitoring results are presented in the Summary Table 5-1.

5.2.7 Discussion of CO_2 Measurements

CO_2 Monitoring was conducted at the proposed site and the surrounding areas. Monitoring results are presented in the Summary Table 5-1.

An overall assessment of the results for these parameters state that the pollution levels for all indicators are within the prescribed limits set by Environmental Protection Agency.

Table 5-1: Summary of Ambient Air Quality Monitoring Results

Location Identification					
Sampling Points	01= Hanzel Paine	02= Hanzel Bala	03= Before Weir Site Near Harpon Village	04= After Weir Site Near Barbuch	05= Near Girls School in Haznel Paine
Date	17-Sep-17 to 18-Sep-17	18-Sep-17 to 19-Sep-17	19-Sep-17 to 20-Sep-17	20-Sep-17 to 21-Sep-17	21-Sep-17 to 22-Sep-17
Time	11:00 AM to 10:00 AM	12:00 PM to 11:00 AM	12:00 PM to 11:00 AM	12:00 PM to 11:00 AM	11:30 AM to 10:30 AM
Coordinates	35°57' 40.8 N 74°12' 31.6 E	35°58' 10.1 N 74°12' 10.8 E	35°59' 49.7 N 74°12' 24.5 E	35°58' 39.1 N 74°11' 58.3 E	35°57' 27.6 N 74°12' 32.8 E
Sampling Person	Mr. Anosh Raza	Mr. Anosh Raza	Mr. Anosh Raza	Mr. Anosh Raza	Mr. Anosh Raza

Parameter	**Unit**	**Duration**	**Average Obtained Concentration**					**NEQS**
			01	**02**	**03**	**04**	**05**	
Nitrogen Dioxide (NO_2)	µg/m³	24Hours	1.64	1.63	1.80	1.75	1.83	80.0
Nitrogen oxide (NO)	µg/m³	24Hours	0.39	0.39	0.45	0.44	0.48	40.0
NO_X	µg/m³	24Hours	2.03	2.02	1.12	2.19	2.31	120.0
Sulphur Dioxide (SO_2)	µg/m³	24 Hours	0.76	1.63	0.86	0.84	0.89	120.0
Carbon Monoxide (CO)	mg/m³	08 Hours	0.34	0.35	0.35	1.53	0.35	05.0
Carbon Dioxide (CO_2)	ppm	24 Hours	401.0	408.0	410.0	405.0	404.0	-
Particulate Matter (PM_{10})	µg/m³	24 Hours	37.57	37.40	38.47	38.06	38.49	150.0
Particulate Matter ($PM_{2.5}$)	µg/m³	24 Hours	13.00	12.32	11.81	19.24	10.23	35.0
Suspended Particulate Matter	µg/m³	24 Hours	50.57	49.70	50.27	57.26	48.72	185.0
Volatile Organic Compound	ppm	24 Hours	0.19	0.15	0.24	0.20	0.18	-
Ozone	µg/m³	1 Hour	3.62	3.59	4.05	3.87	4.08	130.0

Abbreviations: **LDL=** Lowest Detection Limit **NEQS=** National Environmental Quality Standards **µg/m³=** Micrograms per Cubic Meter

5.3 Meteorological Monitoring

The activity for monitoring the meteorological conditions at 05 locations was carried out at project site and in the surroundings for 24 hours. Results obtained during the monitoring exercise are presented in **Annexure-2**.

5.3.1 *Discussion of Results*

The ambient temperature readings were obtained on a 24 hours basis monitoring, with temperatures increasing during the day and dropping during the early morning hours. The readings for wind direction and wind speed vary from time to time. The Air pressure values did not vary much during the monitoring period.

5.4 Surface Water Analysis Result

05 surface water samples were collected from mutually agreed locations on 22-09-2017 by Mr. Anosh Raza which were preserved and submitted in GCEC-Laboratory according to the standard methods. Summary of Analysis Results are given in Table 5-2.

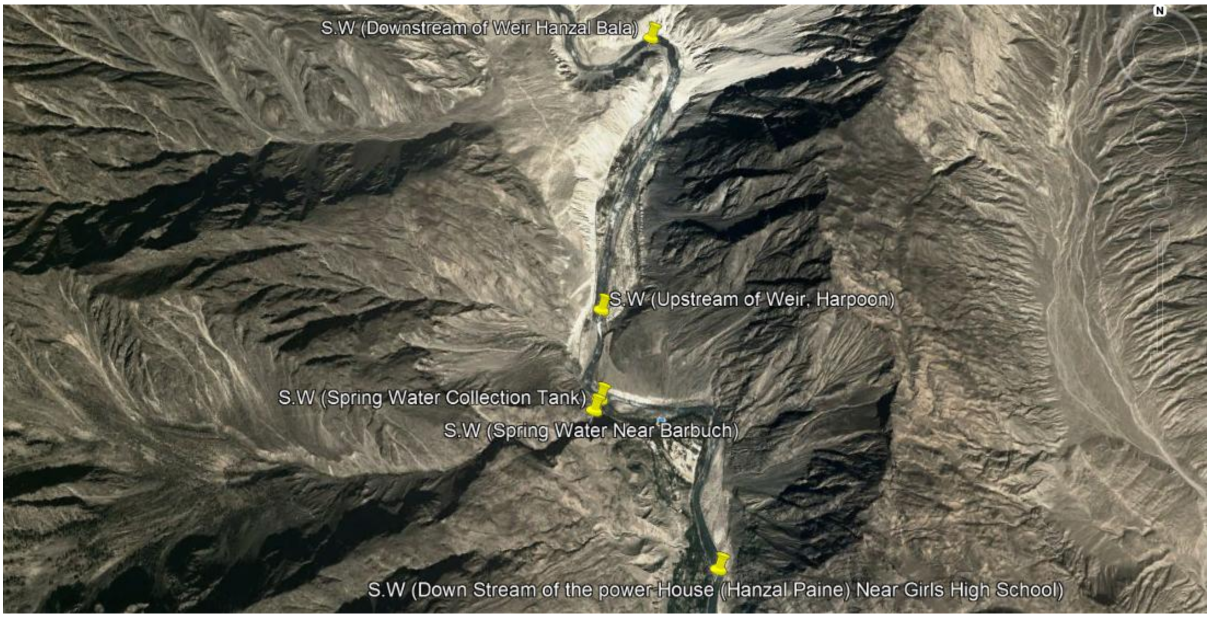


Figure 5-9: Map Showing Locations of Surface Water Sampling Points (22nd Sep 2017)

Table 5-2: Summary of Surface Water Analysis Results

Sample Marking & Identification				
Sample ID	**Sample Location**	**Sampling Date**	**Sampling Time**	**Sampling Coordinates**
01	Upstream of the Weir (Harpoon)	22-09-2017	08:20 AM	35°58'39.0" N 74°12'00.9" E
02	Downstream of the Weir (Hanzel Bala)	22-09-2017	08:45 AM	36°00'03.2" N 74°12'19.5" E
03	Spring Water Near Barbuch	22-09-2017	09:25 AM	35°58'09.3" N 74°11'58.4" E
04	Spring Water Collection Tank	22-09-2017	09:40 AM	35°58'09.3" N 74°11'58.4" E
05	Downstream of the Power House (Hanzel Paine) Near Girls High School	22-09-2017	10:15 AM	35°57'25.8" N 74°12'40.6" E

Sr. No	Analysis Parameter	Units	Results				
			Point 01	Point 02	Point 03	Point 04	Point 05
1	**Temperature**	^{0}C	07	08	06	08	09
2	**pH**	pH unit	7.67	7.71	7.65	7.59	7.52
3	**Total Dissolved Solid**	mg/l	56.0	42.0	38.0	50.0	85.0
4	**Biological Oxygen Demand**	mg/l	<2.0	<2.0	<2.0	<2.0	<2.0
5	**Chemical Oxygen Demand**	mg/l	<5.0	<5.0	<5.0	<5.0	<5.0
6	**Total Suspended Solids**	mg/l	42.0	39.0	12.0	11.0	14.0
7	**Oil & Grease**	mg/l	<10.0	<10.0	<10.0	<10.0	<10.0
8	**Turbidity**	NTU	4.0	5.0	2.0	4.0	<0.1
9	**Dissolved Oxygen**	mg/l	6.2	5.2	6.4	5.3	6.1
10	**Pesticides**	mg/l	ND	ND	ND	ND	ND
11	**Potasium**	mg/l	0.02	ND	0.05	ND	0.03
12	**Nitrogen**	mg/l	<0.03	<0.03	<0.03	<0.03	<0.03
13	**Phosphorous**	mg/l	ND	ND	ND	ND	ND
14	**Phenolic Compound**	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
15	**Chloride (Cl)**	mg/l	5.82	3.88	5.82	5.82	3.88
16	**Fluoride (F)**	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
17	**Cyanide (Cn)**	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
18	**Detergents**	mg/l	ND	ND	ND	ND	ND
19	**Sulphate**	mg/l	223.91	152.70	116.07	199.62	141.59
20	**Sulphide**	mg/l	ND	ND	ND	ND	ND
21	**Ammonia**	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002
22	**Chlorine**	mg/l	<1.0	<1.0	<1.0	<1.0	<1.0
23	**Cadmium**	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
24	**Chromium**	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01

25	**Copper**	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5
26	**Lead**	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
27	**Mercury**	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
28	**Nickel**	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
29	**Zinc**	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5
30	**Arsenic**	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
31	**Silver**	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
32	**Barium**	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
33	**Manganese**	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
34	**Iron**	mg/l	0.05	0.23	0.10	0.12	0.3
35	**Boron**	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
36	**Selenium**	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
37	**Total Toxic Metals**	mg/l	0.07	0.23	0.15	0.12	0.33

Abbreviations:
ND: Not Detected **LOR:** Limit of Reporting
Note: ***Uncertainty of all the parameters and laboratory conditions at the time of analysis will be provided as per client's requirement***

5.5 Ground/ Drinking Water Analysis

One ground water sample was collected from mutually agreed location on 22-09-2017 by Mr. Anosh Raza which were preserved and submitted in GCEC-Laboratory according to the standard methods. Summary of Analysis Results are given below in Table 5-3.

Figure 5-10: Map Showing Locations of Ground Water Sampling Point (22nd Sep 2017)

5.5.1 *Discussion on Results*

The laboratory test results of drinking water are summarized in the table below. It is obvious from the analysis results that the tested drinking water meets the permissible limits of National Environmental Quality Standards.

It is concluded that almost all the measured parameters of the Drinking water including physical and chemical, are within the permissible limits. While microbiological analysis results are exceeding the prescribed limits i.e. microbes must not be detectable in a 100 ml sample, making this water unhealthy for drinking.

Table 5-3: Summary of Ground/Drinking Water Analysis Results

Sample Location				
Sample ID	**Sample Location**	**Sampling Date**	**Sampling Time**	**Sampling Coordinates**
06	Drinking Water Sample from Tap Near Hanzel Stupa	22-09-2017	09:50 AM	35°58'13.8" N 74°12'02.2" E

Parameters	Analysis Method	Unit	LOR	Result 06	NEQS
CHEMICAL ANALYSIS					
pH	APHA-4500H+ B	pH unit	0.1	7.98	6.5-8.5
Odor	In-house	-	-	Odorless	Non-Objectionable
Taste	In-house	-	-	Sweet	Non-Objectionable
Color	APHA-2120 B/C	Pt/Co	5.0	<5.0	<15 TCU
Turbidity	APHA-2130 B	NTU	-	ND	<5 NTU
Total Hardness	APHA-2340 C	mg/l	-	70.56	< 500 mg/l
Total Dissolved Solid (TDS)	APHA-2540 C	mg/l	1.0	91.0	< 1000
Chloride (Cl)	APHA-4500Cl- B	mg/l	0.5	3.88	< 250
Cyanide (Cn)	APHA-4500CN F	mg/l	0.01	<0.01	< 0.05
Fluoride (F)	APHA-4500F- C	mg/l	0.01	<0.01	< 1.5
Nitrite	APHA-4500NO2 B	mg/l	0.003	<0.003	< 3 (P)
Nitrate	APHA-4500NO3 B	mg/l	0.003	0.6	< 50
Phenolic Compound	APHA-5530 D	mg/l	0.001	<0.001	-
Residual Chlorine	APHA-4500Cl G	mg/l	1.0	<1.0	0.2-0.5
Aluminum (Al)	APHA-3500Al B	mg/l	0.1	<0.1	< 0.2
Cadmium	APHA-3500Cd B	mg/l	0.01	<0.01	0.01
Copper	APHA-3500Cu B	mg/l	0.5	<0.5	2
Chromium	APHA-3500Cr B	mg/l	0.01	<0.01	< 0.05 (P)
Mercury	APHA-3500-Hg B	mg/l	0.001	<0.001	< 0.001
Antimony (Sb)	APHA-3500Sb B	mg/l	0.005	<0.005	< 0.005 (P)
Nickel	APHA-3500-Ni B	mg/l	0.01	<0.01	< 0.02
Zinc	APHA-3500-Zn B	mg/l	0.5	<0.5	5.0
Arsenic	APHA-3500As B	mg/l	0.01	<0.01	< 0.05 (P)
Barium	APHA-3500Ba B	mg/l	0.1	<0.1	0.7
Manganese	APHA-3500-Mn B	mg/l	0.1	<0.1	< 0.5
Lead	APHA-3500-Pb B	mg/l	0.01	<0.01	< 0.05
Selenium	APHA-3500Se C	mg/l	0.005	<0.005	0.01 (P)
Boron	APHA-4500B C	mg/l	0.1	<0.10	0.3
Pesticides	APHA-6630 B	mg/l	-	ND	-
MICROBIOLOGICAL ANALYSIS					
Total Coliforms	APHA:9222 B	CFU/100ml	1.0	55.0	0/100ml
Faecal Coliforms (Ecoli)	APHA:9222 D	CFU/100ml	1.0	0	0/100ml

Abbreviations:
ND: Not Detected **LOR:** Limit of Reporting **NEQS:** National Environmental Quality Standard
Note:
**Uncertainty of all the parameters and laboratory conditions at the time of analysis will be provided as per clients requirement*

5.6 Waste Water Analysis Result

One waste water sample was collected from mutually agreed location on 22-09-2017 by Mr. Anosh Raza which was preserved and submitted in GCEC-Laboratory according to the standard methods. Summary of Analysis Results are given in Table 5-4 below.

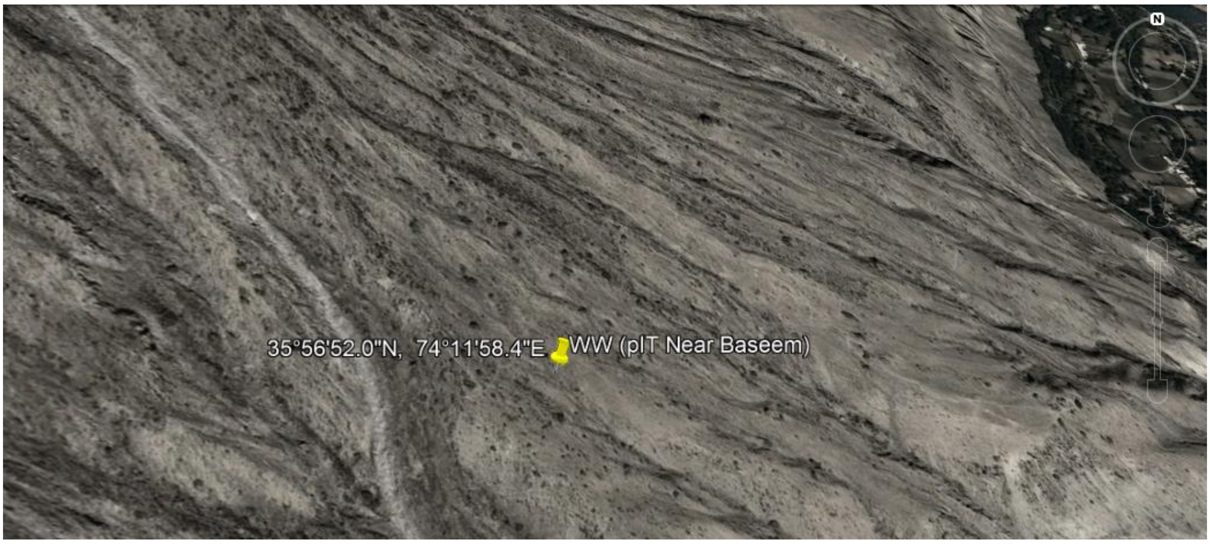


Figure 5-11: Map Showing Locations of Waste Water Sampling Point (22nd Sep 2017)

5.6.1 *Discussion on Results*

From the laboratory test results appended in the table below, it is evident that most of the waste water parameters are within the permissible limits of NEQS except, Sulphates that found to be high in tested sample.

In the light of the above discussion of the liquid effluents test results, it is concluded that most of the measured parameters of the waste water including physical and chemical, are within the permissible limits of quality standards except sulphates.

Table 5-4: Summary of Waste Water Analysis Results

Sample Identification				
Sample ID	**Sample Location**	**Sampling Date**	**Sampling Time**	**Sampling Coordinates**
07	Pit Near Baseen (Before Hanzel Bala)	22-09-2017	10:30 AM	35°56'52.0" N 74°11'58.4" E

CHEMICAL ANALYSIS

Parameters	Analysis Method	Unit	LOR	Result	NEQS
				07	
Temperature	-	^0C	-	23.0	≤3*
pH	APHA-4500H$^+$ B	pH unit	0.1	7.97	6-9
Total Dissolved Solid (TDS)	APHA-2540 C	mg/l	1.0	2767.0	3500
Biological Oxygen Demand	APHA, 5210	mg/l	2.0	8.6	80
Chemical Oxygen Demand	APHA-5220 D	mg/l	5.0	25.0	150
Total Suspended Solids	APHA-2540 D	mg/l	5.0	31.0	200
Oil & Grease	USEPA-1664	mg/l	10.0	<10.0	10
Turbidity	APHA-2130 B	NTU	5.0	5.0	-
Dissolved Oxygen	APHA-4500-O	mg/l	-	6.4	-
Pesticides	APHA-6630-B	mg/l	-	ND	0.15
Potasium	APHA-3500-K-B	mg/l	-	ND	-
Nitrogen	APHA-4500 Norg	mg/l	-	ND	-
Phosphorous	APHA-4500-P C	mg/l	0.03	<0.03	-
Phenolic Compound	APHA-5530 D	mg/l	0.001	<0.001	0.1
Chloride (Cl)	APHA-4500Cl$^-$ B	mg/l	0.5	287.51	1000
Fluoride (F)	APHA-4500F$^-$ C	mg/l	0.01	<0.01	10
Cyanide (Cn)	APHA-4500CN F	mg/l	0.01	<0.01	1.0
Detergents	APHA-5540- C	mg/l	-	ND	-
Sulphate	APHA-4500-SO_4-C	mg/l	0.41	1506.45	600
Sulphide	APHA-4500-S_2 E	mg/l	-	ND	1.0
Ammonia	APHA-4500-NH_3 B	mg/l	0.002	<0.002	40
Chlorine	APHA-4500Cl G	mg/l	1.0	<1.0	-
Cadmium	APHA-3500Cd B	mg/l	0.01	<0.01	0.1
Chromium	APHA-3500Cr B	mg/l	0.01	<0.01	1.0
Copper	APHA-3500Cu B	mg/l	0.5	<0.5	1.0
Lead	APHA-3500-Pb B	mg/l	0.01	<0.01	0.5
Mercury	APHA-3500-Hg B	mg/l	0.001	<0.001	0.01
Nickel	APHA-3500-Ni B	mg/l	0.01	<0.01	1.0
Zinc	APHA-3500-Zn B	mg/l	0.5	<0.5	5.0
Arsenic	APHA-3500As B	mg/l	0.01	<0.01	1.0
Silver	APHA-3500Ag B	mg/l	0.01	<0.01	1.0
Barium	APHA-3500Ba B	mg/l	0.1	<0.1	1.5
Manganese	APHA-3500-Mn B	mg/l	0.1	<0.1	1.5
Iron	APHA-3500-Fe B	mg/l	-	0.83	8.0
Boron	APHA-4500B C	mg/l	0.1	<0.1	6.0
Selenium	APHA-3500Se C	mg/l	0.005	<0.05	0.5
Total Toxic Metal	-	mg/l	-	0.83	-

Abbreviations:
ND: Not Detected **LOR:** Limit of Reporting **NEQS:** National Environmental Quality Standard

Note:
**The effluent should not result in temperature increase of more than 30 ^oC at the edge of the zone where initial mixing and dilution take place in receiving body. In case zone is not defined use 100 meters from the point of discharge.*
*******Uncertainty of all the parameters and laboratory conditions at the time of analysis will be provided as per clients requirement*

Annexure 1:

MONITORING AND ANALYSIS METHODS

A) METHODS FOR WASTEWATER/SURFACEWATER ANALYSIS

Sr. No.	Parameters	Method	
		Description	Reference
01	Temperature	Thermometer	-
02	pH	Electrometric	APHA-4500H+ B
03	Biochemical Oxygen Demand(BOD5)	Manometric	APHA, 5210
04	Chemical Oxygen Demand(COD)	Digestion, Colorimetric	APHA-5220 D
05	Solids, Total Suspended (TSS)	Gravimetric	APHA-2540 D
06	Total dissolved solids	Gravimetric	APHA-2540 C
07	Oil & Grease	Gravimetric	USEPA-1664
08	Phenolic compounds	Distillation + UV-VIS spectrophoto meter	APHA-5530 D
09	Chloride (CI)	Titration	APHA-4500Cl- B
10	Fluoride (F)	Ion Selective	APHA-4500F- C
11	Cyanide (Cn)	Ion selective	APHA-4500CN F
12	Detergents	UV-VIS spectrophoto meter	APHA-5540- C
13	Sulphate (SO_4)	Gravimetric	APHA-4500-SO2- C
14	Sulphide (S)	Titration	APHA-4500S4 E
15	Ammonia (NH_3)	Ion selective	APHA-4500NH3 B
16	Cadmium	AAS	APHA-3500Cd B
17	Chromium	AAS	APHA-3500Cr B
18	Copper	AAS	APHA-3500Cu B
19	Lead	AAS	APHA-3500-Pb B
20	Mercury	AAS	APHA-3500-Hg B
21	Selenium	AAS	APHA-3500Se C
22	Nickel	AAS	APHA-3500-Ni B
23	Silver	AAS	APHA-3500Ag B
24	Zinc	AAS	APHA-3500-Zn B
25	Arsenic	AAS	APHA-3500As B
26	Barium	AAS	APHA-3500Ba B
27	Iron	AAS	APHA-3500-Fe B
28	Manganese	AAS	APHA-3500-Mn B
29	Boron	AAS	APHA-4500B C
30	Chlorine	Titration	APHA-4500Cl G
31	Total Toxic Metals	By Calculation	-
32	Turbidity	Nephleometric	APHA -2130 B
33	Dissolved Oxygen	DO Meter	APHA-4500-O
34	Pesticides	GC/MS	APHA-6630 B
35	Potassium	AAS	APHA-3500-K-B
36	Nitrogen	Distillation + Titration	APHA- 4500 Norg
37	Phosphorous	UV-Vis Spectrophotometer	APHA-4500P C

B) DRINKING WATER ANALYSIS METHODS

Parameters for Microbiological Analysis

Sr. No.	Parameter	Reference Method
1	Total Coliforms	APHA:9222 B
2	Faecal Coliforms (E coli)	APHA:9222 D

Parameters for Chemical Analysis

Sr. No.	Parameter	Method	
		Description	Reference
1.	pH	Electrometric	APHA -4500H+ B
2.	Total Dissolved Solids (TDS)	Gravimetric	APHA- 2540 C
3.	Total Hardness	EDTA Titration	APHA -2340 C
4.	Colour	Pt-Co/Hazen/APHA	APHA -2120 B/C
5.	Odour	Physical	In-House
6.	Turbidity	Nephleometric	APHA -2130 B
7.	Taste	Physical	In-House
8.	Aluminium (Al)	AAS	APHA-3500Al B
9.	Antimony (Sb)	AAS	APHA-3500Sb B
10.	Arsenic (As)	AAS	APHA-3500As B
11.	Barium (Ba)	AAS	APHA-3500Ba B
12.	Cadmium (Cd)	AAS	APHA-3500Cd B
13.	Chloride (Cl)	AAS	APHA-4500Cl- B
14.	Copper (Cu)	AAS	APHA-3500Cu B
15.	Cyanide (CN)	Ion Selective Electrode	APHA-4500CN F
16.	Fluoride (F)	Ion Selective Electrode	APHA-4500F- C
17.	Chromium	AAS	APHA-3500Cr B
18.	Lead (Pb)	AAS	APHA-3500-Pb B
19.	Manganese (Mn)	AAS	APHA-3500-Mn B
20.	Mercury (Hg)	AAS	APHA-3500-Hg B
21.	Nickel	AAS	APHA-3500-Ni B
22.	Nitrite	UV-Vis Spectrophotometer	APHA-4500NO3 B
23.	Nitrate	UV-Vis Spectrophotometer/ Ion Selective Electrode	APHA-4500NO2 B
24.	Selenium	AAS	APHA-3500Se C
25.	Phenol	Direct Photometric Method	APHA 5530- D
26.	Residual Chlorine	DPD/Titration	APHA-4500Cl G
27.	Zinc	AAS	APHA-3500-Zn B
28	Boron	AAS	APHA-4500B C
29	Pesticides	GC/MS	APHA-6630 B

C) AMBIENT AIR QUALITY MONITORING METHODOLOGY

Air Pollutant	Monitoring Technique	Method
Carbon Monoxide (CO)	Cross Flow Modulation, non-dispersive infrared (NDIR) absorption technology	US EPA Designated Method RFCA-0981-054
Carbon Monoxide (CO_2)	Cross Flow Modulation, non-dispersive infrared (NDIR) absorption technology	US EPA Designated Method RFCA-0981-054
Sulphur Dioxide (SO2)	UV fluorescence (UVF)	US EPA Designated Method EQSA-0486-060
Nitrogen Dioxide(NOx)	Cross flow modulation type, reduced pressure chemiluminescence (CLD)	US EPA Designated Method RFNA-1289-074
Ozone	Non dispersive UV absorption Method	U. S. EPA REFERENCE Equivalent Number EQOA-0506-160
Volatile Organic Compounds	IQM 65	USEPA 8260 B
Suspended Particulate Matter	High Volume Sampler	40 CFR 50, App. J (US-EPA)
Particulate Matter (PM 2.5)	β-Ray Absorption Method	40 CFR 50, App. B (US-EPA)
Particulate Matter (PM10)	β-Ray Absorption Method	40 CFR 50, App. B (US-EPA)

Annexure 2:

MONITORING

&

ANALYSIS REPORTS

Green Crescent
Environmental Consultants (Pvt) Ltd.

Punjab-EPA Certified
Lahore Laboratory
Federal-EPA Certified
Islamabad Laboratory

Monitoring & Analysis Report

- Surface Water
- Drinking Water
- Waste Water
- Ambient Air

20MW HANZEL HYDROPOWER PROJECT

October 30, 2017

Job Reference No.: GCEC-PK-147/2017

112 C/E-1, Hali Road, Gulberg III, Lahore
Tel: +92 42 35761300
executive.bd@gcee.pk
www.gceec.com

GCEC Details:	
Country Manager:	Mr. Rashid Maqbool.
Telephone:	+92-42-35761300
Fax:	+92-42-35761301
Email:	country.manager@gcee.pk
Address	112 C/E-1, Hali Road, Gulberg III, Lahore

Signatories:

Rashid Maqbool

(Country Manager)

Sample Details			
Job Ref. No:	GCEC-PK-147/2017	**Sample Matrix:**	Surface Water Sample
No. of Samples:	Five	**Sample Date:**	22-09-2017
Sample Receipt Date:	25-09-2017	**Sampled By:**	GCEC

Sample Identification

Sample ID	Sample Location	Sampling Time	Sampling Coordinates
01	Upstream of the Weir (Harpoon)	08:20 AM	35°58'39.0" N 74°12'00.9" E
02	Downstream of the Weir (Hanzel Bala)	08:45 AM	36°00'03.2" N 74°12'19.5" E
03	Spring Water Near Barbuch	09:25 AM	35°58'09.3" N 74°11'58.4" E
04	Spring Water Collection Tank	09:40 AM	35°58'09.3" N 74°11'58.4" E
05	Downstream of the Power House (Hanzel Paine) Near Girls High School	10:15 AM	35°57'25.8" N 74°12'40.6" E

CHEMICAL ANALYSIS

Parameters	Analysis Method	Unit	LOR	Result				
				01	02	03	04	05
Temperature	-	^0C	-	07	08	06	08	09
pH	APHA-4500H+ B	pH unit	0.1	7.67	7.71	7.65	7.59	7.52
Total Dissolved Solid	APHA-2540 C	mg/l	1.0	56.0	42.0	38.0	50.0	85.0
Biological Oxygen Demand	APHA, 5210	mg/l	2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Chemical Oxygen Demand	APHA-5220 D	mg/l	5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Total Suspended Solids	APHA-2540 D	mg/l	5.0	42.0	39.0	12.0	11.0	14.0
Oil & Grease	USEPA-1664	mg/l	10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Turbidity	APHA-2130 B	NTU	0.1	4.0	5.0	2.0	4.0	<0.1
Dissolved Oxygen	APHA-4500-O	mg/l	5.0	6.2	5.2	6.4	5.3	6.1
Pesticides	APHA-6630-B	mg/l	-	ND	ND	ND	ND	ND
Potasium	APHA-3500-K-B	mg/l	-	0.02	ND	0.05	ND	0.03
Nitrogen	APHA-4500 Norg	mg/l	0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Phosphorous	APHA-4500-P C	mg/l	-	ND	ND	ND	ND	ND
Phenolic Compound	APHA-5530 D	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloride (Cl)	APHA-4500Cl- B	mg/l	0.5	5.82	3.88	5.82	5.82	3.88
Fluoride (F)	APHA-4500F- C	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cyanide (Cn)	APHA-4500CN F	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Detergents	APHA-5540- C	mg/l	-	ND	ND	ND	ND	ND
Sulphate	APHA-4500-SO_4-C	mg/l	0.41	223.91	152.70	116.07	199.62	141.59
Sulphide	APHA-4500-S_2 E	mg/l	-	ND	ND	ND	ND	ND
Ammonia	APHA-4500-NH_3 B	mg/l	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chlorine	APHA-4500Cl G	mg/l	1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Cadmium	APHA-3500Cd B	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	APHA-3500Cr B	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	APHA-3500Cu B	mg/l	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lead	APHA-3500-Pb B	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	APHA-3500-Hg B	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	APHA-3500-Ni B	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	APHA-3500-Zn B	mg/l	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	APHA-3500As B	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	APHA-3500Ag B	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	APHA-3500Ba B	mg/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	APHA-3500-Mn B	mg/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	APHA-3500-Fe B	mg/l	-	0.05	0.23	0.10	0.12	0.3
Boron	APHA-4500B C	mg/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Selenium	APHA-3500Se C	mg/l	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Toxic Metal	-	mg/l	-	0.07	0.23	0.15	0.12	0.33

Abbreviations:
ND: Not Detected **LOR:** Limit of Reporting
Note: **Uncertainty of all the parameters and laboratory conditions at the time of analysis will be provided as per clients requirement*

QA/QC

Sample Details			
Job Ref. No:	GCEC-PK-147/2017	**Sample Matrix:**	Drinking Water Sample
No. of Samples:	One	**Sample Date:**	22-09-2017
Sample Receipt Date:	25-09-2017	**Sampled By:**	GCEC

Sample Identification			
Sample ID	**Sample Location**	**Sampling Time**	**Sampling Coordinates**
06	Drinking Water Sample from Tap Near Hanzel Stupa	09:50 AM	35°58'13.8" N 74°12'02.2" E

Parameters	Analysis Method	Unit	LOR	Result 06	NEQS
CHEMICAL ANALYSIS					
pH	APHA-4500H+ B	pH unit	0.1	7.98	6.5-8.5
Odor	In-house	-	-	Odorless	Non-Objectionable
Taste	In-house	-	-	Sweet	Non-Objectionable
Color	APHA-2120 B/C	Pt/Co	5.0	<5.0	<15 TCU
Turbidity	APHA-2130 B	NTU	-	ND	<5 NTU
Total Hardness	APHA-2340 C	mg/l	-	70.56	< 500 mg/l
Total Dissolved Solid (TDS)	APHA-2540 C	mg/l	1.0	91.0	< 1000
Chloride (Cl)	APHA-4500Cl- B	mg/l	0.5	3.88	< 250
Cyanide (Cn)	APHA-4500CN F	mg/l	0.01	<0.01	< 0.05
Fluoride (F)	APHA-4500F- C	mg/l	0.01	<0.01	< 1.5
Nitrite	APHA-4500NO2 B	mg/l	0.003	<0.003	< 3 (P)
Nitrate	APHA-4500NO3 B	mg/l	0.003	0.6	< 50
Phenolic Compound	APHA-5530 D	mg/l	0.001	<0.001	-
Residual Chlorine	APHA-4500Cl G	mg/l	1.0	<1.0	0.2-0.5
Aluminum (Al)	APHA-3500Al B	mg/l	0.1	<0.1	< 0.2
Cadmium	APHA-3500Cd B	mg/l	0.01	<0.01	0.01
Copper	APHA-3500Cu B	mg/l	0.5	<0.5	2
Chromium	APHA-3500Cr B	mg/l	0.01	<0.01	< 0.05 (P)
Mercury	APHA-3500-Hg B	mg/l	0.001	<0.001	< 0.001
Antimony (Sb)	APHA-3500Sb B	mg/l	0.005	<0.005	< 0.005 (P)
Nickel	APHA-3500-Ni B	mg/l	0.01	<0.01	< 0.02
Zinc	APHA-3500-Zn B	mg/l	0.5	<0.5	5.0
Arsenic	APHA-3500As B	mg/l	0.01	<0.01	< 0.05 (P)
Barium	APHA-3500Ba B	mg/l	0.1	<0.1	0.7
Manganese	APHA-3500-Mn B	mg/l	0.1	<0.1	< 0.5
Lead	APHA-3500-Pb B	mg/l	0.01	<0.01	< 0.05
Selenium	APHA-3500Se C	mg/l	0.005	<0.005	0.01 (P)
Boron	APHA-4500B C	mg/l	0.1	<0.10	0.3
Pesticides	APHA-6630 B	mg/l	-	ND	-
MICROBIOLOGICAL ANALYSIS					
Total Coliforms	APHA:9222 B	CFU/100ml	1.0	55.0	0/100ml
Faecal Coliforms (Ecoli)	APHA:9222 D	CFU/100ml	1.0	0	0/100ml

Abbreviations:
ND: Not Detected **LOR:** Limit of Reporting **NEQS:** National Environmental Quality Standard
Note:
**Uncertainty of all the parameters and laboratory conditions at the time of analysis will be provided as per clients requirement*

QA/QC

Sample Details			
Job Ref. No:	GCEC-PK-147/2017	**Sample Matrix:**	Waste Water Sample
No. of Samples:	One	**Sample Date:**	22-09-2017
Sample Receipt Date:	25-09-2017	**Sampled By:**	GCEC

Sample Identification			
Sample ID	**Sample Location**	**Sampling Time**	**Sampling Coordinates**
07	Pit Near Baseen (Before Hanzel Bala)	10:30 AM	35°56'52.0" N 74°11'58.4" E

CHEMICAL ANALYSIS

Parameters	Analysis Method	Unit	LOR	Result 07	NEQS
Temperature	-	^{0}C	-	23.0	≤3*
pH	APHA-4500H+ B	pH unit	0.1	7.97	6-9
Total Dissolved Solid (TDS)	APHA-2540 C	mg/l	1.0	2767.0	3500
Biological Oxygen Demand	APHA, 5210	mg/l	2.0	8.6	80
Chemical Oxygen Demand	APHA-5220 D	mg/l	5.0	25.0	150
Total Suspended Solids	APHA-2540 D	mg/l	5.0	31.0	200
Oil & Grease	USEPA-1664	mg/l	10.0	<10.0	10
Turbidity	APHA-2130 B	NTU	5.0	5.0	-
Dissolved Oxygen	APHA-4500-O	mg/l	-	6.4	-
Pesticides	APHA-6630-B	mg/l	-	ND	0.15
Potasium	APHA-3500-K-B	mg/l	-	ND	-
Nitrogen	APHA-4500 Norg	mg/l	-	ND	-
Phosphorous	APHA-4500-P C	mg/l	0.03	<0.03	-
Phenolic Compound	APHA-5530 D	mg/l	0.001	<0.001	0.1
Chloride (Cl)	APHA-4500Cl- B	mg/l	0.5	287.51	1000
Fluoride (F)	APHA-4500F- C	mg/l	0.01	<0.01	10
Cyanide (Cn)	APHA-4500CN F	mg/l	0.01	<0.01	1.0
Detergents	APHA-5540- C	mg/l	-	ND	-
Sulphate	APHA-4500-SO_4-C	mg/l	0.41	1506.45	600
Sulphide	APHA-4500-S_2 E	mg/l	-	ND	1.0
Ammonia	APHA-4500-NH_3 B	mg/l	0.002	<0.002	40
Chlorine	APHA-4500Cl G	mg/l	1.0	<1.0	-
Cadmium	APHA-3500Cd B	mg/l	0.01	<0.01	0.1
Chromium	APHA-3500Cr B	mg/l	0.01	<0.01	1.0
Copper	APHA-3500Cu B	mg/l	0.5	<0.5	1.0
Lead	APHA-3500-Pb B	mg/l	0.01	<0.01	0.5
Mercury	APHA-3500-Hg B	mg/l	0.001	<0.001	0.01
Nickel	APHA-3500-Ni B	mg/l	0.01	<0.01	1.0
Zinc	APHA-3500-Zn B	mg/l	0.5	<0.5	5.0
Arsenic	APHA-3500As B	mg/l	0.01	<0.01	1.0
Silver	APHA-3500Ag B	mg/l	0.01	<0.01	1.0
Barium	APHA-3500Ba B	mg/l	0.1	<0.1	1.5
Manganese	APHA-3500-Mn B	mg/l	0.1	<0.1	1.5
Iron	APHA-3500-Fe B	mg/l	-	0.83	8.0
Boron	APHA-4500B C	mg/l	0.1	<0.1	6.0
Selenium	APHA-3500Se C	mg/l	0.005	<0.05	0.5
Total Toxic Metal	-	mg/l	-	0.83	-

Abbreviations:

ND: Not Detected **LOR:** Limit of Reporting **NEQS:** National Environmental Quality Standard

Note:

**The effluent should not result in temperature increase of more than 30 °C at the edge of the zone where initial mixing and dilution take place in receiving body. In case zone is not defined use 100 meters from the point of discharge.*

*******Uncertainty of all the parameters and laboratory conditions at the time of analysis will be provided as per clients requirement*

QA/QC

Monitoring Location # 1
HANZEL PAINE

Green Crescent
Environmental Consultants (Pvt) Ltd.

Punjab-EPA Certified
Lahore Laboratory
Federal-EPA Certified
Islamabad Laboratory

Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Hanzel Paine
Date of Intervention	17-Sep-17 to 18-Sep-17
Time of Intervention	11:00 AM to 10:00 AM
Sampling Coordinates	35°57' 40.8 N 74°12' 31.6 E

Sr. #	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)
1	11:00	0.33	0.27	1.38	1.65	0.59	36.18	12.59
2	12:00	0.26	0.21	1.24	1.45	0.49	35.45	12.15
3	13:00	0.25	0.17	1.15	1.32	0.43	34.95	12.22
4	14:00	0.23	0.13	1.05	1.18	0.37	34.46	12.67
5	15:00	0.46	0.74	2.41	3.15	1.29	41.59	13.11
6	16:00	0.44	0.69	2.31	3.00	1.22	41.09	12.48
7	17:00	0.42	0.64	2.21	2.85	1.15	40.59	13.32
8	18:00	0.40	0.59	2.11	2.70	1.08	40.09	13.97
9	19:00	0.38	0.55	2.02	2.57	1.01	39.60	13.27
10	20:00	0.36	0.51	1.92	2.43	0.95	39.10	13.42
11	21:00	0.35	0.46	1.83	2.29	0.89	38.61	13.22
12	22:00	0.32	0.42	1.74	2.16	0.82	38.11	12.67
13	23:00	0.31	0.38	1.64	2.02	0.76	37.62	12.95
14	00:00	0.30	0.35	1.55	1.90	0.70	37.13	12.44
15	01:00	0.29	0.31	1.47	1.78	0.64	36.65	13.15
16	02:00	0.28	0.26	1.37	1.63	0.58	36.15	13.17
17	03:00	0.27	0.23	1.28	1.51	0.52	35.66	13.63
18	04:00	0.24	0.19	1.19	1.38	0.46	35.17	13.51
19	05:00	0.34	0.14	1.09	1.23	0.39	34.67	12.95
20	06:00	0.45	0.75	2.45	3.20	1.31	41.80	12.86
21	07:00	0.40	0.16	1.12	1.28	0.41	34.82	12.52
22	08:00	0.26	0.20	1.21	1.41	0.48	35.26	13.12
23	09:00	0.41	0.60	2.09	2.69	1.07	39.91	13.25
24	10:00	0.31	0.35	1.53	1.88	0.70	36.94	13.33
Average Concentration		**0.34**	**0.39**	**1.64**	**2.03**	**0.76**	**37.57**	**13.00**

E(QA)

Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Hanzel Paine
Date of Intervention	17-Sep-17 to 18-Sep-17
Time of Intervention	11:00 AM to 10:00 AM
Sampling Coordinates	35°57' 40.8 N 74°12' 31.6 E

Parameter	Unit	Monitoring Duration	LDL	Average Obtained Concentration	NEQS
Nitrogen Dioxide (NO_2)	µg/m³	24Hours	1.00	1.64	80.0
Nitrogen oxide (NO)	µg/m³	24Hours	1.00	0.39	40.0
NO_X	µg/m³	24Hours	1.00	2.03	120.0
Sulphur Dioxide (SO_2)	µg/m³	24 Hours	1.00	0.76	120.0
Carbon Monoxide (CO)	mg/m³	08 Hours	0.01	0.34	05.0
Carbon Dioxide (CO_2)	ppm	24 Hours	1.00	401.0	-
Particulate Matter (PM_{10})	µg/m³	24 Hours	1.00	37.57	150.0
Particulate Matter ($PM_{2.5}$)	µg/m³	24 Hours	1.00	13.00	35.0
Suspended Particulate Matter	µg/m³	24 Hours	1.00	50.57	185.0
Volatile Organic Compound	ppm	24 Hours	0.01	0.19	-
Ozone	µg/m³	1 Hour	1.00	3.62	130.0

Abbreviations:
LDL= Lowest Detection Limit
NEQS= National Environmental Quality Standards
µg/m³= Micrograms per Cubic Meter

E(QA)

Meteorological Data

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Hanzel Paine
Date of Intervention	17-Sep-17 to 18-Sep-17
Time of Intervention	11:00 AM to 10:00 AM
Sampling Coordinates	35°57' 40.8 N 74°12' 31.6 E

Time	Ambient Temperature ^{0}C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
11:00	18	N	12.6	33	630.1
12:00	18	N	9.6	41	630.8
13:00	17	N	9.4	42	631.3
14:00	16	N	11.3	44	631.9
15:00	17	N	11.6	46	631.6
16:00	17	N	9.6	51	631.2
17:00	15	N	10.6	55	631.0
18:00	11	N	9.2	56	631.1
19:00	10	NE	8.0	59	632.8
20:00	10	NE	7.1	60	632.4
21:00	9	NE	5.8	63	632.7
22:00	10	N	4.6	82	632.2
23:00	10	N	3.3	83	632.3
00:00	9	N	6.0	89	632.1
01:00	9	NE	9.1	89	633.7
02:00	9	NE	4.7	73	632.8
03:00	8	NE	5.3	78	632.6
04:00	7	NE	3.2	76	632.3
05:00	8	NE	7.9	81	631.0
06:00	10	NE	12.6	84	631.9
07:00	13	N	11.4	72	631.8
08:00	15	N	11.1	72	630.1
09:00	15	N	14.3	64	630.6
10:00	16	N	9.6	63	630.4

E(QA)

NOISE LEVEL MONITORING REPORT

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Hanzel Paine
Date of Intervention	17-Sep-17 to 18-Sep-17
Time of Intervention	11:00 AM to 10:00 AM
Sampling Coordinates	35°57' 40.8 N 74°12' 31.6 E

Sr. #	Time	Method/Technique	Unit	Results LAavg	NEQS
Night Time					
1.	23:00	Noise Meter	dB	46.2	55.0
2.	00:00	Noise Meter	dB	42.8	
3.	01:00	Noise Meter	dB	40.6	
4.	02:00	Noise Meter	dB	41.4	
5.	03:00	Noise Meter	dB	43.1	
6.	04:00	Noise Meter	dB	44.6	
7.	05:00	Noise Meter	dB	46.9	
8.	06:00	Noise Meter	dB	49.7	
Night Time Average			**dB**	**44.41**	**55.0**
Day Time					
9.	07:00	Noise Meter	dB	51.4	65.0
10.	08:00	Noise Meter	dB	53.6	
11.	09:00	Noise Meter	dB	50.3	
12.	10:00	Noise Meter	dB	56.4	
13.	11:00	Noise Meter	dB	44.3	
14.	12:00	Noise Meter	dB	43.1	
15.	13:00	Noise Meter	dB	51.6	
16.	14:00	Noise Meter	dB	54.0	
17.	15:00	Noise Meter	dB	53.2	
18.	16:00	Noise Meter	dB	49.3	
19.	17:00	Noise Meter	dB	46.1	
20.	18:00	Noise Meter	dB	43.4	
21.	19:00	Noise Meter	dB	41.9	
22.	20:00	Noise Meter	dB	48.8	
23.	21:00	Noise Meter	dB	43.6	
24.	22:00	Noise Meter	dB	42.6	
Day Time Average			**dB**	**48.35**	**65.0**

E(QA)

Monitoring Location # 2
HANZEL BALA

Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Hanzel Bala
Date of Intervention	18-Sep-17 to 19-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°58' 10.1 N 74°12' 10.8 E

Sr. #	Time	CO (mg/m^3)	NO (µg/m^3)	NO_2 (µg/m^3)	NO_x (µg/m^3)	SO_2 (µg/m^3)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)
1	12:00	0.35	0.44	1.76	2.20	0.85	36.23	11.41
2	13:00	0.24	0.14	1.09	1.23	0.39	34.63	11.93
3	14:00	0.29	0.28	1.39	1.67	0.60	36.21	11.99
4	15:00	0.46	0.75	2.44	3.19	1.31	41.76	12.17
5	16:00	0.27	0.24	1.29	1.53	0.53	35.72	12.33
6	17:00	0.44	0.70	2.34	3.04	1.24	41.26	12.14
7	18:00	0.26	0.19	1.20	1.39	0.47	35.22	12.54
8	19:00	0.42	0.65	2.24	2.89	1.17	40.76	12.45
9	20:00	0.25	0.15	1.11	1.26	0.41	34.73	12.75
10	21:00	0.40	0.61	2.15	2.76	1.10	40.27	12.31
11	22:00	0.23	0.11	1.01	1.12	1.04	34.23	12.29
12	23:00	0.39	0.57	2.06	2.63	1.25	39.77	12.75
13	00:00	0.45	0.71	2.36	3.07	0.97	41.36	12.33
14	01:00	0.37	0.52	1.96	2.48	0.73	39.27	12.00
15	02:00	0.32	0.37	1.58	1.95	0.36	37.24	12.12
16	03:00	0.28	0.12	1.04	1.16	1.07	34.35	12.67
17	04:00	0.41	0.59	2.10	2.69	0.49	40.01	12.37
18	05:00	0.30	0.22	1.23	1.45	0.69	35.25	12.82
19	06:00	0.34	0.34	1.52	1.86	0.43	36.83	12.34
20	07:00	0.31	0.18	1.13	1.31	0.64	34.76	12.42
21	08:00	0.36	0.32	1.44	1.76	0.35	36.35	12.33
22	09:00	0.33	0.13	1.02	1.15	0.59	34.25	12.29
23	10:00	0.38	0.30	1.35	1.65	1.26	35.85	12.64
24	11:00	0.43	0.72	2.37	3.09	0.78	41.37	12.28
Average Concentration		**0.35**	**0.39**	**1.63**	**2.02**	**1.63**	**37.40**	**12.32**

____
E(QA)

Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Hanzel Bala
Date of Intervention	18-Sep-17 to 19-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°58' 10.1 N 74°12' 10.8 E

Parameter	Unit	Monitoring Duration	LDL	Average Obtained Concentration	NEQS
Nitrogen Dioxide (NO_2)	µg/m³	24Hours	1.00	1.63	80.0
Nitrogen oxide (NO)	µg/m³	24Hours	1.00	0.39	40.0
NO_X	µg/m³	24Hours	1.00	2.02	120.0
Sulphur Dioxide (SO_2)	µg/m³	24 Hours	1.00	1.63	120.0
Carbon Monoxide (CO)	mg/m³	24 Hours	0.01	0.35	05.0
Carbon Dioxide (CO_2)	ppm	24 Hours	1.00	408.0	-
Particulate Matter (PM_{10})	µg/m³	24 Hours	1.00	37.40	150.0
Particulate Matter ($PM_{2.5}$)	µg/m³	24 Hours	1.00	12.32	35.0
Suspended Particulate Matter	µg/m³	24 Hours	1.00	49.70	185.0
Volatile Organic Compound	ppm	24 Hours	0.01	0.15	-
Ozone	µg/m³	1 Hour	1.00	3.59	130.0

Abbreviations:
LDL= Lowest Detection Limit
NEQS= National Environmental Quality Standards
µg/m³= Micrograms per Cubic Meter

E(QA)

Meteorological Data

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Hanzel Bala
Date of Intervention	18-Sep-17 to 19-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°58' 10.1 N 74°12' 10.8 E

Time	Ambient Temperature ⁰C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
12:00	29	N	2.9	31	630.2
13:00	29	N	4.5	34	630.8
14:00	28	N	8.7	40	630.4
15:00	27	N	7.9	42	631.0
16:00	26	N	6.3	45	631.7
17:00	21	NW	3.1	48	631.6
18:00	22	NW	2.8	48	631.3
19:00	22	NW	1.9	51	631.0
20:00	19	NW	6.1	58	632.9
21:00	19	NW	4.7	60	632.4
22:00	17	NW	2.3	74	632.8
23:00	17	NW	3.6	73	632.7
00:00	16	N	4.4	76	632.1
01:00	15	N	2.2	79	632.2
02:00	15	N	1.0	83	632.3
03:00	11	N	0.8	84	632.4
04:00	11	N	6.1	86	631.8
05:00	11	NW	9.9	90	631.2
06:00	16	NW	8.7	79	632.4
07:00	17	NW	3.6	76	632.8
08:00	20	NW	7.2	62	633.3
09:00	24	NW	9.3	55	633.0
10:00	25	NW	6.6	49	633.6
11:00	27	NW	8.4	38	633.4

E(QA)

Green Crescent
Environmental Consultants (Pvt) Ltd.

Punjab-EPA Certified
Lahore Laboratory
Federal-EPA Certified
Islamabad Laboratory

NOISE LEVEL MONITORING REPORT

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Hanzel Bala
Date of Intervention	18-Sep-17 to 19-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°58' 10.1 N 74°12' 10.8 E

Sr. #	Time	Method/Technique	Unit	Results LAavg	NEQS
Night Time					
1.	23:00	Noise Meter	dB	44.9	55.0
2.	00:00	Noise Meter	dB	44.6	
3.	01:00	Noise Meter	dB	49.4	
4.	02:00	Noise Meter	dB	46.8	
5.	03:00	Noise Meter	dB	48.1	
6.	04:00	Noise Meter	dB	49.2	
7.	05:00	Noise Meter	dB	46.3	
8.	06:00	Noise Meter	dB	49.4	
Night Time Average			**dB**	**47.34**	**55.0**
Day Time					
9.	07:00	Noise Meter	dB	54.8	65.0
10.	08:00	Noise Meter	dB	51.1	
11.	09:00	Noise Meter	dB	56.2	
12.	10:00	Noise Meter	dB	51.3	
13.	11:00	Noise Meter	dB	50.4	
14.	12:00	Noise Meter	dB	55.1	
15.	13:00	Noise Meter	dB	54.6	
16.	14:00	Noise Meter	dB	53.3	
17.	15:00	Noise Meter	dB	64.9	
18.	16:00	Noise Meter	dB	60.0	
19.	17:00	Noise Meter	dB	54.6	
20.	18:00	Noise Meter	dB	60.4	
21.	19:00	Noise Meter	dB	51.8	
22.	20:00	Noise Meter	dB	58.2	
23.	21:00	Noise Meter	dB	51.3	
24.	22:00	Noise Meter	dB	45.7	
Day Time Average			**dB**	**54.61**	**65.0**

E(QA)

Monitoring Location # 3 BEFORE WEIR SITE NEAR HARPON VILLAGE

Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Before Weir Site Near Harpon Village
Date of Intervention	19-Sep-17 to 20-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°59' 49.7 N 74°12' 24.5 E

Sr. #	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
1	12:00	0.31	0.56	2.02	1.29	1.02	39.54	10.91
2	13:00	0.24	0.16	1.12	0.64	0.41	34.82	11.05
3	14:00	0.23	0.12	1.03	0.58	0.35	34.33	11.21
4	15:00	0.45	0.72	2.39	1.56	1.27	41.46	10.16
5	16:00	0.43	0.68	2.29	1.49	1.20	40.96	11.01
6	17:00	0.41	0.63	2.19	1.41	1.13	40.46	10.93
7	18:00	0.39	0.58	2.09	1.34	1.06	39.96	10.85
8	19:00	0.37	0.53	1.98	1.26	0.99	39.45	10.97
9	20:00	0.36	0.48	1.88	1.18	0.92	38.96	11.58
10	21:00	0.34	0.44	1.79	1.12	0.86	38.46	11.78
11	22:00	0.25	0.13	1.04	0.59	0.36	34.37	11.96
12	23:00	0.46	0.73	2.40	1.57	1.28	41.49	12.00
13	00:00	0.42	0.67	2.28	1.48	1.19	40.99	12.03
14	01:00	0.40	0.61	2.18	1.40	1.12	40.48	12.11
15	02:00	0.35	0.55	2.07	1.31	1.04	39.98	12.09
16	03:00	0.33	0.50	1.96	1.23	0.96	39.47	12.35
17	04:00	0.32	0.45	1.86	1.16	0.89	38.97	12.25
18	05:00	0.29	0.41	1.76	1.09	0.82	38.47	12.78
19	06:00	0.30	0.37	1.67	1.02	0.77	37.97	12.67
20	07:00	0.28	0.34	1.59	0.97	0.71	37.48	12.39
21	08:00	0.27	0.30	1.50	0.90	0.66	37.00	12.59
22	09:00	0.26	0.27	1.42	0.85	0.60	36.51	12.32
23	10:00	0.38	0.24	1.33	0.79	0.55	36.03	12.58
24	11:00	0.44	0.21	1.25	0.73	0.50	35.55	12.87
Average Concentration		**0.35**	**0.45**	**1.80**	**1.12**	**0.86**	**38.47**	**11.81**

E(QA)

Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Before Weir Site Near Harpon Village
Date of Intervention	19-Sep-17 to 20-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°59' 49.7 N 74°12' 24.5 E

Parameter	Unit	Monitoring Duration	LDL	Average Obtained Concentration	NEQS
Nitrogen Dioxide (NO_2)	µg/m³	24Hours	1.00	1.80	80.0
Nitrogen oxide (NO)	µg/m³	24Hours	1.00	0.45	40.0
NO_X	µg/m³	24Hours	1.00	1.12	120.0
Sulphur Dioxide (SO_2)	µg/m³	24 Hours	1.00	0.86	120.0
Carbon Monoxide (CO)	mg/m³	24 Hours	0.01	0.35	05.0
Carbon Dioxide (CO_2)	ppm	24 Hours	1.00	410.0	-
Particulate Matter (PM_{10})	µg/m³	24 Hours	1.00	38.47	150.0
Particulate Matter ($PM_{2.5}$)	µg/m³	24 Hours	1.00	11.81	35.0
Suspended Particulate Matter	µg/m³	24 Hours	1.00	50.27	185.0
Volatile Organic Compound	ppm	24 Hours	0.01	0.24	-
Ozone	µg/m³	1 Hour	1.00	4.05	130.0

Abbreviations:
LDL= Lowest Detection Limit
NEQS= National Environmental Quality Standards
µg/m³= Micrograms per Cubic Meter

E(QA)

Meteorological Data

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Before Weir Site Near Harpon Village
Date of Intervention	19-Sep-17 to 20-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°59' 49.7 N 74°12' 24.5 E

Time	Ambient Temperature ^{0}C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
12:00	26	N	4.2	38	633.4
13:00	27	N	6.8	41	633.9
14:00	26	N	3.1	44	633.2
15:00	28	N	2.3	43	633.4
16:00	24	N	1.9	41	632.8
17:00	22	N	8.8	49	632.7
18:00	21	NE	4.1	53	632.3
19:00	19	NE	6.2	56	632.6
20:00	19	NE	2.3	61	631.1
21:00	17	NE	1.6	63	631.2
22:00	17	NE	3.4	64	631.4
23:00	17	NE	1.2	61	631.8
00:00	14	NE	3.3	65	631.1
01:00	14	N	1.9	67	631.6
02:00	15	N	2.0	71	632.3
03:00	12	N	4.6	78	632.9
04:00	11	N	6.2	81	6328
05:00	10	N	8.4	83	632.7
06:00	16	NE	2.8	71	632.1
07:00	18	NE	1.1	63	633.2
08:00	21	NE	6.3	48	633.4
09:00	20	NE	3.6	41	633.3
10:00	23	NE	4.4	38	633.6
11:00	26	NE	9.2	33	633.4

E(QA)

Green Crescent
Environmental Consultants (Pvt) Ltd.

Punjab-EPA Certified
Lahore Laboratory
Federal-EPA Certified
Islamabad Laboratory

NOISE LEVEL MONITORING REPORT

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Before Weir Site Near Harpon Village
Date of Intervention	19-Sep-17 to 20-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°59' 49.7 N 74°12' 24.5 E

Sr. #	Time	Method/Technique	Unit	Results LAavg	NEQS
Night Time					
1.	23:00	Noise Meter	dB	43.6	55.0
2.	00:00	Noise Meter	dB	44.1	
3.	01:00	Noise Meter	dB	43.6	
4.	02:00	Noise Meter	dB	46.2	
5.	03:00	Noise Meter	dB	49.4	
6.	04:00	Noise Meter	dB	48.7	
7.	05:00	Noise Meter	dB	51.9	
8.	06:00	Noise Meter	dB	53.1	
Night Time Average			**dB**	**47.58**	**55.0**
Day Time					
9.	07:00	Noise Meter	dB	49.2	65.0
10.	08:00	Noise Meter	dB	55.4	
11.	09:00	Noise Meter	dB	56.3	
12.	10:00	Noise Meter	dB	58.6	
13.	11:00	Noise Meter	dB	51.2	
14.	12:00	Noise Meter	dB	46.1	
15.	13:00	Noise Meter	dB	54.3	
16.	14:00	Noise Meter	dB	53.8	
17.	15:00	Noise Meter	dB	51.0	
18.	16:00	Noise Meter	dB	53.1	
19.	17:00	Noise Meter	dB	51.3	
20.	18:00	Noise Meter	dB	46.9	
21.	19:00	Noise Meter	dB	43.7	
22.	20:00	Noise Meter	dB	46.2	
23.	21:00	Noise Meter	dB	41.4	
24.	22:00	Noise Meter	dB	40.3	
Day Time Average			**dB**	**49.93**	**65.0**

E(QA)

Monitoring Location # 4 AFTER WEIR SITE NEAR BARBUCH

Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-147/17
Monitoring Point	After Weir Site Near Barbuch
Date of Intervention	20-Sep-17 to 21-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°58' 39.1 N 74°11' 58.3 E

Sr. #	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)
1	12:00	0.30	0.31	1.45	1.76	0.64	36.57	17.78
2	13:00	0.33	0.39	1.63	2.02	0.76	37.45	17.97
3	14:00	0.28	0.27	1.37	1.64	0.58	36.17	18.11
4	15:00	0.24	0.16	1.13	1.29	0.42	34.90	18.29
5	16:00	0.35	0.38	1.60	1.98	0.74	37.28	18.39
6	17:00	0.29	0.26	1.34	1.60	0.56	35.99	18.75
7	18:00	0.38	0.49	1.82	2.31	0.90	38.38	18.67
8	19:00	0.34	0.36	1.57	1.93	0.72	37.09	18.99
9	20:00	0.42	0.58	2.03	2.61	1.03	39.47	19.21
10	21:00	0.37	0.47	1.78	2.25	0.87	38.20	19.34
11	22:00	0.31	0.34	1.52	1.86	0.69	36.90	19.33
12	23:00	0.41	0.56	1.99	2.55	1.01	39.29	19.42
13	00:00	0.36	0.45	1.75	2.20	0.84	38.01	19.47
14	01:00	0.44	0.65	2.20	2.85	1.15	40.38	19.85
15	02:00	0.40	0.54	1.95	2.49	0.98	39.10	19.75
16	03:00	0.32	0.42	1.70	2.12	0.81	37.82	19.45
17	04:00	29.00	0.64	2.17	2.81	1.13	40.20	19.27
18	05:00	0.39	0.52	1.91	2.43	0.95	38.91	19.06
19	06:00	0.46	0.72	2.36	3.08	1.26	41.28	19.58
20	07:00	0.27	0.61	2.12	2.73	1.09	40.00	20.13
21	08:00	0.23	0.14	1.09	1.23	0.39	34.72	20.15
22	09:00	0.43	0.70	2.32	3.02	1.23	41.09	20.37
23	10:00	0.26	0.59	2.08	2.67	1.06	39.81	20.18
24	11:00	0.25	0.12	1.06	1.18	0.37	34.54	20.22
Average Concentration		**1.53**	**0.44**	**1.75**	**2.19**	**0.84**	**30.06**	**19.24**

E(QA)

Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-147/17
Monitoring Point	After Weir Site Near Barbuch
Date of Intervention	20-Sep-17 to 21-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°58' 39.1 N 74°11' 58.3 E

Parameter	Unit	Monitoring Duration	LDL	Average Obtained Concentration	NEQS
Nitrogen Dioxide (NO_2)	µg/m³	24Hours	1.00	1.75	80.0
Nitrogen oxide (NO)	µg/m³	24Hours	1.00	0.44	40.0
NO_X	µg/m³	24Hours	1.00	2.19	120.0
Sulphur Dioxide (SO_2)	µg/m³	24 Hours	1.00	0.84	120.0
Carbon Monoxide (CO)	mg/m³	24 Hours	0.01	1.53	05.0
Carbon Dioxide (CO_2)	ppm	24 Hours	1.00	405.0	-
Particulate Matter (PM_{10})	µg/m³	24 Hours	1.00	38.06	150.0
Particulate Matter ($PM_{2.5}$)	µg/m³	24 Hours	1.00	19.24	35.0
Suspended Particulate Matter	µg/m³	24 Hours	1.00	57.26	185.0
Volatile Organic Compound	ppm	24 Hours	0.01	0.20	-
Ozone	µg/m³	1 Hour	1.00	3.87	130.0

Abbreviations:
LDL= Lowest Detection Limit
NEQS= National Environmental Quality Standards
µg/m³= Micrograms per Cubic Meter

E(QA)

Meteorological Data

Job Reference Number	GCEC-PK-147/17
Monitoring Point	After Weir Site Near Barbuch
Date of Intervention	20-Sep-17 to 21-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°58' 39.1 N 74°11' 58.3 E

Time	Ambient Temperature °C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
12:00	26	NE	0.9	30	627.7
13:00	24	NE	1.8	29	630.5
14:00	37	N	2.2	14	630.1
15:00	34	N	3.1	15	629.9
16:00	28	N	1.4	23	629.8
17:00	26	N	1.6	28	629.0
18:00	23	NE	1.3	43	628.4
19:00	22	NE	0.6	47	628.0
20:00	21	NE	1.5	49	628.5
21:00	19	NE	0.8	54	628.5
22:00	19	N	0.5	62	628.5
23:00	18	N	0.9	62	628.6
00:00	18	NW	0.9	63	628.8
01:00	18	NW	1.8	61	629.3
02:00	16	NW	1.3	73	629.4
03:00	17	NW	1.8	70	629.6
04:00	17	N	1.4	70	630.0
05:00	17	N	0.5	69	630.5
06:00	16	N	0.9	66	630.9
07:00	16	N	1.3	65	631.4
08:00	18	NW	1.3	70	631.5
09:00	22	NW	2.7	67	631.6
10:00	29	NW	1.8	50	631.3
11:00	30	NW	2.7	37	631.5

E(QA)

NOISE LEVEL MONITORING REPORT

Job Reference Number	GCEC-PK-147/17
Monitoring Point	After Weir Site Near Barbuch
Date of Intervention	20-Sep-17 to 21-Sep-17
Time of Intervention	12:00 PM to 11:00 AM
Sampling Coordinates	35°58' 39.1 N 74°11' 58.3 E

Sr. #	Time	Method/Technique	Unit	Results LAavg	NEQS
Night Time					
1.	23:00	Noise Meter	dB	59.1	55.0
2.	00:00	Noise Meter	dB	48.7	
3.	01:00	Noise Meter	dB	43.6	
4.	02:00	Noise Meter	dB	48.3	
5.	03:00	Noise Meter	dB	47.2	
6.	04:00	Noise Meter	dB	51.4	
7.	05:00	Noise Meter	dB	54.8	
8.	06:00	Noise Meter	dB	54.2	
Night Time Average			**dB**	**50.91**	**55.0**
Day Time					
9.	07:00	Noise Meter	dB	52.3	65.0
10.	08:00	Noise Meter	dB	51.9	
11.	09:00	Noise Meter	dB	59.6	
12.	10:00	Noise Meter	dB	55.1	
13.	11:00	Noise Meter	dB	53.0	
14.	12:00	Noise Meter	dB	49.6	
15.	13:00	Noise Meter	dB	51.2	
16.	14:00	Noise Meter	dB	53.8	
17.	15:00	Noise Meter	dB	56.4	
18.	16:00	Noise Meter	dB	54.2	
19.	17:00	Noise Meter	dB	51.4	
20.	18:00	Noise Meter	dB	59.0	
21.	19:00	Noise Meter	dB	52.1	
22.	20:00	Noise Meter	dB	58.2	
23.	21:00	Noise Meter	dB	54.4	
24.	22:00	Noise Meter	dB	52.8	
Day Time Average			**dB**	**54.06**	**65.0**

E(QA)

Monitoring Location # 5
NEAR GIRLS SCHOOL IN HANZEL PAINE

Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Near Girls School in Haznel Paine
Date of Intervention	21-Sep-17 to 22-Sep-17
Time of Intervention	11:30 AM to 10:30 AM
Sampling Coordinates	35°57' 27.6 N 74°12' 32.8 E

Sr. #	Time	CO (mg/m^3)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)
1	11:30	0.24	0.14	1.07	1.21	0.38	34.57	9.15
2	12:30	0.31	0.32	1.49	1.81	0.66	36.70	9.86
3	13:30	0.27	0.22	1.24	1.46	0.50	35.43	9.75
4	14:30	0.35	0.43	1.70	2.13	0.81	37.80	9.27
5	15:30	0.32	0.31	1.45	1.76	0.64	36.52	9.08
6	16:30	0.39	0.52	1.91	2.43	0.96	38.90	9.17
7	17:30	0.36	0.41	1.66	2.07	0.79	37.62	9.43
8	18:30	0.29	0.29	1.41	1.70	0.61	36.33	9.87
9	19:30	0.40	0.51	1.88	2.39	0.94	38.72	9.99
10	20:30	0.34	0.39	1.63	2.02	0.76	37.43	10.10
11	21:30	0.43	0.61	2.09	2.70	1.08	39.81	10.18
12	22:30	0.38	0.49	1.84	2.33	0.91	38.53	10.38
13	23:30	0.30	0.37	1.58	1.95	0.73	37.24	10.47
14	00:30	0.42	0.59	2.06	2.65	1.06	39.63	10.58
15	01:30	0.37	0.47	1.80	2.27	0.88	38.34	10.69
16	02:30	0.45	0.68	2.26	2.94	1.19	40.72	10.94
17	03:30	0.41	0.57	2.02	2.59	1.03	39.44	11.23
18	04:30	0.46	0.75	2.45	3.20	1.31	41.78	11.11
19	05:30	0.33	0.65	2.22	2.87	1.16	40.52	10.96
20	06:30	0.28	0.54	1.97	2.51	0.99	39.24	10.85
21	07:30	0.44	0.73	2.41	3.14	1.28	41.60	10.59
22	08:30	0.26	0.63	2.17	2.80	1.12	40.33	10.64
23	09:30	0.23	0.16	1.15	1.31	0.43	35.06	10.74
24	10:30	0.25	0.71	2.37	3.08	1.25	41.41	10.48
Average Concentration		**0.35**	**0.48**	**1.83**	**2.31**	**0.89**	**38.49**	**10.23**

E(QA)

Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Near Girls School in Haznel Paine
Date of Intervention	21-Sep-17 to 22-Sep-17
Time of Intervention	11:30 AM to 10:30 AM
Sampling Coordinates	35°57' 27.6 N 74°12' 32.8 E

Parameter	Unit	Monitoring Duration	LDL	Average Obtained Concentration	NEQS
Nitrogen Dioxide (NO_2)	µg/m³	24Hours	1.00	1.83	80.0
Nitrogen oxide (NO)	µg/m³	24Hours	1.00	0.48	40.0
NO_X	µg/m³	24Hours	1.00	2.31	120.0
Sulphur Dioxide (SO_2)	µg/m³	24 Hours	1.00	0.89	120.0
Carbon Monoxide (CO)	mg/m³	24 Hours	0.01	0.35	05.0
Carbon Dioxide (CO_2)	ppm	24 Hours	1.00	404.0	-
Particulate Matter (PM_{10})	µg/m³	24 Hours	1.00	38.49	150.0
Particulate Matter ($PM_{2.5}$)	µg/m³	24 Hours	1.00	10.23	35.0
Suspended Particulate Matter	µg/m³	24 Hours	1.00	48.72	185.0
Volatile Organic Compound	ppm	24 Hours	0.01	0.18	-
Ozone	µg/m³	1 Hour	1.00	4.08	130.0

Abbreviations:
LDL= Lowest Detection Limit
NEQS= National Environmental Quality Standards
µg/m³= Micrograms per Cubic Meter

E(QA)

Meteorological Data

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Near Girls School in Haznel Paine
Date of Intervention	21-Sep-17 to 22-Sep-17
Time of Intervention	11:30 AM to 10:30 AM
Sampling Coordinates	35°57' 27.6 N 74°12' 32.8 E

Time	Ambient Temperature °C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
11:30	30	N	0.9	37	630.8
12:30	29	N	4.6	34	630.2
13:30	27	N	3.4	35	630.3
14:30	23	N	2.2	46	630.6
15:30	26	N	1.0	41	629.4
16:30	20	NE	0.9	45	629.9
17:30	19	NE	0.8	42	629.4
18:30	17	NE	4.3	55	629.6
19:30	17	NE	3.9	55	629.1
20:30	16	NE	2.6	61	628.2
21:30	17	N	1.4	63	628.3
22:30	17	N	0.8	64	628.8
23:30	16	E	0.6	70	628.4
00:30	16	E	4.9	72	628.9
01:30	17	SE	2.8	71	628.2
02:30	19	SE	1.4	73	629.3
03:30	21	SE	0.6	75	629.8
04:30	23	SE	3.0	73	629.4
05:30	23	SE	1.3	74	629.2
06:30	21	E	1.9	78	630.3
07:30	22	E	4.2	63	630.6
08:30	19	E	3.4	47	631.9
09:30	26	E	1.6	36	631.8
10:30	24	E	0.4	43	631.9

E(QA)

Green Crescent
Environmental Consultants (Pvt) Ltd.

Punjab-EPA Certified
Lahore Laboratory
Federal-EPA Certified
Islamabad Laboratory

NOISE LEVEL MONITORING REPORT

Job Reference Number	GCEC-PK-147/17
Monitoring Point	Near Girls School in Haznel Paine
Date of Intervention	21-Sep-17 to 22-Sep-17
Time of Intervention	11:30 AM to 10:30 AM
Sampling Coordinates	35°57' 27.6 N 74°12' 32.8 E

Sr. #	Time	Method/Technique	Unit	Results LAavg	NEQS
Night Time					
1.	23:30	Noise Meter	dB	43.0	55.0
2.	00:30	Noise Meter	dB	40.0	
3.	01:30	Noise Meter	dB	40.0	
4.	02:30	Noise Meter	dB	41.0	
5.	03:30	Noise Meter	dB	40.0	
6.	04:30	Noise Meter	dB	42.0	
7.	05:30	Noise Meter	dB	46.0	
8.	06:30	Noise Meter	dB	49.0	
Night Time Average			**dB**	**42.63**	**55.0**
Day Time					
9.	07:30	Noise Meter	dB	51.0	65.0
10.	08:30	Noise Meter	dB	52.0	
11.	09:30	Noise Meter	dB	51.0	
12.	10:30	Noise Meter	dB	58.0	
13.	11:30	Noise Meter	dB	61.0	
14.	12:30	Noise Meter	dB	58.0	
15.	13:30	Noise Meter	dB	55.0	
16.	14:30	Noise Meter	dB	58.0	
17.	15:30	Noise Meter	dB	54.0	
18.	16:30	Noise Meter	dB	53.0	
19.	17:30	Noise Meter	dB	49.0	
20.	18:30	Noise Meter	dB	43.0	
21.	19:30	Noise Meter	dB	44.0	
22.	20:30	Noise Meter	dB	46.0	
23.	21:30	Noise Meter	dB	49.0	
24.	22:30	Noise Meter	dB	48.0	
Day Time Average			**dB**	**51.88**	**65.0**

E(QA)

Annexure 3:

PICTORAL EVIDENCE OF MONITORING & SAMPLING

Pictorial Evidence for Monitoring (17th to 22nd Sep 2017)


aeroqual
AQM65


aeroqual
AQM65

Pictorial Evidence for Water Sampling (22nd Sep, 2017)

Annexure 4:

CALIBERATION CERTIFICATES

aeroqual

CALIBRATION CERTIFICATE

Client Name:	Green Crescent Environmental Consultants Pvt. Limited
Location:	112 C/E-1, Hali Road, Gulberg III, Lahore
Certificate Number:	10CP/3912
Instrument Type:	Ambient Air Quality Station
Model Number:	AQM65 – A65-SE-98-A-W-RPCOWS
Serial Number:	37201
Calibration Date:	June 26, 2017
Calibration Due Date:	June 25, 2018

Calibration Procedure

The instrument detail above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the latest versions of the international standards EN ISO/IEC 17025 CISPR-11 Radiated RF emission measurements CISPR-11 Mains Terminal RF emission measurements IEC-61000-3-3 Mains Terminal voltage fluctuation measurements IEC-61000-3-2 where applicable.

Calibration Climate Conditions

The climate test conditions were all maintained within the permitted limits of EN ISO/IEC 17025.

Temperature	19.9 ℃ ± 0.1 ℃	**Relative Humidity**	39.2% ± 1 %rH
Static Pressure:	974 hPa	**Ambient Noise level:**	45.1 dB

Measurement Results

Sr.	Module-ID	Reference Value	Actual Value	Signal Source/Equipment
1-	CO-17-1189	0.5 PPM	0.5 PPM	GasCAL Dilutor
		1.0 PPM	1.0 PPM	GasCAL Dilutor
		2.5 PPM	2.5 PPM	GasCAL Dilutor
		10.0 PPM	10.0 PPM	GasCAL Dilutor
2-	O3-17-1190	0.1 PPM	0.1 PPM	GasCAL - Ozonator
		0.45 PPM	0.45 PPM	GasCAL - Ozonator
		0.8 PPM	0.8 PPM	GasCAL - Ozonator
		1.0 PPM	1.0 PPM	GasCAL - Ozonator
3-	NOx-17-1191	0.5 PPM	0.5 PPM	GasCAL Dilutor
		1.0 PPM	1.0 PPM	GasCAL Dilutor
		5.0 PPM	5.0 PPM	GasCAL Dilutor
		10.0 PPM	10.0 PPM	GasCAL Dilutor
4-	SO2-17-1192	0.5 PPM	0.5 PPM	GasCAL Dilutor
		1.0 PPM	1.0 PPM	GasCAL Dilutor
		2.5 PPM	2.5 PPM	GasCAL Dilutor
		5.0 PPM	5.0 PPM	GasCAL Dilutor

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland 1026, New Zealand
Phone: +64 9 623 3013, Fax: +64 9 623 3012

5-	VOC-15-1193	0.08 PPM	0.09 PPM	GasCAL Dilutor
		0.52 PPM	0.52 PPM	GasCAL Dilutor
		1.04 PPM	1.05 PPM	GasCAL Dilutor
		1.51 PPM	1.54 PPM	GasCAL Dilutor
6	PM 2.5 Micron	Filtered Air = 0	Filtered Air = 0	Zero Air Filter
		Filtered Air = 0	Filtered Air = 0	Zero Air Filter
7	PM 10 Micron	Filtered Air = 0	Filtered Air = 0	Zero Air Filter
		Filtered Air = 0	Filtered Air = 0	Zero Air Filter

Note:
The measuring instruments are adjusted by a Calibrator 4 levels of adjustment by a GasCAL Dilutor & Cal Cylinders.

Calibrator Details

Manufacturer	Serial	Description
Honeywell Gases	332891	CO Cylinder
Honeywell Gases	330073	NOx Cylinder
Honeywell Gases	209681	SO2 Cylinder
Honeywell Gases	092794	Isobutylene Cylinder
Aeroqual	AQ-09451-QW	Ozonator
Aeroqual	PO23/842	PM 2.5 Filter
Aeroqual	PO24/901	PM 10 Filter

Verified by:

Morgan

Lee Morgan

Aeroqual Limited
460 Rosebank Road, Avondale, Auckland 1026, New Zealand
Phone: +64 9 623 3013, Fax: +64 9 623 3012

Certificate of Calibration

Certificate Number: 824596

Page: 1 of 1

Custometr Details:

Customer name: EXTECH INSTRUMENTS

Customer Number: 00024

Instrument Details:

Manufacturer:	Extech Instruments Corporation	**Date Received:**	September 30, 2015
Description:	Sound Level Meter	**Calibration Date:**	October 11, 2015
Model Number:	407730	**Calibration Due:**	October 11, 2017
Serial Number:	7526841	**Interval:**	12 Months

Environmental Details:

Temperature:	$21^{\circ}C \pm 5^{\circ}C$	**Measured value**	94db

Procedure Used:

Checking Procedure: CMM-15 dated July 1999 - QC.

Calibration Procedure: Calibrator

Certification

Extech Instruments certifies that the instrument listed above meets the specifications of the manufacturer at the completetion of its calibration.Standards used are traceable to the National Institute of Standards and Technology (NIST).or have been derived from accepted values,natural physical constants,or through the use of the ratio method of self-calibration techniques.Methods used are in accordance with ISO10012-1 and ANSI/NCSL ZS40-1-1994.This certificate is not to be reproduced other than in full,except with prior written approval of Extech Instruments Corporation.All the calibration standards used have an accuracy of 4:1 or better, unless otherwise staded.

Technical's Notes:

Technician: Murk Landry

Approved By: Rob Goozn.

Robert Godzoon
Calibration Lab Manager

ANNEX 5: NOTIFICATION OF COMMUNITY CONTROLLED HUNTING AREA

Ada
10/6/13

GOVERNMENT OF GILGIT-BALTISTAN
GILGIT-BALTISTAN SECRETARIAT
FOREST WILDLIFE AND ENVIRONMENT DEPARTMENT

Dated the 28th May, 2013

NOTIFICATION

No. FW&E – 4(10)F/2013: In exercise of powers conferred upon him under Section-5 of Gilgit Baltistan Wildlife Preservation Act 1975, the Chief Minister Gilgit-Baltistan has been pleased to declare following conservancies as Community Controlled Hunting Areas with details given below with immediate effect and till further order:-

S #	Name of Conservancy and Location.	Composition	Area	Coordinates	Physical boundaries
01.	Kargah Gilgit.	Kashrote, Majini Muhallah, Amphary, Basin, Napura, Kargah, Hanzal, Sharote and Shikiote.	254 KM	Lies in between 35.44' – 36.04' N and 73.58' - 74.18' E.	Gilgit River in North, Khanbari, Hudur and Khiner valleys Diamer in South, Jutial/Barmas in East and Gulapur/Biarchi in West.
02.	Sai Gilgit.	Sai Paeen, Damote, Sai Bala, Chakarkote, Sabil Balas, Gasho and Pahote.	326 KM	Lies in between 35.34' – 35.50' N and 74.12' – 74.36' E.	Jutial Conservancy in North, Goharabad Diamer in South, Indus River in East and Hudur and Khanbari Valleys Diamer in West.
03.	Nar-Ghoro Skardu	Area between Shigar Valley, Thalley Valley, Kiris Valley and Indus River.	21366 Hectare	Grid Reference North (76.01' – 40.251 E, 35.22' -11.251' N) East (75.58', 59.447' E, 35.19' – 58.944' N) South (75.52, 10.3533' E, 35.14', 45.097' N) West (75.46', 48.706' E, 35.18', 55.844' E)	The northern boundary of the CMCA follows the district boundary between Skardu and Ghanche. The eastern boundary of the CMCA starts from the district boundary between Skardu and Ghanche. The Southern boundary of the CMCA follows the River Indus and the western boundary of the area starts from Union Council boundary between Marapi UC and Nar Ghoro UC.

Supdt. I, Pl circulate it & all concerned for record Pl.
11/6/13

(Mir Zaman)
Section Officer (Forest)

Distribution

1. The Conservator Parks and Wildlife GB, Gilgit.
2. The Conservator of Forest Gilgit Circle, Gilgit.
3. The Conservator of Forest Baltistan Circle, Skardu.
4. The Depty Commissioner Gilgit/Skardu.
5. The Deputy Secretary, Chief Minister's Secretariat Gilgit.
6. The Deputy Secretary (Staff) to Chief Secretary GB, Gilgit.
7. The Divisional Forest Officer Wildlife GB, Gilgit.

ANNEX 6: NOTIFICATION FROM THE ARCHAEOLOGY DEPARTMENT

No. 39/13/2010-Arch (P-II)
GOVERNMENT OF [illegible]
DEPARTMENT OF [illegible]
[illegible]
[illegible]

(051) 9252516
Gram: ARCHAEOLOGY
Fax: (051) [illegible]

slamabad the October, 2010

The Deputy Accountant General,
AGPR, Sub-Office,
<u>Gilgit.</u>

Subject: - **PAYMENT FOR THE COST OF ACQUIRED LAND AT HANZEL STUPA, GILGIT**

Dear Sir,

In exercise of the powers conferred upon me as Head of the Department vide item No.9 (40) of the Finance Division D.O. No.F.3(2)Exp-III/2006, dated 13th September,2006, I have the honour to accord sanction to an expenditure not exceeding to Rs.1,705,7[illegible]0/- (Rupees one million seven hundred five thousand seven hundred only) being incurred by the office of the Assistant Director, Sub-Regional Office, Gilgit on account of payment of cost of acquired land at Hanzel Stupa, Gilgit vide Land Acquisition Collector, Gilgit letter No. DK-1(Hanzel)/3920/2008 dated 05-12-2008 (Copy enclosed) The amount will be drawn through cross cheque by the DDO SRO, Gilgit in favor of Land Acquisition Collector, Gilgit.

The expenditure involved will be met out from within the sanctioned budget grant of this Department under Functional-cum-object classification, 04-Economic Affairs, 041-General Economic Affairs, 041102-Anthropological, Archaeological and Others Sociological Survey, (GI0001) **(Sub-Regional Office Archaeological Museum, Gilgit)** under Demand **No.18**-Ministry of Culture for the current financial year, 2010-2011 and is debitable to the head: **A09-Physical Assets, A01-Purchase of Building, A09101-Land and Buildings.**

Yours faithfully,
---Sd---
(DR. FAZAL DAD KAKAR)
DIRECTOR GENERAL

[illegible]

No. 39/13/2010-Arch (P-II) Islamabad, the 25th October, 2010

Copy forwarded for information and necessary action to the:-
1. The Assistant Director, SRO, Gilgit.
2. The Cash & Accounts Section, Head Office, Islamabad.

[illegible signature]
25-10-10
ASSISTANT DIRECTOR

Office of the Asst. Director
Dy. No. 148
Date. 2-11-010
S. R. O. Gilgit

ANNEX 7: LAND ACQUISTION PAYMENT DETAILS

Annex 7: Land Acquistion Payment Details

Government of Gilgit-Baltistan
OFFICE OF THE PROJECT DIRECTOR
20 MW Hydropower Project Hanzel Gilgit

PD-HPP-Hanzel-(12)2017/ 40 Dated 17 May 2017

Deputy Commissioner/Collector
District Gilgit

Subject: **Cheque amounting to Rs. 25 million for Land Acquisition 20 MW Hydropower Project Hanzel Gilgit**

Reference: This office Letter No. PD-HPP-Hanzel-(9)2017/32 dated 19 April 2017

This office vide above referred letter deposited an amount of Rs. 20 million (twenty million) on account of Land Acquisition against the Hanzel Power Project.

2. Further amount of Rs. 25 million (twenty five million) through government cheque bearing No. 032804 dated 09/05/2017 (**cheque attached**) on account of payment for Land Acquisition, is being deposited with your office. Therefore the total amount deposited is **Rs. 45 million (Forty Five million)**, to date.

3. You are well aware that the **Notification** No. RC-1(2)/2015 dated 27 January, 2017 under provision of Section-4 of the Land Acquisition Act, 1894 stands issued by Secretary Law Gilgit Baltistan, whereby authorization for Section-4 is given to Deputy Commissioner / Collector Land Acquisition. Following step may please be initiated:

i) The process of Land Acquisition may be initiated including implementation of Section-4 at project zone please.

ii) The revenue field staff will be assisted by ARE Civil of this office

iii) The project demarcation plan is tentative and will be finalized upon selection of EPC Contractor and his final design/layout.

iv) The tentative / preliminary layout of project components according to lengths, cross sections & sizes of the Civil and E/M installations like Diversion Weir, Intake, Connecting Channel, Sedimentation Basin/Tank, Headrace Canal, Forebay, Spill Channels, Power House, Tailrace, Switch Yard, Grid etc. can be shown during field preparation book to the revenue staff.

v) During verification of land compensation papers on field book, the actual layout as per changes if any (after EPC Contractor survey and design) may be incorporated / modified in the presence of revenue staff. Accordingly the verified land compensation papers will be forwarded to your office for pass of award and payment to the land owners.

4. Please acknowledge receipt of the above referred cheque in para-2.

(Intikhab W. Khan)
Project Director

C.C:

1. Secretary Water & Power department Gilgit-Baltistan
2. National Engineering Services (Pvt.) Limited, Lahore.
3. Engineering Section 20 MW HPP Hanzel Gilgit
4. Accounts Section 20 MW HPP Hanzel Gilgit

PHOTOLOGS

BASELINE PHOTOS

Plate 1: View of the Hanzel Road near power house connecting Hanzel and Harpoon Villages

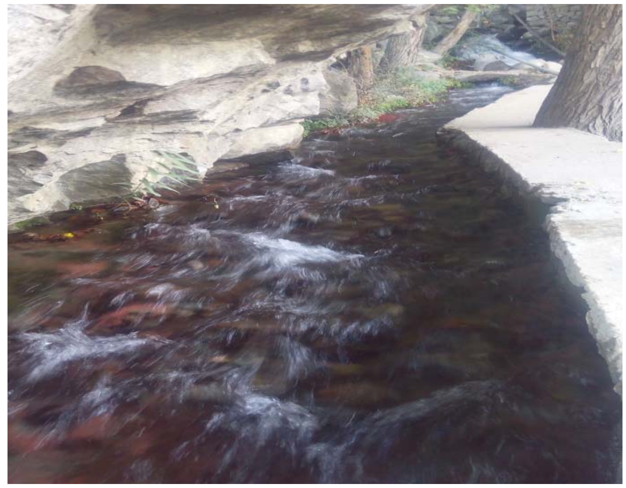


Plate 2: View of the Spring Water that locals utilized for Irrigation and Drinking

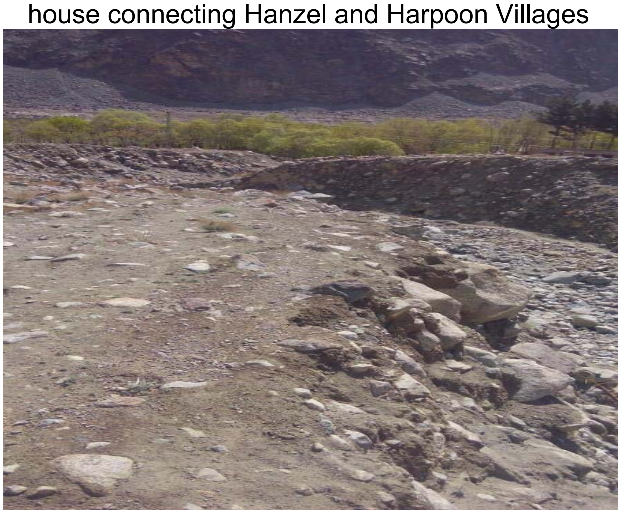


Plate 3: View of existing water channel in Hanzel Paine village near the proposed Spillway Channel

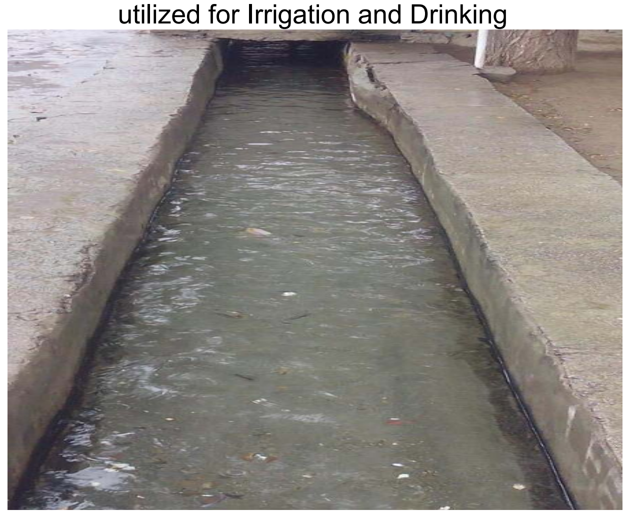


Plate 4: Lined surface water channel for Irrigation Purpose near Hanzel Bala Village

Plate 5: View of Solid Waste on the Hanzel Road Side

Plate 6: View of Hotel on the foothill of Headrace Channel


Plate 7: View of the residential house structure in Forebay Area


Plate 8: House built on the foothills of the Headrace Channel


Plate 9: View of Agricultural Field in the downstream area of the Weir.

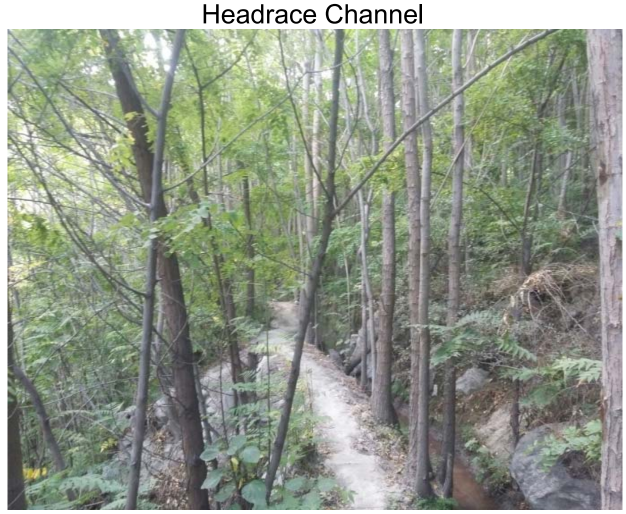


Plate 10: Trees on the right bank of the Gilgit River in Power House Area


Plate 11: View of Agricultural Field and Trees on the Foothill of the Headrace Channel


Plate 12: Ecologist measuring the girth of a tree in Project area

CONSULTATION WITH LOCAL COMMUNITIES

Plate 13: Community Consultations at Hanzel Bala in a Government Dispensary

Plate 14: Consultations with Locals of Hanzel Bala

Plate 15: Consultation with the Hotel Owner in Hanzel Bala

Plate 16: Combined consultation with the locals of Hanzel Bala, Hanzel Paine and Harpon Village

Plate 17: Department Consultation with Director, EPA, Gilgit Baltistan During Scoping Stage

Plate 18: Plate 19: Department Consultation with Director, Fisheries, Gilgit Baltistan

Plate 19: Department Consultation with Director, EPA, Gilgit Baltistan During Baseline survey

Plate 20: Stakeholder Consultation with the Official of Forest Department

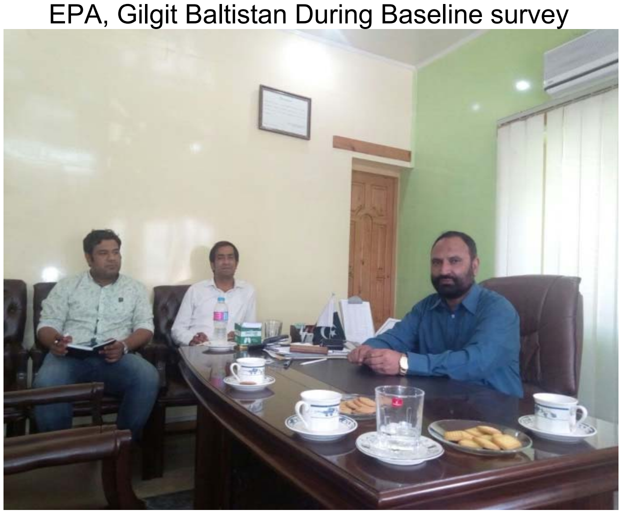


Plate 21: Stakeholder Consultation with the official of Education Department Gilgit

Plate 22: Stakeholder Consultation with the Principal of Primary School at Hanzel Bala

Plate 23: Stakeholder Consultation with Deputy Secretary, Archeology Department

Plate 24: Stakeholder Consultation with the Official of Social Welfare Department

Plate 25: Department Consultation with the Official of Agriculture Department

Plate 26: Consultation in Field with the Officials of the Wildlife Department

REFERENCES

- Ahmed. I. and Iftikhar. M. May. 2014. Revised Working Plan for Government Managed Private Coniferous Forest of Chilas, Darel & Tangir Sub-Divisions. Diamer. District, Gilgit-Baltistan. Forest Department.
- Building Code of Pakistan (Seismic Provisions – 2007), Ministry of Housing and Works.
- Feasibility Review Report, June 2017.
- Feasibility Study of Hanzel Hydropower Project 2009.
- Government of GB, Official Website.
- HEPO, WAPDA: Comprehensive Planning Region – 6 Yasin, 1999.
- Mir, A. 2006. Impact Assessment of Community Based Trophy Hunting in MACP areas of NWFP and Northern Areas. Mountain Area Conservancy Project.
- National Environmental Quality Standards (NEQS) for Municipal and Liquid Industrial Effluents, 2000.
- National Standards for Drinking Water Quality, 2010.
- PC-1 Performa (Modified), 2014.
- Sheikh, M. I. 1993. Trees of Pakistan. Pakistan Forest Institute Peshawar.
- Strategic Environmental Assessment of the Master Plan for Gilgit City, IUCN Pakistan (National Impact Assessment Programme).
- Tender Document Contract No ICB-01, Volume -2, Part I – Project Construction Requirements.
- Weather Data obtained from Environmental Protection Agency, Gilgit Baltistan.

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LIMITED
Geotechnical & Geoenvironmental Engineering Division
NESPAK House, 1-C, Block N, Model Town Extension, Lahore
Tel: +92-42-99231917, 99090310 Fax: +92-42-99231918, 99231950
Email: geotech@nespak.com.pk Web site: www.nespak.com.pk