



**National Highway Authority**

**Pre-Feasibility Study and Feasibility Study  
of Shounter (Neelum Valley AJ&K) –  
Rattu (Astor Valley G&B) Road Tunnel**

# **Environmental Impact Assessment Report**

**For Rattu (Astor Valley G&B)**

**October 2019**

**(Revised)**



**Dohwa Engineering Co., Ltd. Republic of Korea**

**in association with**



**Prime Engineering & Testing Consultants (Pvt) Ltd, Pakistan**



## EXECUTIVE SUMMARY

The executive summary herein developed is for the project titled “Shounter Road & Tunnel Project Report”. National Highway Authority (NHA), aims to Construct Shounter - Rattu (12.7km long) road tunnel. The length of road corridors from (Kel to Shounter) and (Shounter to Gorikot) are about 26.9km and 41.5km respectively. It will traverse adjacent to town of Kel, Lower Domel, Dhakki Nakka, Khora, Chitta katha, Upper Domel, and Chattian, Shounter in Neelum AJ&K area and Morcha Guzair, Mirmalik, Rattu, Nasirabad, Chugam, Rehmanpur and Gorikot in Astore GB area. The project site is approximate 65km away from Astore. The Route via Neelum Valley to Astore Valley, through Shounter is very important socially, economically and geographically. Shounter - Rattu road tunnel project would save the five hours’ travelling of Gilgit Baltistan residents to Islamabad, the capital of Pakistan via District Neelum (AJK). During field visits the people of the project area, confirmed that this was the main route which was used by traders to travel from Astore to Islamabad in the past. Later on, it was disconnected having no communication between the two territories. In the past people of the region used mules and donkeys to transport goods from AJ&K area to GB area. The project location map shown in Figure: 1.1.



Figure:1.1 Project Location Map

It is desired by people of the project area to add this project in China Pakistan Economic Corridor (CPEC). The National Highway Authority (NHA) under the Federal Ministry of Communications is focusing on advanced road and tunnels facilities in Pakistan to connect the low lands of Pakistan with project area. DOHWA Engineering Co., Ltd. In Association with Prime Engineering & Testing Consultants (Pvt.) Ltd. has been assigned to prepare a complete feasibility of the project; including the preparation of the EIA. The project falls under Schedule-II of the EPA regulations requiring an extensive environmental investigation for the construction of a tunnel and access roads across in GB and AJK. The AJ&K part EIA report is approved from competent Authority and this is GB part EIA report.

To carry out the present EIA Study, the environmental legislation and Guidelines enforced by the Pakistan Environmental Protection Agency (PEPA) & Gilgit-Baltistan Environmental Protection Agency (GB-EPA) have been followed. The Prime Engineering & Testing Consultants (Pvt.) Ltd. with the assignment of carrying out an EIA Study of the proposed tunnel and access roads project.

The Report lists the identified environmental impacts and their mitigation measures. The report includes an Environmental Management Plan to cover the mitigation measures, monitoring requirements and institutional responsibilities (during design, construction and operation phases of the proposed project).

This study has been conducted using standard environmental assessment methodology, in accordance with the environmental legislation and Guidelines enforced by the Pakistan Environmental Protection Agency (PEPA) & Gilgit-Baltistan Environmental Protection Agency (GB-EPA). The study evaluates the proposed project according to the environmental assessment requirements of the Pakistan Initial Environmental Examination and Environmental Impact Assessment Review Regulations 2000.

The specific objectives of this EIA are to:

- ❖ Assess the existing conditions in the project area and develop a baseline of its current environmental and socioeconomic conditions;
- ❖ Assess the proposed activities of the project to identify their potential impact, evaluate these effects, and determine their significance;
- ❖ To propose mitigation measures that would help the Project Proponent in conducting the operation in an environmentally sustainable manner;
- ❖ To develop an Environmental Management Plan that would assist the Project Proponent in the effective implementation of the recommendations of the EIA.

The discussion and analysis of alternatives in Environmental Impact Assessment (EIA) should consider other practicable strategies that will promote elimination of identified negative environmental impacts. This section is a requirement of the EPA Pakistan including GB and is critical in consideration of the ideal development with minimal environmental disturbance. This report has identified the major environmental impacts noted by scientific experts. The findings of these impacts were utilized to analyze possible options for the final development.

Efforts were made to develop a holistic approach to study all of the environmental, physical, socio-economic aspects of the project region. As the project falls in GB and AJK areas.

Stakeholder consultation was carried out with the objective of involving people in the project. Local residents, industrialists, shop keepers, vendors, hospital owners, teachers, pedestrians, businessmen and government officials from various departments were identified as potential stakeholders for the project. Survey and scoping sessions were held with these stakeholders to find out their perceptions and perceived impacts about the existing road and proposed tunnel between AJK and GB. Majority of the residents contacted, showed their satisfaction about the tunnel between both areas, and considered the proposed project a necessary component for the betterment of the region. The proposed project will also contribute in reducing travel time between both areas and also link the northern part of Pakistan to the southern end more conveniently.

The potential impacts associated with the proposed project construction and operation activities included: loss of vegetation and habitat; soil erosion due to earthwork, vehicle movement; soil contamination; increase in water consumption, air pollution from vehicle, generator exhausts and fuel combustion, waste generation, noise and disturbance; increased pressure on the wildlife of the area.

For effective implementation and management of mitigation measures, an Environmental Management & Monitoring Plan has been prepared. The EMMP provides a delivery mechanism to address potential impacts of project activities, to enhance project benefits and to introduce standards of good practice in all project activities. The EMMP has been prepared with the objective of:



- ❖ Defining legislative requirements, guidelines and best industry practices that apply to the project;
- ❖ Defining mitigation/ monitoring plan required for avoiding or minimizing potential impacts assessed by the EIA;
- ❖ Defining roles and responsibilities of the project proponent and the contractor;
- ❖ Defining requirements for environmental monitoring and reporting;
- ❖ Defining the mechanism with which training will be provided to the project personnel.

The study concludes that the project does not involve any long term irreversible negative impacts. Most of the negative impacts identified in the study are temporary and manageable through adopting mitigation measures. Generally, the proposed project is an environmental improvement project aimed to facilitate sustainable development of GB, and therefore the overall impacts on the environment and the socio-economic conditions will be very much positive.





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## Abbreviations

AD	Assistant Director
ADB	Asian Development Bank
AJ&K	Azad Jammu & Kashmir
AKRSP	Aga Khan Rural Support Programme
BHU	Basic Health Unit
CFC	Chloro-Flouro Carbons
CMS	Conservation of Migratory Species
CPEC	China Pakistan Economic Corridor
DD	Deputy Director
EC	Environmental Committee
EDO	Executive Director Officer
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMMP	Environmental Management Plan
EPAs	Pakistan Environment Protection Agency's
ES	Executive Summary
ESPS	Emergency Standby Power System
FWO	Frontier Works Organization
GB	Gilgit Baltistan
GCMs	Global Climate Models
GHG	Greenhouse Gasses
GIIP	Good International Industry Practice
GRM	Grievance Redress Mechanism
ha	Hectare = 10,000 m <sup>2</sup>
HBIB	Habib Metro Bank
HCFC	Hydro-Chloro-Flouro Carbons
HSSE	Health Safety Security and Environmental Management
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
JICA	Japan International Caption Authority
KKB	Karakorum Bank
KKH	Karakorum Highway
km	Kilometer
Km	Kilometer
Km <sup>2</sup>	Square Kilometer
m	Meter
M	Million



max	Maximum
MC	Monitoring Consultant
ME	Monitoring Evaluation
MFB	Micro Finance Bank
min	Minimum
MMP	Management Mitigation Plan
MP	Monitoring Plan
MSDS	Material Safety Data Sheet
MVEs	Motor Vehicle Examiners
MVR	Motor Vehicle Rules
NBP	National Bank Pakistan
NCCW	National Council for Conservation of Wildlife
NCS	National Conservation Strategy
NEP	National Environmental Policy
NEQS	National Environmental Quality Standard
NFPA	National Fire Protection Association
NGOs	Non- Governmental Organizations
NHA	National Highway Authority
NOC	No-Objection Certificate
NPS	Normal Power Supply
NRSPB	Northern Rural Support Project Bank
NTC	National Trade Corridor
O&M	Operation and maintenance
ODSs	Ozone depleting Substances
P&D	Planning and Development
PAPs	Project Affects Persons
PBL	Punjab Bank Limited
PEMC	Project Environmental Management Committee
PEPA	Pakistan Environmental Protection Act 1997
PEPC	Pakistan Environmental Protection Council
PEQS	Pakistan Environmental Quality Stranded
PESMU	Project Environmental and Social Management Unit
PGRC	Project Grievance Resolution Committee
PM	Particulate Matter
PMC	Project Management Consultant
PMD	Pakistan Meteorological Department
PNCS	Pakistan National Conservation Strategy
PPE	Personal Protective Equipment
PTDC	Pakistan Tourism Development Corporation
RAP	Resettlement Action Plan



ROW	Right of Way
SC	Supervision Consultant
SCO	Special Communication Organization
SPS	Safety Power Supply
TOR	Terms of Reference
UNFCCC	National Framework Convention on Climate Change
UPS	Uninterruptible Power Supply
WB	World Bank
WHO	World Health Organization
WWF	World Wide Fund
ZTB	Zarai Taraqati Bank Ltd.



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Figure:1.1 Project Location Map

It is desired by people of the project area to add this project in China Pakistan Economic Corridor (CPEC). The National Highway Authority (NHA) under the Federal Ministry of Communications is focusing on advanced road and tunnels facilities in Pakistan to connect the low lands of Pakistan with project area. DOHWA Engineering Co., Ltd. In Association with Prime Engineering & Testing Consultants (Pvt.) Ltd. has been assigned to prepare a complete feasibility of the project; including the preparation of the EIA. The project falls under Schedule-II of the EPA regulations requiring an extensive environmental investigation for the construction of a tunnel and access roads across in GB and AJK. The AJ&K part EIA report is approved from competent Authority and this is GB part EIA report.

To carry out the present EIA Study, the environmental legislation and Guidelines enforced by the Pakistan Environmental Protection Agency (PEPA) & Gilgit-Baltistan Environmental Protection Agency (GB-EPA) have been followed. The Prime Engineering & Testing Consultants (Pvt.) Ltd. with the assignment of carrying out an EIA Study of the proposed tunnel and access roads project.

The Report lists the identified environmental impacts and their mitigation measures. The report includes an Environmental Management Plan to cover the mitigation measures, monitoring requirements and institutional responsibilities (during design, construction and operation phases of the proposed project).

This study has been conducted using standard environmental assessment methodology, in accordance with the environmental legislation and Guidelines enforced by the Pakistan Environmental Protection Agency (PEPA) & Gilgit-Baltistan Environmental Protection Agency (GB-EPA). The study evaluates the proposed project according to the environmental assessment requirements of the Pakistan Initial Environmental Examination and Environmental Impact Assessment Review Regulations 2000.

The specific objectives of this EIA are to:

- ❖ Assess the existing conditions in the project area and develop a baseline of its current environmental and socioeconomic conditions;
- ❖ Assess the proposed activities of the project to identify their potential impact, evaluate these effects, and determine their significance;
- ❖ To propose mitigation measures that would help the Project Proponent in conducting the operation in an environmental sustainable manner;
- ❖ To develop an Environmental Management Plan that would assist the Project Proponent in the effective implementation of the recommendations of the EIA.

The discussion and analysis of alternatives in Environmental Impact Assessment (EIA) should consider other practicable strategies that will promote elimination of identified negative environmental impacts. This section is a requirement of the EPA Pakistan including GB and is critical in consideration of the ideal development with minimal environmental disturbance. This report has identified the major environmental impacts noted by scientific experts. The findings of these impacts were utilized to analyze possible options for the final development.

Efforts were made to develop a holistic approach to study all of the environmental, physical, socio-economic aspects of the project region. As the project fall GB and AJK areas.

Stakeholder consultation was carried out with the objective of involving people in the project. Local residents, industrialists, shop keepers, vendors, hospital owners, teachers, pedestrians, businessmen and government officials from various departments were identified as potential stakeholders for the project. Survey and scoping sessions were held with these stakeholders to find out their perceptions and perceived impacts about the existing road and proposed tunnel between AJK and GB. Majority of the residents contacted, showed their satisfaction about the tunnel between both areas, and considered the proposed project a necessary component for the betterment of the region. The proposed project will also contribute in reducing travel time between both areas and also link the northern part of Pakistan to the southern end more conveniently.

The potential impacts associated with the proposed project construction and operation activities included: loss of vegetation and habitat; soil erosion due to earthwork, vehicle movement; soil contamination; increase in water consumption, air pollution from vehicle, generator exhausts and fuel combustion, waste generation, noise and disturbance; increased pressure on the wildlife of the area.

For effective implementation and management of mitigation measures, an Environmental Management & Monitoring Plan has been prepared. The EMMP provides a delivery mechanism to address potential impacts of project activities, to enhance project benefits and to introduce standards of good practice in all project activities. The EMMP has been prepared with the objective of:



- ❖ Defining legislative requirements, guidelines and best industry practices that apply to the project;
- ❖ Defining mitigation/ monitoring plan required for avoiding or minimizing potential impacts assessed by the EIA;
- ❖ Defining roles and responsibilities of the project proponent and the contractor;
- ❖ Defining requirements for environmental monitoring and reporting;
- ❖ Defining the mechanism with which training will be provided to the project personnel.

The study concludes that the project does not involve any long term irreversible negative impacts. Most of the negative impacts identified in the study are temporary and manageable through adopting mitigation measures. Generally, the proposed project is an environmental improvement project aimed to facilitate sustainable development of GB, and therefore the overall impacts on the environment and the socio-economic conditions will be very much positive.



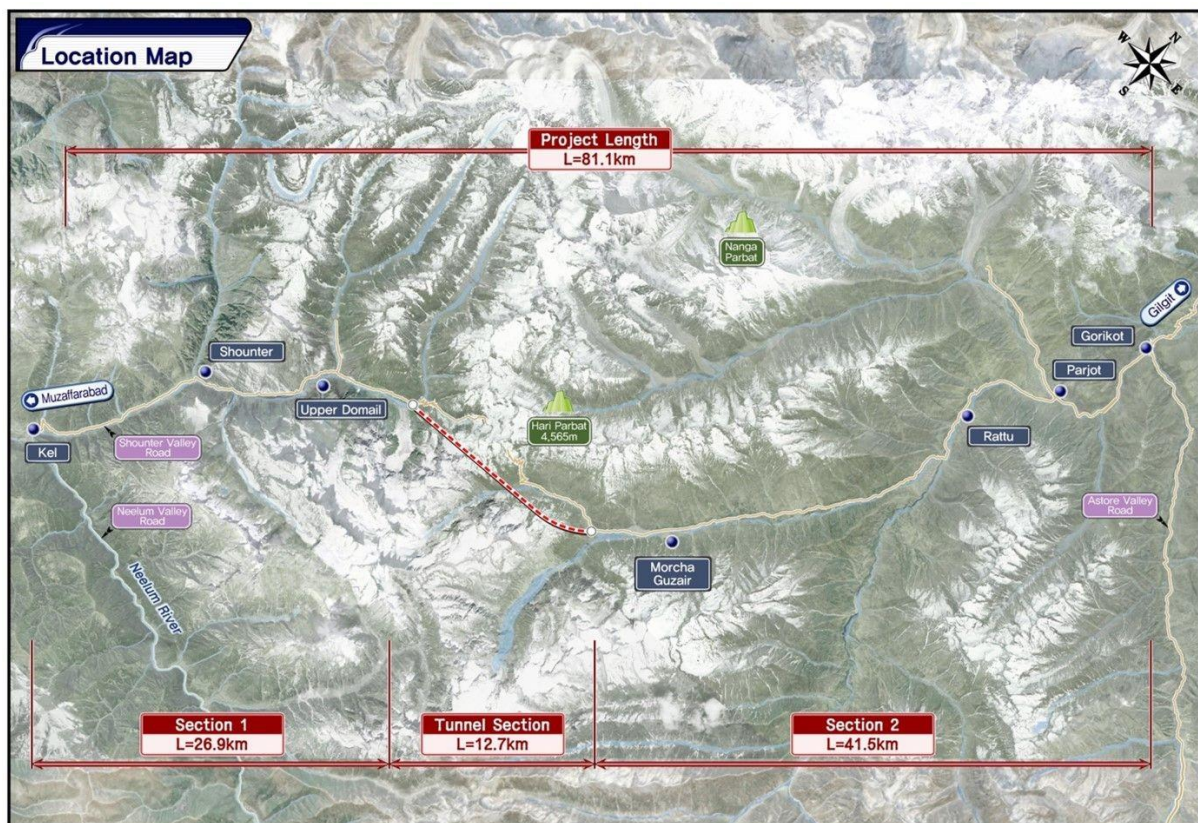
## CHAPTER-1 INTRODUCTION

This chapter presents the data relevant to the undertaking of the Environmental Impact Assessment (EIA) carried out by DOHWA Engineering Co., Ltd. in association with Prime Engineering & Testing Consultants (Pvt) Ltd. The project is between Shounter and Rattu (12.7 km long) road tunnel the length of road corridors from (Ke to Shounter) and (Shounter to Gorikot) are about 26.9km and 41.5km respectively. It will traverse adjacent to town of Kel, Lower Domel, Dhakki Nakka, Khora, Chitta katha, Upper Domel, and Chattian, Shounter in Neelum AJ&K area and Morcha Guzair, Mirmalik, Rattu, Nasirabad, Chugam, Rehmanpur and Ghorikot in Astore GB area. The AJ&K area EIA report is approved from competent Authority and this EIA report is under jurisdiction of Gilgit Balistan area. The project site is approximate 65km away from Astore. The consultants, project rationale and the approach taken to the EIA study.

### 1.1 PROJECT TITLE AND PROJECT PROPONENTS

#### 1.1.1 PROJECT TITLE

The proposed project to which this Environmental Impact Assessment (EIA) relates is entitled as *“Proposed Shounter Tunnel Project”*. A key map showing the location of the project area is shown in **Figure: 1.1**.



**Figure: 1.1** Proposed Project Location Map

#### 1.1.2 PROJECT PROPONENT

The proponent of the project is “National Highway Authority (NHA)”; while DOHWA Engineering Co., Ltd. In Association with Prime Engineering & Testing Consultants (Pvt) Ltd. has been assigned to prepare a complete feasibility of the project; including the preparation of the EIA of the said project to be submitted by them to NHA.

## 1.2 CONSULTANTS

The EIA study was carried out by environmental team of Prime Engineering & Testing Consultants (Pvt) Ltd. comprising of Environmentalist, Sociologist and Geologist with diversified experience on local and international assignments. The project environmental team list provided in **Annex: 4**.

## 1.3 PURPOSE OF THE REPORT

EIA is mandatory according to the Gilgit Baltistan Environmental Protection Act 2014 states that: No proponent of a project shall commence construction or operation unless he has filed an environmental impact assessment, and has obtained from the GB EPA approval in respect thereof.

## 1.4 BRIEF DESCRIPTION OF NATURE, SIZE, AND LOCATION OF THE PROJECT

The proposed project to which this Environmental Impact Assessment (EIA) relates is entitled as “*Proposed Shounter Tunnel Project*”. The project is between Shounter and Rattu (12.7 km long) road tunnel the length of road corridors from (Ke to Shounter) and (Shounter to Gorikot) are about 26.9km and 41.5km respectively. The project once completed will provide a good link to the towns and villages along the alignment as well as prove to be advantageous for the freight traffic moving goods, products and material within areas.

## 1.5 EIA PROCESS

### 1.5.1 OVERVIEW OF EIA

EIA is a systematic process to identify, predict and evaluate the environmental impacts of proposed actions and projects. The process is applied prior to major decisions and commitments being made. Wherever appropriate, social, cultural and health effects are considered as an integral part of EIA. Particular attention is given to practical implementation of EIA to prevent and mitigate significant adverse effects of proposed undertakings.

### 1.5.2 OBJECTIVE OF EIA

The main objective of the EIA Study is to highlight anticipated impacts of the proposed project covering environmental and occupational health and safety issues and to suggest mitigation measures to eliminate or reduce the foreseen negative impacts to an acceptable level. These objectives can be further elaborated as below:

- Description of the proposed project, including an estimate of emissions, effluent and waste and consideration of the project alternatives;
- Identify and investigate all impacts of the proposed project on the physical, biological, and socio-economic environment;



- Evaluation of the baseline environmental conditions in the impact zone to provide a basis for assessing the incremental impacts of the proposed project, including existing pollution levels and nuisance conditions;
- Identification and assessment of the potential impacts on the environment during each of the project phases;
- To propose mitigation measures that would help the Project Proponent in conducting the operation in an environmental sustainable manner; and to develop an Environmental Management Plan that would assist the Project Proponent in the effective implementation of the recommendations of the EIA.

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### 1.5.3 SCOPE OF EIA

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This EIA covers the construction & operational anticipated impacts of “*Proposed Shounter Tunnel Project*”. An approximate length of the project would be around 81.1km including access roads. The scope of the EIA includes:

- Construction activities at the proposed project site;
- Relevant off-site construction activities;
- Operation.

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### 1.5.4 SPATIAL SCOPE

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Impacts are assessed within the area of influence of the proposed project defined as:

- Immediate Area of Influence: at immediate foot print of proposed project location.
- Direct Area of Influence: within the proposed project corridor and immediate surrounding of Right of Way (ROW).

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## 1.6 EIA METHODOLOGY

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The EIA project passes through series of stages prior to report preparation. The EIA process and the approach followed for the proposed project is defined below:

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### 1.6.1 SCOPING

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Scoping is an early stage of the process and is designed to ensure that the environmental studies provide all the relevant information on:

- the impacts of the project, in particular focusing on the most important impacts;
- the alternatives to the project;
- Other environmental sensitivities to be addressed at early stage.
- The EIA process started with the scoping.

The purpose of scoping was to identify:

- the important issues to be considered in an EIA;
- the appropriate time and space boundaries of the EIA study;
- the information necessary for decision-making;

- the significant effects and factors to be studied in detail.

The scoping was followed by data collection describes in subsequent section.

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## 1.6.2 DATA COLLECTION

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Following literature review and data collection was carried out for EIA:

- A generic description of the proposed project and its related activities was collected from the Prime Engineering & Testing Consultants (Pvt.) Limited.
- Legislative review of the applicable laws, regulations, guidelines and standards from various organisations and literature search.
- Baseline of the area's environmental and socio-economic settings was collected through different departments and offices, literature search and field surveys.

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## 1.6.3 BASELINE

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The environmental impact is measured through a change in the environment, resulting from a designated action or activity. In order to identify such a change, it is essential to have as complete as practicable understanding of the nature of the existing environment, prior to its interaction with the proposed activity. This translates into the need to characterize the existing baseline environmental conditions, including establishing prevailing conditions for a range of environmental media, particularly air, water, soil and groundwater, flora, fauna and the human environment. This was achieved through a detailed review of all secondary resources (i.e. existing documentation, literature and different departments and offices); and the undertaking of project specific baseline studies and surveys to collect supplementary data in the following areas:

- Geology;
- Flora and fauna;
- Water quality characteristics;
- Soil quality;
- Traffic;
- Ambient air quality;
- Noise conditions;
- Socio-economic conditions.

Both the existing secondary sources, literature studies and different departments/offices were conducted and integrated into one coherent description of baseline characteristics.

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## 1.6.4 STAKEHOLDER CONSULTATION

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Communities within the project area were consulted during the field work to record their concerns and suggestions.

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## 1.6.5 EVALUATION OF ALTERNATIVES

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To establish an environmentally sound preferred option for achieving the objectives of the proposed project, different alternatives including site selection, raw material and technology alternatives were studied in collaboration with the project proponent.

- Technology selection was made taking in to consideration environmentally, economically and socially suitable as well as technically feasible options.

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### 1.6.6 IMPACT ASSESSMENT AND MITIGATION

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The information collected in the previous phases was used to assess the potential environmental impacts of the proposed project activities. The impact assessment approach and methodology is included in Chapter 7 of the report. Mitigation measures were evaluated to reduce the impacts of project activities on environment. The issues studied during impact assessment include potential impacts on:

- Physical environment of the area
- Biological environment of the area
- Socio-economic environment of the area.

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### 1.7 STRUCTURE OF THE REPORT

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This Report includes following sections, which cover all the requirements provided by EPA:

1. **“Introduction”** briefly presents the project background, objectives and need for the EIA study.
2. **“Policy, Legal and Administrative Framework”** comprises policy guidelines, statutory obligations and roles of institutions concerning EIA study of the proposed project.
3. **“Project Description”** furnishes information about the location of the proposed project, cost and size of the project, and its major components.
4. **“Analysis of Alternatives”** discusses different alternatives considered for the proposed project to arrive at the preferred alternative for detailed environmental assessment.
5. **“Baseline Data”** establishes baseline conditions for the physical, biological and socio-economic and cultural conditions prevalent in and around the project area.
6. **“Stakeholder Consultation and Disclosure”** describes the outcome of the public consultation sessions held with different stakeholder groups that may be impacted by the project.
7. **“Environmental Impacts and Mitigation Measures”** identifies, predicts and evaluates environmental impacts of the proposed project activities at the design, construction and operation stages. It also details the measures (including the mitigations costs) to reduce/eliminate potential adverse impacts of the project on different environmental conditions at respective stages.
8. **“Environmental Management Plan”** lays out the mitigation measures for the impacts identified, defines responsibilities of the project proponent, contractor(s) and other role players; identifies training requirements at different levels; specifies supervision and monitoring mechanisms and parameters; and provides budgetary requirements to ensure that all the mitigation measures are effectively implemented during construction and operation stages of the project.
9. **“Conclusions and Recommendations”** describes the outcome of the study with recommendations to get full benefits of the project in an environmentally sound and acceptable way.



## CONTACT DETAILS

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## CHAPTER-2 POLICY, LEGAL & ADMINISTRATIVE FRAMEWORK

### 2.1 GENERAL

This section deals with the relevant policy, legal and administrative framework instituted by the Government of Pakistan and Gilgit Baltistan for the protection of environment. All the relevant provisions of these policy and legal frameworks have been duly considered in this EIA study and a brief overview has been included for each regulation. In addition to this, the roles and responsibilities of the proponent as well as the PEPA and Gilgit-Baltistan Environmental Protection Agency (GB-EPA) have been mentioned in this section.

### 2.2 POLICY FRAMEWORK

The Federal Ministry of Environment has been devolved under 18th amendment in the constitution of Islamic Republic of Pakistan and similarly provinces were enabled to legislate on the subject of environment, therefore Gilgit Baltistan assembly under schedule 4 of “Gilgit-Baltistan (Empowerment and Self-Governance) Order 2009” can make laws on the list of subjects provided in it. In that context, Gilgit Baltistan has its own Environmental Protection Act and hence the Gilgit Baltistan Environmental Protection Agency (GB-EPA) is the responsible authority for policy making on environmental protection in Gilgit Baltistan. The proposed project will be financed by Govt. of Pakistan which requires compliance to the Environmental Policy and Guidelines, so it is obligatory on the part of the Proponent to follow these for environmental assessment.

### 2.3 NATIONAL ENVIRONMENTAL POLICY - 2005

The National Environmental Policy (2005) provides an overarching framework for addressing the environmental issues (particularly pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification etc.) confronting Pakistan. It recognizes the goals and objectives of the Pakistan National Conservation Strategy (PNCS, 1992), National Environmental Action Plans, and other existing environment related national policies, strategies, and action plans. It also provides broad guidelines to the federal government, provincial governments, federally administered territories and local governments to address their environmental concerns and to ensure effective management of their environmental resources.

### 2.4 LEGAL FRAMEWORK

The Government of Gilgit Baltistan has promulgated laws/acts, regulations and standards for the protection, conservation, rehabilitation and improvement of the environment. In addition to this, they have also developed environmental assessment procedures governing developmental projects. Following are the excerpts of these laws and procedures relevant to the proposed project.

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## 2.4.1 GILGIT BALTISTAN ENVIRONMENTAL PROTECTION ACT, 2014 (GBEPA-14)

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The Act was enacted in 2014 by repealing the Pakistan Environmental Protection Act (1997). It provides the framework for establishment of the Gilgit Baltistan Environmental Protection Council, establishment of Gilgit-Baltistan Environmental Protection Agency, Establishment of the Gilgit-Baltistan Sustainable Development Fund, protection and conservation of species, conservation of renewable resources, establishment of Environmental Courts and Green Courts, Initial Environmental Examination (IEE), and Environmental Impact Assessment (EIA). Section 16 of the Act stresses the need to carry out environmental assessment study prior to construction or operation of a project.

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## 2.4.2 EPA (REVIEW OF IEE AND EIA) REGULATIONS, 2000

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These regulations provide lists of the projects requiring IEE and EIA. They also briefly describe the preparation and review of environmental reports.

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## 2.4.3 PAKISTAN ENVIRONMENTAL ASSESSMENT PROCEDURES, 1997

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Pakistan Environmental Assessment Procedures (1997) is, in fact, a package which contains the following sets of information relevant to the proposed Project:

**Policy and Procedures for Filing:** Review and Approval of Environmental Assessment Reports It describes environmental policy and administrative procedures to be followed for filing of environmental assessment reports by the proponents and its review and approval by the concerned environmental protection agency/department.

**National Environmental Quality Standards, 2000:** The Pakistan Environmental Protection Council first approved these standards in 1993. They were later revised in 1995 and 2000. They furnish information on the permissible limits for discharges of municipal and industrial effluent parameters and industrial gaseous emissions in order to control environmental pollution.

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## 2.5 OTHER RELEVANT LAWS

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### 2.5.1 LAND ACQUISITION ACT (1894)

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Projects may require government procurement of privately owned land and the displacement of land users. Land may be acquired through:

- i) Expropriation (Compulsory Acquisition)
- ii) Voluntary negotiation with the owners for sale of land
- iii) Donation from the land owners

The Land Acquisition Act (1894) deals with the government acquisition of private properties for public purposes including large development projects. There are 55 sections in this Act mainly dealing with area notifications, surveys, acquisition, compensation, apportionment awards, disputes resolution, penalties and exemptions.

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### 2.5.2 PROJECT IMPLEMENTATION AND RESETTLEMENT OF AFFECTED PERSONS ORDINANCE 2000

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This ordinance will be used to safeguard the interests of persons and groups involuntarily displaced from the existing places to new resettlement areas.

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### 2.5.3 CANAL AND DRAINAGE ACT, 1873

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This Act entails provisions for the prevention of pollution of natural or man-made water bodies.

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### 2.5.4 FOREST ACT 1927 AND LATER AMENDMENTS

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This act is applicable to all regions of Pakistan including proposed project areas. It includes procedures for constituting and managing various types of forests, such as reserved forests, village forest and protected forests. There are a few shrubs, but no forests in the primary or secondary impact zone of the Proposed Project area however, in case of any deviation from the ROW, proponent shall intimate to the Department about the same.

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### 2.5.5 DRAFT NATIONAL FOREST POLICY 2001

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A draft of the National Forest Policy was prepared in 2001 which is also applicable to the Northern Areas. It emphasizes the sustainable use of natural resources with community participation and recommends that timber harvesting be used for poverty alleviation. It also aims to rehabilitate the environment.

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### 2.5.6 NORTHERN AREAS FOREST RULES 1983

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The 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.

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### 2.5.7 PRIVATE FOREST REGULATION 1970

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Forests in state ownership in the Northern Areas have been designated as “protected forests” under the Pakistan Forest Act (1927). The other legal category of forests here is “private forest” which is owned by the local communities. These forests are legally covered under the Gilgit Private Forests Regulations (1970) and the rules framed thereafter.

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### 2.5.8 CUTTING OF TREES (PROHIBITION) ACT, 1975

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This Act prohibits cutting or lopping of trees along roads and tunnel planted by the Forest Department, without permission of the Forest Department.

The Northern Areas Province Wildlife (Protection, Preservation, Conservation and Management).Act, 1975.

This Act defines rules and regulations for the protection, preservation, conservation and management of wildlife.

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### 2.5.9 NORTHERN AREAS CUSTOMARY LAWS

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In Northern Areas customary laws are also practiced besides national laws. This system provides for at least one authority, chosen by the community either by nomination or election, with responsibility

for managing natural resources and enforcing customary laws. This customary normative framework includes provisions for: community and individual ownership; resource use fees; and fines as penalties for violations of these laws. Most of the occupants, who claim to be the owner, do not have any written tenancy agreement. For such cases in the non-settled area, confirmation by the village jirgas on land possession is accepted at community, court and local administration levels. Adoption of current 'Northern Areas Neuter Rule' (1980) envisages that the occupant of land will be treated as its owner. All other land beyond the settlements, mostly barren, will belong to the Northern Areas Administration. This position was also reaffirmed by the Courts of NA.

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#### 2.5.10 NORTHERN AREA STRATEGY FOR SUSTAINABLE DEVELOPMENT 2003

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The Northern Area Strategy for Sustainable Development presents a vision and a strategic framework for economic, social, cultural, and ecological well-being of the people of the Northern Areas. It provides a road map to improve governance, integrated gender, environment and sustainability, prioritized development needs, and creation of an enabling environment by improving policies and legislation.

Regulations of Mines and Oil Fields and Mineral Development Act, 1948.

This Act provides regulatory procedures for the quarrying and mining of construction material on public as well as private lands.

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#### 2.5.11 HIGHWAYS SAFETY ORDINANCE, 2000

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This ordinance includes provisions for the licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control, offences, penalties and procedures; the establishment of a police force for motorways and national highways charged with regulating and controlling traffic on the national highways and keeping the highways clear of encroachments.

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#### 2.5.12 THE ANTIQUITIES ACT, 1975

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Archaeological sites and monuments are specifically protected by this Act.

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#### 2.5.13 MOTOR VEHICLE RULES, 1969

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Motor Vehicle Rules 1969 (MVR 1969) define powers and responsibilities of Motor Vehicle Examiners (MVEs). The establishment of MVE inspection system is one of the regulatory measures that can be taken to tackle the ambient air quality problems associated with the vehicular emissions.

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#### 2.5.14 EXPLOSIVE ACT, 1884

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

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#### 2.5.15 PAKISTAN PENAL CODE, 1860

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This Act defines the penalties for violations concerning pollution of air, water bodies and land.

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#### 2.5.16 THE TELEGRAPHY ACT 1910

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This act was promulgated for the installation of telegraph poles and lines. This Act makes provision of installing poles and towers without acquiring any land. However, provision is also made for temporary acquisition of land during the construction period. As such, compensation is made for the loss of crops for a specific period.

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### 2.5.17 LABOR LAWS

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The Gilgit Baltistan has yet to put forward the regulations for labors and laws pertaining to them hence, till now, GB follows the labor laws of Pakistan. Labor laws in Pakistan are governed by several legislative tools. However, the principal labor rights are provided by the constitution of Pakistan. The following articles enforce key labor rights.

- Article 11 of the constitution prohibits all forms of slavery, forced labor and child labor.
- Article 17 provides for a fundamental right to exercise the freedom of association and the right to form union.
- Article 18 prescribes the right of its citizen to enter upon any lawful profession or occupation and to conduct any lawful trade or business.
- Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone.
- Article 37 (e) makes provisions for securing just and human conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women employment.

In addition to constitutional rights, Act and Ordinances have been enforced for limiting working hours, minimum working age, and conditions of employment.

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### 2.5.18 LOCAL GOVERNMENT ORDINANCE 2001

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This Act empowers the Government of Pakistan and provincial governments to enforce laws for land use; conservation of natural vegetation; air, water, and land pollution; disposal of solid waste and wastewater effluents; and public health and safety, including some provisions for environmental protection.

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### 2.5.19 FACTORIES ACT, 1934

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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.

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### 2.5.20 ENVIRONMENTAL ASSESSMENT PROCEDURES

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The EPA has published a set of environmental procedures and guidelines for carrying out environmental assessments and the environmental management of different types of development projects. The guidelines that are relevant to the Proposed Tunnel Project are listed below, followed by comments on their relevance to the proposed project.

Policy and Procedures for Filing, Review and Approval of Environmental Assessments

These guidelines define the policy context and the administrative procedures that will govern the environmental assessment process, from the project pre-feasibility stage to the approval of the environmental report.

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## 2.5.21 CONVENTION ON BIOLOGICAL DIVERSITY

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The Convention on Biological Diversity was adopted during the Earth Summit of 1992 at Rio de Janeiro. The Convention requires parties to develop national plans for the conservation and sustainable use of biodiversity, and to integrate these plans into national development programs and policies. Parties are also required to identify components of biodiversity that are important for conservation, and to develop systems to monitor the use of such components with a view to promoting their sustainable use.

### 2.5.21.1 THE CONVENTION ON CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS, 1979

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The Convention on the Conservation of Migratory Species of Wild Animals (CMS), 1979, requires countries to take action to avoid endangering migratory species. The term "migratory species" refers to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries. The parties are also required to promote or co-operate with other countries in matters of research on migratory species. The Convention contains two appendices. Appendix I contain the list of migratory species that are endangered according to the best scientific evidence available. For these species, the member states are required to endeavor to:

- Conserve and restore their habitats.
- Prohibit their hunting, fishing, and capturing, harassing and deliberate killing.
- Remove obstacles and minimize activities that seriously hinder their migration.
- Control other factors that might endanger them, including control of introduced exotic species.
- Appendix II lists migratory species, or groups of species, that have an unfavorable conservation status as well as those that would benefit significantly from the international co-operation that could be achieved through intergovernmental agreements.

### 2.5.21.2 CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF FAUNA AND FLORA (CITES)

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This convention came into effect in March 1973 at Washington. In all 18 countries are signatory to this convention with Pakistan signing the convention in 1976. The convention requires the signatories to impose strict regulations (including penalization, confiscation of the specimen etc.) regarding trade of all species threatened with extinction or that may become so, in order not to endanger further their survival. The Convention contains three appendices. Appendix I include all species threatened with extinction, which are or may be affected by trade. The Convention requires that trade in these species should be subject to strict regulations. Appendix II includes species that are not necessarily threatened presently but may become so unless trade in specimen of these species is subject to strict regulations. Appendix III includes species which any contracting party identifies as subject to regulations in trade and requires other parties to co-operate in this matter.

International Union for Conservation of Nature and Natural Resources (IUCN) Red List

The red list is published by IUCN and includes those species that are under potential threat of extinction. These species have been categorized as:

- **Endangered:** species that are sent to be facing a very high risk of extinction in the wild in the near future, reduction of 50% or more either in the last 10 years or over the last three generations, survive only in small numbers, or have very small populations.
- **Vulnerable in Decline:** species that are seen to be facing a risk of extinction in the wild, having apparent reductions of 20% or more in the last 10 years or three generations.
- **Vulnerable:** species that are seen to be facing a high risk of extinction in the wild, but not necessarily experiencing recent reductions in population size.
- **Lower Risk:** species that are seen to be facing a risk of extinction that is lesser in extent that for any of the above categories.
- **Data Deficient:** species that may be at risk of extinction in the wild but at the present time there is insufficient information available to make a firm decision about its status.

#### 2.5.21.2 INTERNATIONAL AND NATIONAL NGOS

International environmental and conservation organizations such as IUCN and the World-Wide Fund for nature (WWF) have been active in Pakistan for some time. Both these organizations have worked closely with government and act in an advisory role with regard to the formulation of environmental and conservation Policies. Since the convening of the Rio Summit, a number of national environmental NGO's have also been formed, and have been engaged in advocacy, and in some cases, research. AKRSP also engaged in this area on different projects.

#### 2.5.21.3 PROJECT ADMINISTRATIVE BODIES

The implementing agency of the proposed project is NHA, therefore, NHA is responsible for liaising with line departments to ensure that the Project complies with the laws and regulations controlling the environmental concerns of highway, road and tunnel construction and operation, and that all pre-construction requisites, such as permits and clearances are met. The Office of Environment, Afforestation, Land and Social (EALS) of NHA will be responsible for ensuring that all the measures proposed in the Environmental Management Plan are effectively implemented by the contractor during construction phase and by Directorate of Operation & Maintenance of NHA during operation phase of the proposed Project.

#### 2.5.21.4 WILDLIFE DEPARTMENT GILGIT BALTISTAN

Gilgit Baltistan Wildlife Department controls the district wildlife through District Officers Wildlife DO (W). According to wildlife department setup, this project comes under the jurisdiction of DO (W) of the District Astore. Wildlife related issues pertaining to such areas and associated with the jurisdiction of Astore (GB) during all stages of the Project, the contractor/ proponent will resolve it with the consultation of respective wildlife offices.

### 2.5.22 GUIDELINES FOR THE PREPARATION AND REVIEW OF ENVIRONMENTAL REPORTS

These guidelines on preparation of environmental reports address project proponents, and specify:

- The nature of the information to be included in environmental reports
- The minimum qualifications of the EIA consultant
- The need to incorporate suitable mitigation measures into every stage of project implementation



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

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### 2.5.23 GUIDELINES FOR PUBLIC CONSULTATION

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The guidelines deal with possible approaches to public consultation and techniques for designing an effective programme of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in impact assessment

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### 2.5.24 GUIDELINES FOR SENSITIVE AND CRITICAL AREAS

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The guidelines identify officially notified protected areas in Pakistan, including critical ecosystems, archaeological sites, etc., and present 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.

The guidelines state that the approach recommended in the document should extend to areas near such sensitive and critical sites, although the term ‘vicinity’ is not explicitly defined. Since there are no other sensitive areas within or near the project area, these guidelines will not apply.

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### 2.5.25 SECTORAL GUIDELINES: MAJOR SEWERAGE SCHEMES

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This guideline identifies and explains issues that should be addressed for a sewage collection, transportation, treatment, and disposal system. The guidelines primarily address the issues associated with domestic sewage but are applicable to the Proposed Tunnel Project. The guidelines should be consulted during planning and designing the disposal of sewage from the contractors’ camps, offices and colonies at project sites.

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### 2.5.26 SOLID WASTE MANAGEMENT POLICY

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This policy was promulgated by PEPA in collaboration with JICA in 2000, which aims to facilitate control on waste by providing the principles of good waste management and reducing waste at source. The guidelines should be consulted during planning and designing the disposal of solid waste from contractors’ camps, offices and colonies.

## CHAPTER-3 PROJECT DESCRIPTION

This section provides the brief detail of the proposed project construction of the 12.7 km long tunnel and access roads of GB and AJ&K areas about 26.9 km and 41.5km length (from Kel to Shounter and Shounter to Gorikot). The project traverses through two districts Astore (GB) and Neelum (AJK). Proposed project aims are to connect the major towns of Kel, Lower Domel, Dhakki Nakka, Khora, Chitta katha, Upper Domel, and Chattian, Shounter in Neelum AJ&K area and Morcha Guzair, Mirmalik, Rattu, Nasirabad, Chugam, Rehmanpur and Gorikot in Astore GB area.

### 3.1 TYPE AND CATEGORY OF THE PROJECT

According to Pakistan Environment Protection Agency regulations for review of IEE and EIA highway, road and tunnel projects fall into Schedule-II, i.e. projects requiring EIA. The environmental guidelines of the road and Shounter Tunnel Project would fall within the category 'C' projects having significant impacts on the environment and requiring a full scale EIA.

### 3.2 NEED ASSESSMENT OF THE PROJECT & OBJECTIVES

National Highways play an important role from regional perspective as they carry transit traffic from Pakistan to China, Iran, Afghanistan and Central Asian States and provide access to almost all parts of the country. Under this project National Highway Authority (NHA) has planned the project tunnel and access roads project. The project is expected to benefit both areas communities as well as tourism in these regions. The implementation of the project is envisaged to have the following objectives:

- To provide a safe, efficient, unobstructed, controlled, congestion free and high-speed transport route to road and tunnel users across the districts and country with improved environment and services;
- To open up this land of producing high quality of agriculture products and expose it to new vistas of development, providing villages and towns along the roads and tunnel smoother, easier and unobstructed access to larger cities and larger markets.
- To provide a safe and more efficient passage across the settled areas where people are suffering serious and acute accidents on existing narrow and broken road.
- Promotion of industry and other infrastructure on either side of the road and tunnel for efficient transport of agriculture produce from farm to markets and to industries between GB and AJK areas requiring agriculture based inputs
- Creation of job opportunities for the locals in the project area during the construction and operational phase of the project;
- To boost harmony in the country by providing efficient means of transport for the people of this area to different parts of the country to meet one another
- Connect cities of GB with AJK, Gilgit, Skardu and Islamabad etc. bringing more population in the stream of benefits.

Reduce the rate of crime in this area. In addition, the road project will serve the following objectives:

- Improve the horizontal curves, stopping and passing sight distances, steep grades and sharp curves.



- Strengthen the road pavement structure to sustain heavy loads.
- Improve the existing road as divided 2-lane road and 4-lane tunnel with median and shoulders.
- Assure Design speed as a 60km/h in level terrain, 50km/h in rolling terrain and 30km/h in mountainous terrain. The vertical grade in tunnel section, one of the most important geometric design conditions of this project, is a 1.5% vertical grade as an optimum condition, to improve travelling conditions.

### 3.3 PROJECT LOCATION

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The proposed Shounter tunnel project is located in Shounter valley. The Proposed Project is start from Kel to Shounter and ends at Gorikot. The project site is approximate 65km away from Astore.

### 3.4 PROJECT ADMINISTRATIVE JURISDICTION

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The project corridors will pass through administrations of two districts Astore (GB) and Neelum (AJ&K).

### 3.5 LAND USE ON THE SITE

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The proposed project initiates between Neelum Valley (AJ&K) and Astore Valley (GB), alignment of this section passes entirely through mountainous terrain and crossing water channels and connecting roads to villages. The entire stretch crosses the different streams and Nallahs. These are major surface water body of the project area. Land use of proposed project is mostly agricultural. Dualization and improvement include the widening way of existing road. Topography of the area is almost mountains or hills within the project area. A detail on land/topography and socioeconomic setting of the area is described in Chapter 5.

### 3.6 ROAD ACCESS

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The existing road of section passes through deep gorges, landslide and snow avalanche susceptible area with rather fair horizontal and vertical alignment. In winter season, this road is closed for five or six months due to heavy snowfall. The total length of this section (Astore District) from east portal of the tunnel to Gorikot intersection along the existing road is approximately 41.5 km. The road section is located in mountainous terrain. The formation width of existing road varies from 4.0m to 10.0m irregularly. Most of the road section is unpaved. Even if some section of the existing road is paved, it is worn out and has deteriorated rapidly by a lot of potholes, rutting, and cracks. The lowlands in the existing road pass through a river bed that will be under water in rainy season. Proper measures have been provided in the design of access roads on both sides to counteract these negative impacts of water to the road to be constructed. Therefore, remedial measures and/or partial realignment will be reviewed for designing an all-weather road. The project area access road existing condition of the road is shown in image-1.

Image 1- Proposed Access Road Existing Condition



### 3.7 VEGETATION FEATURES OF THE SITE

The number of anthropogenic activities in the area is very high. The area is under cultivation, leaving little room for natural flora. Major crops in the project area are wheat and maize. The main species were recorded with reference to their existence in the project area like *Pinus wallichiana* (blue pine/cheer), *Pinus macropoda* (chalghoza pine/tholesht), *Betula utilis* (birch/jongji), *Salix tetrasperma* (willow/beyo), *Ailanthus altissima* (ailanthus/kikar) and *Juglans rigia* (walnut/khakai). At present, there is generally a mixture of species found in the tract. The area has been used for agricultural purposes for almost a century; the few small natural floras have been completely replaced. The detail of vegetation is provided in Chapter 5.

### 3.8 PROJECT IMPLEMENTATION SCHEDULE

The construction of the proposed project is expected to be completed within a time period of 108 months in 2027. The construction of the proposed project will be executed after receiving all relevant approvals.

### 3.9 ALIGNMENT ALTERNATIVES

Keeping in view the environmental, social and economic aspects of the development; three locations were considered for the proposed tunnel project. Most feasible option in the context of environment, economic and social sustainability was considered for further development. The options that were evaluated to achieve the required goal are provided in Chapter 4 – “Project Alternatives”.

### 3.10 COMPONENTS OF THE PROJECT

The proposed tunnel project is designed as a 60km/h in level terrain, 50km/h in rolling terrain and 30km/h in mountainous terrain. The vertical grade in tunnel section, one of the most important geometric design conditions of this project, is a 1.5% vertical grade as an optimum condition speed facility. The project is designed for 2-lane divided roadway. The Right of Way (ROW) is 16ft for each

side. The civil works will involve construction of four lanes, fence, under passes, bridge on streams and nallas etc. The Typical Cross Section of design is shown in Table-1 and The Salient Features of Road Tunnel are shown in Table-2.

The project road follows the existing road and track except at bridge locations where it has been rerouted. The plan and profile drawings for the designed access roads have been attached as Annexure-10.

### 3.11 PROJECT COST & MAGNITUDE

The total cost of the proposed project is estimated to be around Rs.40 billion in Pak rupees. The project will be a 4 Lane tunnel with an approximate length of 12.7Km and 2 Lane access roads are about 26.9km and 41.5km.

### 3.12 DESIGN OF PROPOSED TUNNEL & ACCESS ROADS

#### 3.12.1 APPROACH AND METHODOLOGY

##### APPROACH

The project development stages of a Shounter tunnel project are subdivided into 4 different stages:

- Conceptual Design
- Preliminary Design
- Tender Design (Detailed Design, phase 1)
- Construction Design (Detailed Design, Phase 2)

The Consultants have performed the conceptual design and preliminary design in accordance with TOR; however, the Consultants have also studied in line with tender design and construction design. At the beginning of a project, the following basics were prepared:

- Proposed alignment in plan and profile
- Standardized cross section
- Topographic investigation and description
- Environmental investigation including noise, vibration, air pollution, etc.

For the project development of road tunnels the following additional aspects were prepared:

Preliminary considerations to M&E (electromechanical) design, in particular ventilation aspects.

- Traffic forecast and study
- Meteorological investigations

The following general aspects of a project were carried out before the start of design:

- Site visits
- Literature research
- Research into published data and documentation
- Research into relevant standards and guidelines.



### 3.12.1.1 METHODOLOGY

#### 3.12.1.1.1 GROUND INVESTIGATION

It is commonly agreed that high standards and quality for ground investigation lead to an economical and technically sound tunnel construction. However, investigation items and quantities depend largely on the geological complexity of the ground and their requirements of the project.

In general, the investigations were conducted in stages commencing with fast and simple investigation methods and moving towards more time and cost consuming techniques. A combination of cost constraints and the necessary information determined the most suitable investigation program.

As such, after collecting and reviewing existing geological map, aerial photos, available, references, and the results of a preliminary site reconnaissance, surface geological mapping of rock outcrops shall be performed by experienced engineering geologists to obtain detailed, site-specific information on rock quality and structure, which is in compliance with the TOR. Geological mapping was done to collect local, detailed geological data systematically, and was used to characterize and document the condition of rock mass or outcrop for rock mass classification such as discontinuity type, discontinuity orientation, discontinuity infilling, discontinuity spacing, discontinuity persistence, and weathering.

By interpreting and extrapolating all these data, the geologist had a better understanding of the rock conditions likely to be present along the proposed tunnel and at the proposed portal and shaft excavations. The collected mapping data was used in stereographic projections for statistical analysis using appropriate computer software (e.g. DIPS). In addition, the following surface features were observed and documented during the geological mapping program:

- Landslide new and old, particularly in proposed portal and shaft areas
- Faults; Rock weathering
- Groundwater springs
- Presence of talus or boulders

The mapping data also helped in targeting subsurface investigation borings and in-situ testing in areas of observed variability and anomalies. The Consultant carried out the geological mapping with aims to correlate rock mass properties with rock mass behavior through rock and project specific key parameters during the early design.

#### 3.12.1.1.2 DESIGN STANDARDS

AASHTO's "A Policy on Geometric Design of Highways and Streets, 6th Edition (2011)" provides the general design considerations used for Shounter tunnel and recommendations for other requirements specifically for this road tunnel. In addition to the highway standards, geometrical design for road tunnel must consider tunnel systems such as fire safety elements, ventilation, lighting, traffic control, fire detection and protection, communication, etc. Therefore, design of the alignment and cross section of a road tunnel must also comply with National Fire Protection Association (NFPA) 502-Standard for Road Tunnel, Bridges, and Other Limited Access Highways and other international standards.

#### 3.12.1.1.3 TUNNEL GEOMETRY CONTROLS

The principal factors determining the center line include the relative positions of the portals and directions of approach, geology, clearances from external obstacles, gradients, vertical curve, and horizontal curves.



#### 3.12.1.1.4 APPROACHES

For very short and simple tunnel, approach road to a tunnel portal is made with a straight line joining the portals, otherwise introduces curves to suit the approaches with varying gradients to the portal. In general, probability of traffic accidents at portals is significantly high because of climate and environmental changes between open road and inside of proposed tunnel. The Consultant has designed the approach road to the proposed tunnel taking into account the traffic density and taken efforts for the reduction of accidents due to traffic.

#### 3.12.1.1.5 GEOLOGY

Proposed Tunnel is situated in good topographic and geologic conditions and having enough overburden and lower ground level, considering the investigation results and measures to preserve the surrounding environment. The tunnel portal is usually situated in a slope having small overburden. The preferred portal position is at the edge of a mountain ridge and nearly perpendicular to the maximum angle of slope, and in solid ground with no danger of landslides.

#### 3.12.1.1.6 CLEARANCE FROM EXTERNAL OBSTACLES

As a broad generalization, it is usually satisfactory if uniform undisturbed ground outside the proposed tunnel extends for one tunnel diameter; more careful analysis is required if discontinuities and obstructions occur within this zone.

#### 3.12.1.1.7 GRADIENTS

A steep gradient should not be used for road tunnel because heavy vehicles resort to use of their lowest gears, reducing traffic capacity and increasing demand on the ventilation system. Gradient should be limited to 2-3% in a long tunnel. Maximum effective grades in main road tunnel should not exceed 4%. A minimum gradient should be specified (0.25%, usually) to ensure longitudinal drainage of the roadway.

#### 3.12.1.1.8 VERTICAL CURVES

Changes of gradient are normally small in mountain tunnel and connecting curves are correspondingly short, and should follow applicable roadway geometry specifications.

#### 3.12.1.1.9 HORIZONTAL CURVES

In plan, curves may be necessary to align the tunnel with its approach roads and to avoid obstacles in the ground. The same considerations apply in determining the radius as in surface roads: design speed, centrifugal force, super elevation, and line of sight. On very sharp curves, some extra lane width for vehicles is desirable, but may be prohibitively expensive.

#### 3.12.1.1.10 TUNNEL CROSS SECTIONAL REQUIREMENTS

The cross section of proposed tunnel is the important factor in designing the tunnel as construction costs vary greatly accordingly. The cross section is determined by the space required for traffic, space required for other facilities, and by construction methods.

#### 3.12.1.1.11 TRAFFIC SPACE

This shall be defined by the lane width and maximum load height of vehicle. The minimum normal tunnel will accommodate two lanes of traffic.

#### 3.12.1.1.12 OTHER SPACE

Walkways are used for inspection, maintenance, and emergency use for access to the site of an accident and for escape. Additional space may also be necessary for ventilation ducts.

In case of longitudinal ventilation, jet-fan, at least 200mm marginal space between the bottom of jet-fan and the construction limit should be secured. Separation distance of 0.3 Diameter of jet-fan between the top of jet fan and the crown should be kept. In a circular tunnel, the spaces beneath the roadway and above the clearance line are available without extra excavation, and in a horseshoe tunnel there is normally a substantial area in the crown.

#### 3.12.1.1.13 CYCLISTS AND PEDESTRIANS

In the construction of proposed tunnels, there is a demand for crossing facilities for cyclists and pedestrians. This can be disproportionately costly if incorporated in a vehicular traffic system. Other facilities, in addition to ventilation, to be incorporated within the proposed tunnel and are the services for the tunnel itself: lighting, emergency services such as telephones and fire alarms, fire mains, air quality monitoring devices and visibility, public address systems, traffic lights and signals, drainage and pumping. Reference was made to National Fire Protection Association (NFPA) Standard 502 (2001).

#### 3.12.1.1.14 CONSTRUCTION REQUIREMENTS

The shape of a proposed tunnel, whether rectangular, circular or horseshoe in form, is dictated by the method of construction adopted to suit the ground conditions. For excavation by full face machine, usually, the circular form pertains. In long mountain tunnels, a rising gradient is preferred to simplify drainage during construction; in shield-driven tunnel, sharp curves, horizontal or vertical, present difficulties in steering the shield and building the lining. The Consultants will develop the proposed tunnel cross section based on the space required for traffic, space required for other facilities, tunnel driving method and marginal space for construction error.

#### 3.12.1.2 TUNNEL DESIGN OF PROPOSED PROJECT (GB AREA)

It is envisaged that the Project shall be constructed as 4-Lane tunnel with bridges over streams and nallas. Road furniture comprising of lane markings, traffic signs, guard rails and reflectors shall be provided. Proper intersections shall be designed where required. The 12.7 km long tunnel and access road is about 41.5km (from Shouenter to Gorikot). Shouenter tunnel and access road shall be a limited access facility and shall conform to the following specifications entailing Design speed as a 60km/h in level terrain, 50km/h in rolling terrain and 30km/h in mountainous terrain. The vertical grade in tunnel section, one of the most important geometric design conditions of this project, is a 1.5% vertical grade as an optimum condition, road width (Travel Lanes) consisting of two lane. Various locations along the proposed ROW require provision for smooth connection for the existing route for communication.

#### 3.12.1.3 BRIDGES

Four bridges are located in this section crossing Mir Malik Gah Nallah and its tributaries. All the bridges are a concrete girder type. The replacement is needed when an existing bridge is dangerous or functionally obsolete, but a bridge becomes functionally obsolete, even though it is structurally sound, due to incompliance with the adopted geometric design standards. Therefore, the replacement or preservation of the existing bridges shall be determined during the alignment design. No drainage system is identified on the existing road.

TABLE 1-TYPICAL CROSS-SECTIONS (ROADWAY, BRIDGES & TUNNEL)

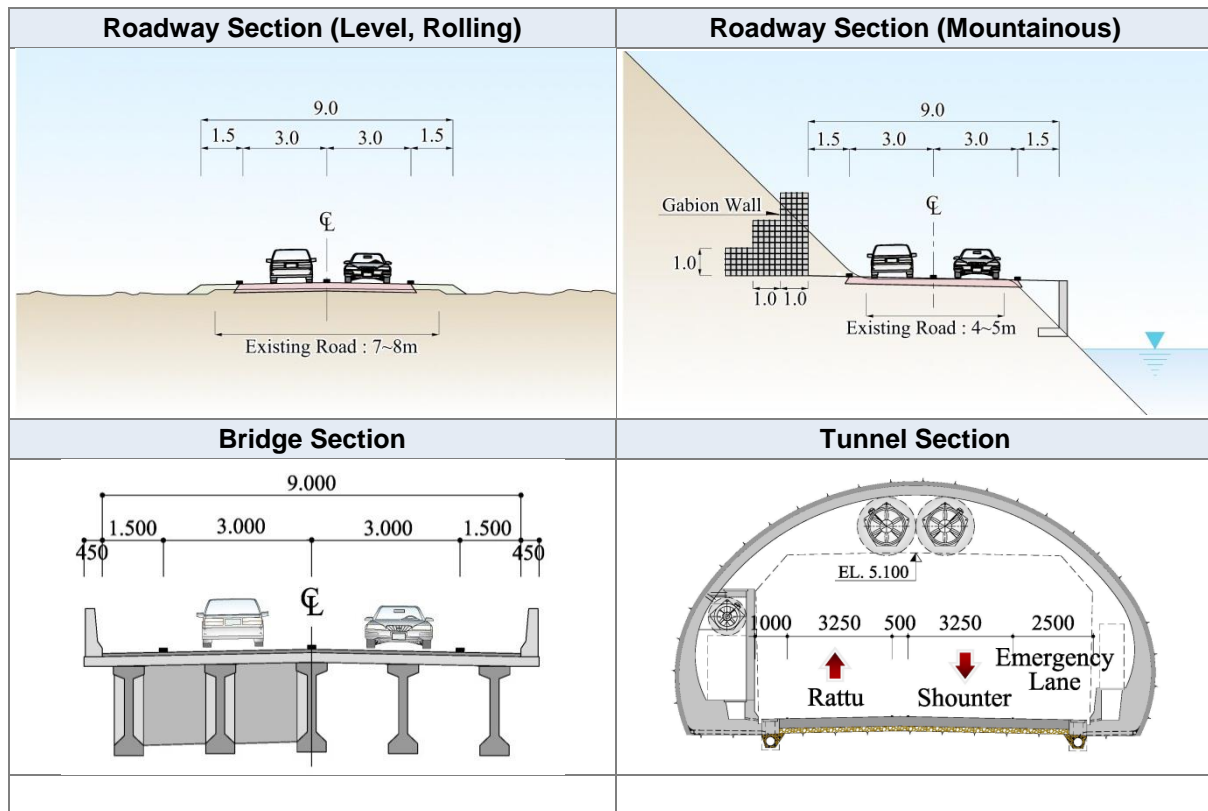


TABLE 2- SALIENT FEATURES OF ROAD TUNNEL

Division		Shounter-Rattu Road Tunnel	Remarks
Tunnel Length		12.7km	Including 10m of Open Cut Tunnel at Two Portals
Horizontal Alignment		Straight + Curve + Straight	R=5,000m, L=2.995km
Vertical Grade		+1.5% ~ (-)1.5%	
Vertical Clearance		5.1m	
Road Width and Shoulders		1.0+3.25+0.5+3.25+2.5=10.5m	Left Shoulder:1.0m, Lane Width:3.25m Median:0.5m, Emergency Lane:2.5m
Super elevation		-2.0%	Concrete Pavement
Portal Structure	West Portal	Arch-shaped Wall Type	
	East Portal	Arch-shaped Wall Type	
Ventilation System		Ventilation Shaft with Jet Fan Longitudinal Ventilation	Diameter of Shaft = 7.0m Height = 333m Raise Climber Excavation Method
Tunnel Excavation Method		Drill and Blasting	Conventional Tunneling, NATM
Tunnel Safety Facility		Lay-bys (3.0m width) + Emergency Lane (2.5m width) +Evacuative Passage (1.2m width)	Lay-bys are installed every 750m

### 3.12.1.4 CIVIL WORKS

The civil works will involve construction of four lanes, grade-separated cross bridge on streams etc. The tunnel will be 4 lanes (2 lanes each direction) and access road will be 2 lanes. The proposed pavement structure is as under: Table-3 and Table-4.

#### 3.12.1.4.1 PAVEMENT DETAILS

TABLE 3-PROPOSED DESIGN FOR FLEXIBLE PAVEMENT (ADDITIONAL CARRIAGEWAY)

Layer	Proposed Thickness (mm)
Asphalt Wearing Course	50
Asphalt Base Course	190
Aggregate Base Course	200
Granular Sub-base Course	200
Subgrade (CBR $\geq$ 15%)	300

TABLE 4-PROPOSED DESIGN FOR FLEXIBLE PAVEMENT (EXISTING CARRIAGEWAY)

Layer	Proposed Thickness (mm)
Asphalt Wearing Course	50
Asphalt Base Course New Layer 90	90
Aggregate Base Course Existing 100	100
WBM Existing 300	300
Sub- Base course Existing 200	200

### 3.12.1.5 CONSTRUCTION MATERIALS

The materials to be used in construction of this access road and Proposed Tunnel Project would include coarse aggregates (crush), fine aggregates (sand), soil, water, asphalt, reinforcement, cement etc. Almost all these raw materials are mostly locally available along the alignment. Huge magnitude of construction material for access road and proposed tunnel project will be procured from approved quarries and new quarries may be required by the contractor to be approved during that stage.

### 3.12.1.6 CONSTRUCTION CAMPS

Camp sites will be selected keeping in view the availability of adequate area for establishing camp sites, including parking areas for machinery, stores and workshops, access to local markets, and an appropriate distance from sensitive areas in the vicinity. Final locations will be selected by the contractor after approval from client- NHA. The area requirement for construction camps will depend upon the deployed manpower and the type and quantity of machinery mobilized. In view of the area required, it will be possible to locate camp sites within the ROW and the contractors will not have to acquire additional land for the establishment of Camps. Environmental Management Plan (EMP) considerations will have to be considered before the selection of sites for the required purpose.

### 3.12.1.7 MANPOWER REQUIREMENTS

The contractor will mobilize staff depending on the stretch of site to be constructed and package length awarded to the contractor. The manpower required during the construction and operation of the proposed tunnel and access road would be approximately 250- 300 during construction phase and approximately 50-70 staff during operation phase of the project.

### 3.12.1.8 CONSTRUCTION MACHINERY AND EQUIPMENT

The list of the machinery and the equipment required but not limited to for the access road and proposed tunnel project is given below:

1. Dump Truck	12. Asphalt Distributor
2. Front End Loader	13. Batching Plant/Crusher
3. Dozer	14. Concrete Transit Truck
4. Grader	15. Concrete Pump
5. Vibratory Roller	16. Excavator
6. Water Tankers	17. Water Pumps
7. Spreader	18. Cranes
8. Three Wheel Rollers	19. Vibrators
9. Tandem Roller	20. Tunnel Boring Machine (TBM)
10. Asphalt Plant	21. Generators
11. Self-Propelled Pneumatic Roller	

### 3.12.1.9 ENERGY RESOURCES AT CAMP AREAS

With regard to electric power supply, the most important task in the early stage of the Project is the estimation of the power required for supply. In order to attain a high level of efficiency, the components should work with a load of 70 to 80 % of the maximum power output. Under sizing causes malfunctions, while over sizing results in excess costs. The network configuration is determined dependent on the requirements resulting from the Project facilities' use. In line with the specifications made by the installation company and the intended use of the Project facilities, the required power output must be distributed between different sources of supply. If redundancy is a system requirement, an additional reserve must be considered in the planning. Besides the demand to be met by the normal power supply (NPS), the power required from a safe and reliable source of supply must also be estimated. This demand of safety power supply (SPS) is divided between the emergency stand by power system (ESPS) and the uninterruptible power supply (UPS). When the NPS fails, the UPS shall be supplied from the ESPS.

During construction period, the consultant has planned electrical equipment to supply steady electrical power without excessive fluctuation of voltage. The NHA will be reasonable to installing a small hydropower unit for environmentally friendly energy resources in the view of environmental sensitivity of the region, where project is going to be executed on Shounter stream/Nullah for tunneling machinery such as ventilation fans and jumbo drills, site camps and illumination, etc.

Following Table-5 shows each required electric power at each location. During construction period, 7,500 kVA would be needed, and during road sections operation period, approximately 8,850kVA would be needed.

TABLE 5- ELECTRICAL SUPPLIES BY LOCATION

Location	Required Electric Power	
	During Construction Period	During Operation Period
Shounter Side	3000kVA	2200kVA
Rattu Side	3000kVA	2200kVA
Ventilation Complex	1500kVA	4,250kVA
Sum	7,500kVA	8,850kVA

### 3.12.1.10 RESTORATION AND REHABILITATION PLAN

After the completion of construction phase of the proposed project, it is the responsibility of the contractor to restore the site that has been disturbed due to construction activities. It is responsibility of NHA to ensure that environmental value of the project area is maintained for future generations. There may be areas that could be affected by construction activities which may require rehabilitation such as stockpile sites, campsites, side-tracks, borrow pits and washing yard.

**Stockpile sites:** Stockpile areas and construction camp sites should be developed to sustain the visual aspect of the project area. Limits of disturbance and/or clearing must be clearly settlement/market out on the site using posts or flagging tape before any ground disturbing activity takes place.

**Side-tracks:** Sidetracks may create a much greater impact than the actual construction site itself. If sidetracks are justified, limits of disturbance must be clearly marked out on the site before any ground disturbing activity takes place. Rehabilitation of sidetracks requires removal and disposal of fill materials used for temporary approaches, abutments, crossings or embankments. All remaining areas must be reshaped to blend back in with preexisting landforms.

**Borrow Pits:** Borrow pits are areas either in a road reserve or adjacent land holdings that have been used to extract materials such as gravels and soils. They can vary considerably in size, depending on the quantity of material taken and the borrow pits' reserve body of remaining material. The variable size, shape and nature of borrow pits preclude very specific recommendations; however, the following general conditions apply.

- Before extraction commences, licenses and permits should be checked and limits of disturbance and/or clearing must be clearly settlement/marked out on the site before any ground disturbing activity takes place; and
- At the completion of extraction, the former borrow pit must be made stable and safe.

This usually requires the sides of the pit to be reshaped with gentle safe grades. All disturbed areas associated with borrow pits must be retopsoiled, seeded, fertilized and mulched (if appropriate) as part of the restoration plan. Tunnel and Roads has been discouraging the conversion of borrow pits to stock watering points.

**Monitoring:** To achieve continuous improvement and ensure the activities specified in contracts are being adhered to, regular monitoring will be undertaken with emphasis placed on the continuity between site characteristics and the adjacent landscapes. Restoration of sites disturbed by construction activities is unlikely to ever mimic the original landscape. Performance of the contractor can usually be gauged by comparing adjacent landscapes. Low continuity between these landscapes usually indicates that no attention has been given to site stability.





Description	2018			2019			2020			2021			2022			2023			2024			2025			2026		
	4	8	12	4	8	12	4	8	12	4	8	12	4	8	12	4	8	12	4	8	12	4	8	12	4	8	12
Detailed Design																											
Procurement of Contract																											
Road Works																											
Bridge Work																											
Tunnel Excavation and Support works																											
Tunnel Concrete Lining and Waterproof																											
Tunnel Portal Works																											
Tunnel Pavement Works																											
Electro-Mechanical Works																											
Operation Building Works																											
Ancillary Works																											

## CHAPTER-4 PROJECT ALTERNATIVES

The discussion and analysis of Alternatives in an Environmental Impact Assessment (EIA) considers different practicable strategies that will promote the elimination of identified negative environmental impacts. This section is a requirement of the EPA Gilgit Baltistan and is critical in consideration of the ideal development with minimal environmental disturbance. This report has identified some major environmental impacts as noted by scientific experts. The findings of these impacts were utilized to analyze possible options for the final development. The following alternatives have been identified and are discussed in further detail below:

- ❖ Alternative-I ‘No Development Option’
- ❖ Alternative II ‘Site Option - Site Selection Criteria’
- ❖ Alternative-III ‘Other Transport Modes’

### 4.1 ALTERNATIVE-I “NO DEVELOPMENT OPTION”

The “No Development” alternative is required to ensure the consideration of the original environment without any development. This is necessary for the decision makers in considering all possibilities. The development will have a minimal effect on the physical environment. In terms of the social environment, the “No Development” alternative would result in traffic density on the existing roads, detour during floods / rains, increase travel hazard, eliminate job opportunities, higher transport costs, higher travel time, less efficient traveling, lack of incentive for frequent longer distance travels, non-development of the hinter-land, increase the dust nuisance created by driving on deteriorated tunnel/road and increase the wear and tear on the vehicles. Residents of the proposed belt will keep on suffering from degraded or lacking efficient transportation access. The No Project conditions will result in further worsening the present environmental conditions and increased disturbance to residents of the existing road and proposed tunnel network areas and the road users. Keeping in view increased population, lack of vibrant and efficient economic corridor across the country, lack of job opportunities, lack of good governance and security control, it is important that the existing road and proposed tunnel network should be improved to cater for the increased vehicular movement carrying the freight and passengers across the two districts; Astore (GB) and Neelum (AJK) and to provide impetus for regional connectivity to country.

### 4.2 ALTERNATIVE-II ‘SITE OPTION - SITE SELECTION CRITERIA’

Keeping in view the environmental, social and economic aspects of the development, three locations were considered for the proposed project. Most feasible option in the context of environment, economic and social sustainability was considered for further development. For the tunnel corridor route of Rattu-Shounter, three (03) alternative alignments were considered. The proposed project consists and salient features and their differences are listed below:

The proposed project consists of the following:

- 1) Access Road (AJ&K – Neelum District)
  - a) From Kel to Shounter
- 2) Tunnel
  - a) Connecting Shounter to Morcha Guzair

### 3) Access Road (Gilgit Baltistan – Astore District)

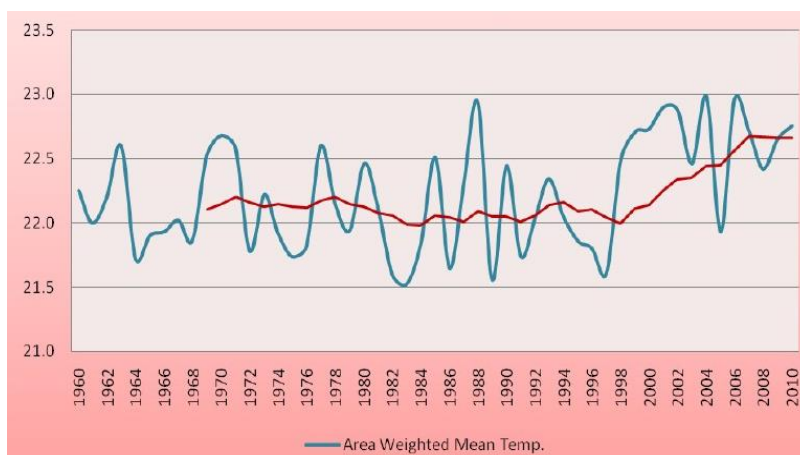
#### a) Morcha Guzair to Gorikot

The existing snowline in of the region was first done to understand and estimate the variability of snow cover for the future.

## 4.2.1 REVIEW OF SNOWLINE ELEVATION

Basically, the project goal is the provision of a reliable all-weather road as requested in TOR. To decide an optimal route, the Consultant investigated the past snowfall data and snowline elevation of project area using regression analysis based on reliable source and climate change data issued by Climate Change Division of Pakistan, and ADB.

Snowline is the extent of down slope elevations up to which snow used to occur during the winter season. They are the regions where air temperatures drop below zero for an extended time period.



WEIGHTED MEAN TEMPERATURE(1960-2010)  
CLIMATE CHANGE DIVISION OF PAKISTAN

Observed air temperature trends in Pakistan go along with the global trends. The latest observed temperature data obtained from Pakistan Meteorological Department (PMD) shows that the mean surface air temperature in Pakistan has risen at the rate of 0.099°C per decade from 1960-2010 resulting in total change of 0.47 °C. Drastic rise in temperature in the last decade has been observed.

The northern mountains producing the Himalayan-Karakoram-Hindukush glaciers have retained more heat than the low elevation plains. A research (Global warming and expected snowline shift along northern mountains of Pakistan, Proc. of 1st Symposium Yokohama, Japan.) conducted by Rasul, et al., 2006, pointed out that snowline has risen up sharply slope by about a 1 km during the last 25 years. It is shown that snow line has been increased up to 40m per 1 year. And according to the report (A Report on climate change and its impact in Kashmir, authored by Arjimand Hussain Talib), the snow line in project area is predicted about 3,200~3,700m in 2016.



Growth of Glacial Lake Over a Period of 3 Years

Based on these research reports, we can predict that snow line will be increased as below Table-6 in the future. Among these data, the Consultant will apply the medium snowline elevation predicted.

TABLE 6-PREDICTED SNOWLINE IN THE FUTURE

Snowline	2006	2008	2010	2012	2014	2016	2018	2020
Minimum(m)	3,000	3,040	3,080	3,120	3,160	<b>3,200</b>	3,240	3,280
Medium(m)	3,250	3,290	3,330	3,370	3,410	<b>3,450</b>	3,490	3,530
Maximum(m)	3,500	3,540	3,580	3,620	3,660	<b>3,700</b>	3,740	3,780

The elevation of the existing road ranges from 2,100m to 3,300m. The snowline elevation of project area is predicted about 3,450m. Therefore, the snowline elevation is not so important factor to determine the final vertical alignment and the length of tunnel since the design level of tunnel portal is lower than predicted snowline elevation at tunnel portal.

#### 4.2.2 KEY CONSIDERATIONS FOR ALTERNATIVE TUNNEL CORRIDORS

- The location of tunnel portal and tunnel length on the basis of terrain conditions
- Avoidance of the major landslides
- Longitudinal gradient of tunnel and ventilation system
- Avoidance of excessive slope cutting at tunnel portal sites
- Avoidance of steep sloped area for tunnel portals due to snow avalanche
- Improvement of the horizontal and vertical alignment of existing road

#### 4.2.3 KEY CONSIDERATIONS FOR EXISTING ROAD

- Improvement of existing alignment by providing tunnel route corridor
- The horizontal and vertical alignment between tunnel and access road
- Consideration of problematic areas such as major landslides, steep gradients and tight curve of the existing road alignment

#### Key Issues for Optimal Route Selection

The existing road can be divided into two sections given engineering, terrain characteristics and anticipated tunnel portals. Two sections divided are as follows:

- Section 1** is from Shounter Valley Road, starting from Kel intersection at Kel village, to Upper Domail (South portal of the tunnel). The length of this road section is about 26.1km.
- Section 2** is from North portal of the tunnel at Butt wash village to Astore Valley Road at Gorikot intersection. The length of this road section is about 41.6km

Existing road plan and overall findings of each section are described below:



## SECTION 1 (KEL ~ SHOUNTER ~ UPPER DOMAIL ~ WEST PORTAL OF THE TUNNEL)



1. Starting Point of Project, Kel Intersection



2. Existing Wooden Bridge



3. Existing Road Condition



4. Need to Drainage System



5. Variation of Road Width



6. Rugged Unpaved Road



7. Steep Vertical Grade



8. Shounter Village



9. Tight Hairpin Curve



Kel intersection, a start of the project road, is the crossing point of Shounter Valley road and Tao Butt road. From Kel intersection to Shounter Valley, the villages that come across are Kel, Bagnuwali, Shounter and Upper Domail.

The existing road has steep vertical grade and tight curve on hairpin bend, causing vehicles in dangerous circumstances. The elevation varies from 2,105m at Kel intersection to 3,150m at anticipated west portal of the project. The road length of section 1 from Kel to west portal along the existing road is approximately 26.1km.

**Existing Road Conditions:** Most of the alignment conditions are badly poor and risky except some road sections. The risks of existing road alignment are steep vertical grades and tight hairpin curves. The formation width of existing road varies from 4m to 10m irregularly. Most of the existing road is unpaved. The lowlands in the existing road pass through a river bed that will be under water in rainy season unless proper measures put into practice. Therefore remedial measures and/or partial realignment will be reviewed for designing the all-weather road.



**Assessment of Slope:** The slopes along the existing road are steep and materials exposed are composed of highly weathered sedimentary, metamorphic rock or colluvium deposits. Unstable slopes with highly weathered fragile materials are likely to trigger off landslide steadily and progressively. And rock falls are ongoing from place to place, so that high risks of traffic accidents are anticipated. Sweeping away rock fragments and soil particles due to rainfall/snow melting causes debris-flow gully leading to block the existing road. Moreover snow avalanche still remains on site to produce run-off, which will contribute to a potential landslide.



#### Requirements for Bridging and Other Structures:

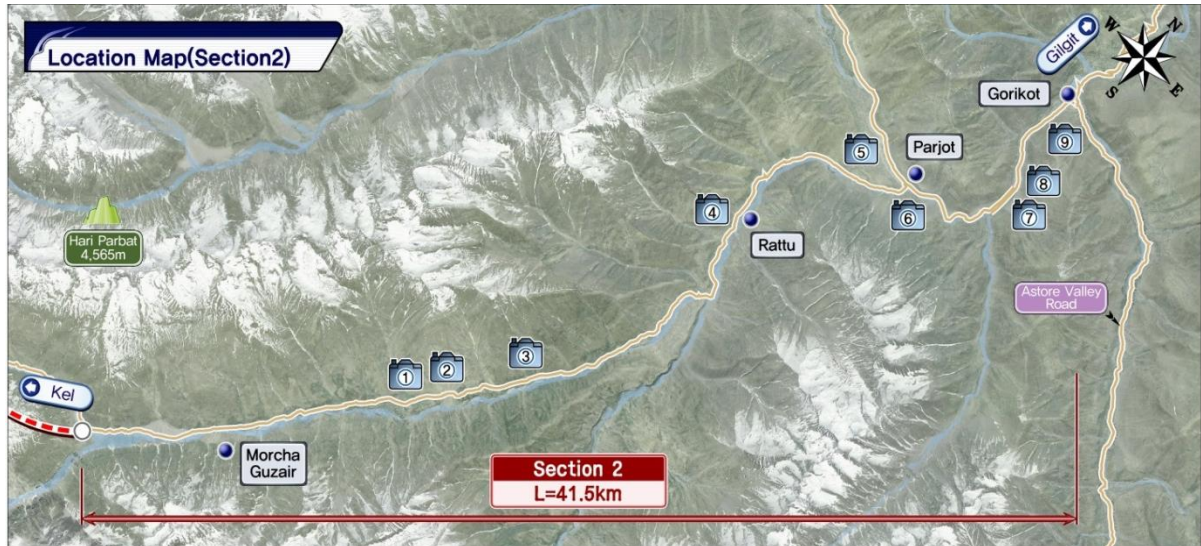
Total three (3) bridges, crossing the tributaries of Baral Nallah, are located on the existing road i.e. temporary wooden bridge (L=10m), Acrow panel bridge (L=21m) at Lower Domali, and Acrow panel bridge (L=24m) at Upper Domali. The replacement is needed when an existing bridge is dangerous or functionally obsolete, but a bridge becomes functionally obsolete, even though it is structurally sound, due to incompliance with the adopted geometric design standards. Therefore, the replacement or preservation of the existing bridges shall be determined during the alignment design.

Key issues for route corridor selection are:

- i) Route corridor should avoid the major landslide and landslide prone area.
- ii) The horizontal and vertical alignment of existing road will be improved considering topography condition, construction cost, environmental and social aspects.
- iii) Route corridor shall be selected after considering whether the slope reinforcement is feasible or partial realignment is reasonable to avoid landslide areas.

## SECTION 2 (EAST PORTAL OF THE TUNNEL ~ MORCHA GUZAIR ~ RATTU ~ GORIKOT)





The Gorikot intersection, an end of the project road, is the crossing point of Astore Valley road and Rattu road. The existing road of section 2 passes through deep gorges, landslide and snow avalanche area with rather fair horizontal and vertical alignment. In winter season, this road has been closed for

five or six months due to a heavy snowfall. The total length of section 2 from east portal to Gorikot intersection along the existing road is approximately 41.6km.

**Existing Road Condition:** The road section 2 is located in mountainous terrain. The formation width of existing road varies from 4.0m to 10.0m irregularly. Most of the road section 2 is unpaved. Even if some section of the existing road is paved, it is worn out and deteriorated rapidly by a lot of potholes, rutting, and cracks.

The lowlands in the existing road pass through a river bed that will be under water in rainy season unless proper measures put into practice. Therefore remedial measures and/or partial realignment will be reviewed for designing an all-weather road.

**Assessment of Slope:** The slope is comprised of mainly metamorphic and sedimentary rock. Some section of the existing road is covered with rock fragments due to weathering and erosion. Nevertheless, fewer landslide prone areas are identified than section 1. Most of landslides are mainly debris flow and rock falls due to the geological weak formation and a steep slope.

A section from Gorikot to Rattu needs to clear slope surface where rock falls are ongoing sporadically. After Rattu village, sweeping away due to rainfall /snow melting is the same problematic issue of debris-flow with Section-1 but the existing route passes apart from the unstable slope at a distance.

**Requirements for Bridging and Other Structures:** Four bridges are located in this section crossing Mir Malik Gah Nallah and its tributaries. All the bridges are a concrete girder type. The replacement is needed when an existing bridge is dangerous or functionally obsolete, but a bridge becomes functionally obsolete, even though it is structurally sound, due to incompliance with the adopted geometric design standards. Therefore, the replacement or preservation of the existing bridges shall be determined during the alignment design. No drainage system is identified on the existing road. The hydrological and hydraulic investigation will be carried out for preliminary drainage design.

Key issues for route corridor selection are:

- i) Route corridor should avoid the major landslide and landslide prone area.
- ii) Preservation and widening of the existing bridges shall be considered since the existing bridges are structurally in sound conditions.
- iii) Remedial measures and/or partial realignment shall be reviewed for the flood prone area of the existing road on the basis of high-water level.

**Existing Road Condition**



**Debris Flow Prone Slope near Gorikot**





## 4.2.4 SELECTION OF ROUTE CORRIDORS

### 1) Control Points for Selection of Route Corridor

The Consultants confirmed three alternative routes through desk study and site reconnaissance. Overall findings concerning control points for selection of route corridor as mentioned earlier can be summarized as follow;

- i) The primary objective of project road is the provision of basic all-weather access even in winter season to satisfy a proven demand.
- ii) Route corridor should balance the socio-economy and transport requirements, given the challenge in meeting basic access needs is deriving standards which can deliver the minimum level of services necessary to promote and sustain the development of rural community.
- iii) Route corridor should avoid the major landslide and landslide prone area. Major landslide is neither possible, nor feasible, nor even desirable to prevent.
- iv) Realignment of some sections where the sharp u-turn on hairpin curves exist, is essential for all-weather access. Tunnel route corridor should cover this problem.
- v) Minimum length of tunnel, wherever possible, should be provided in accordance with basic access road concept, since a tunnel is an expensive option.

Focusing above mentioned key issues/control points for route corridor selection, the Consultant proposed three (3) candidate routes, which is compliance with the terms of reference (TOR).

## 4.2.5 THE MAIN CHARACTERISTICS OF ROUTE ALTERNATIVES

The salient features of each alternative are described as below;

### 4.2.5.1 ALIGNMENT 1 (TUNNEL LENGTH 12.68KM)

#### DESCRIPTION OF ALIGNMENT

The length of alignment No.1 is almost 81.13km (west access road 26.93km + tunnel 12.68km + east access road 41.52km=81.13km). It starts from Kel village and culminates at near Gorikot village. The west portal of Alignment No.1 is located at a road distance of approximately 26.93km from Kel village. The Alignment 1 can avoid the potential problematic zone.

#### 4.2.5.1.1 GEOMETRIC ALIGNMENT CONDITIONS

The horizontal alignment of alternative No. 1 traverses level, rolling and mountainous terrain. Also, the geometric design of horizontal alignment No. 1 meets the design criteria based on the design speed as a 60km/h in level terrain, 50km/h in rolling terrain and 30km/h in mountainous terrain. The vertical grade in tunnel section, one of the most important geometric design conditions of this project, is a 1.5% vertical grade as an optimum condition.

#### 4.2.5.1.1 TUNNEL PORTAL CONDITION

##### WEST PORTAL CONDITIONS (SHOUNTER SIDE)

The geological formation of the west portal is composed of colluvium deposit including rock fragments fallen down along the steep slope. Rock unit exposed at the portal is meta-igneous rock having horizontal schistosity induced by the regional metamorphism.

Under the portal area, Baral Nallah flowing toward Kel is located and scouring the bottom of the mountain slope. Water ingress from the slope face of the portal is not detected and relatively thin colluvium deposit on the bed rock is anticipated in view of geomorphology. An access road will travel to the slope face of the portal with  $73^\circ$ , so that the portal condition is relatively favorable in a tunnel engineering perspective compared with surrounding regional geological conditions.



A few houses are located near the west tunnel. Control of noise, vibration and stability of existing building is required timely because the inhabitant moves here and lives in the village in only farming season but there is no inhabitant in the village in winter season.

Reinforcement of steel pipe with grouting which is umbrella arch method type must be applied to guarantee the tunnel stability because tunnel portal will be constructed in frequently changing ground. With respect to the tunnel portal structure, application of retaining-wall-type tunnel portal, which can shorten the open cut tunnel length, may be required to avoid interference between tunnel portal construction and abutment construction of the bridge overpassing Baral Nallah to be constructed.

##### EAST PORTAL CONDITIONS (RATTU SIDE)

The slope of the mountain at the east portal is rather gentle and it is covered with soil and rock debris layers. The exposed outcrops cannot be found at the portal location. However thickness of soil layer seems to be shallow. Geology of the east portal area is paragneiss having inclined schistosity as a bed rock.



At upper-left side of the portal, small gully is located. The gully has no water stream at present but the water flow along the gully is expected during rainfall. And water ingress from the slope face of the portal is not detected. Intersection angle of tunnel axis and the slope face is about  $43^\circ$  and it means that tunnel will be excavated within unsymmetrical surrounding rock mass in view of terrain-tunnel relationship. Therefore the geology condition of the east portal is better than one of the west portal but geomorphological condition is worse than the west because of presence of small gully which needs drainage remedial works and inclined advancing tunnel toward the slope face.

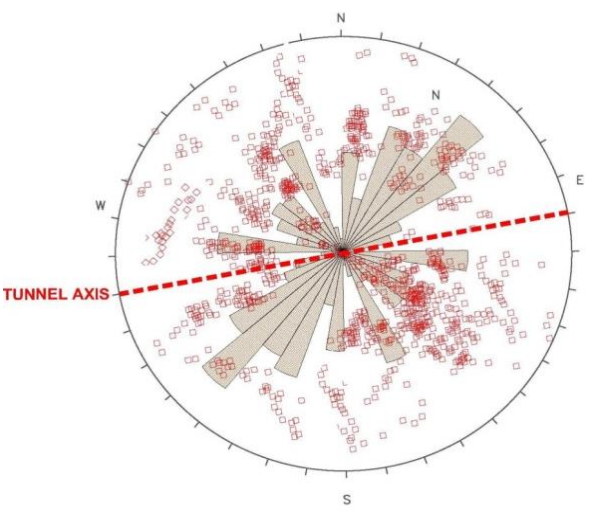
There is no house near the west tunnel to consider hazards due to tunnel blasting, but it is necessary to give careful attention to the tunnel blasting while some livestock such as horses and sheep passes by tunnel construction area.

Reinforcement of steel pipe with grouting which is umbrella arch method type must be applied to guarantee the tunnel stability because tunnel portal will be constructed in unsymmetrical topography. With respect to the tunnel portal structure, application of retaining-wall-type tunnel portal, which can shorten the open cut tunnel length, may be required to avoid interference between tunnel portal construction and abutment construction of the bridge overpassing Mir Malik Gah Nallah to be constructed.

## GEOLOGICAL CONDITION

Main rock type along the alternative 1 (tunnel length L=12.68km) is Meta volcanic, metasediment, metaigneous, amphibolite. Geological characteristics of Alternative 1 are that strike direction of joint and tunnel axis are about 34° to the tunnel axis within tunnel section. According to RMT distribution designated in Tunnel Profile of Excavation Class, Alternative 1 has more competent ground conditions than ones of Alternative 2. Thus, Alternative 1 is quite better condition for tunneling than Alternative 2. Furthermore Alternative 1 has challenging condition for tunneling because 12 faults are crossing the tunnel route. However the numbers of faults are fewer than ones of Alternative 2.

### Geological Features of Alternative 1

Characteristic of Alternative 1	Geotechnical Description
	<ul style="list-style-type: none"> <li>Major Rock Units: <ul style="list-style-type: none"> <li>- Alluvial and glaciofluvial deposit</li> <li>- Meta volcanic, meta sediment, meta igneous and amphibolite</li> </ul> </li> <li>Strike Direction of Joint: <ul style="list-style-type: none"> <li>- The Strike direction runs about 34° to the tunnel axis</li> </ul> </li> <li>Major RMTs: <ul style="list-style-type: none"> <li>- RMT 1, 3, 4, 5, 7, 8 and 11.</li> </ul> </li> <li>Faults and Water Condition: <ul style="list-style-type: none"> <li>- 12 faults are crossing the tunnel route</li> <li>- 10 liter to 30liter/sec of water ingress is anticipated.</li> </ul> </li> <li>Risk of Tunnel Excavation: <ul style="list-style-type: none"> <li>- West portal site is located in a steep slope</li> <li>- A small gully is located in in Upper-left of east portal site</li> <li>- Rock burst is anticipated in some high overburden area</li> </ul> </li> <li>Horizontal alignment: <ul style="list-style-type: none"> <li>-Straight + Curve (with radius 5,000m) + Straight</li> </ul> </li> <li>Vertical grade: (+)1.5% ~ (-)1.5%</li> </ul>

## CONDITION OF BRIDGE LOCATION

There is a wooden bridge at the beginning point and two Acrow panel bridges in the middle of the route. These are required to be replaced by concrete girder bridges. On the access road to Shounter portal, a new bridge with a length of 380m is required to align the approach road to Shounter tunnel portal. On the access road to Rattu portal, there are four concrete girder bridges which are planned to be widened based on the alignment design.

### 4.2.5.2 ALIGNMENT 2 (TUNNEL LENGTH 12.72KM)

#### DESCRIPTION OF ALIGNMENT

The length of alignment No.2 is almost 81.05km long (west access road 26.88km + tunnel 12.72km + east access road 41.45km=81.05km). It starts from Kel village and culminates at near Gorikot village likewise alignment 1. The west portal of Alignment No.2 is located at a road distance of approximately 26.88km from Kel village. The tunnel portal is located near the valley.

#### 4.2.5.2.1 GEOMETRIC ALIGNMENT CONDITIONS

The horizontal alignment of alternative No. 2 traverses level, rolling and mountainous terrain. Also, the geometric design of horizontal alignment No. 2 meets the design criteria based on the design speed as a 60km/h in level terrain, 50km/h in rolling terrain and 30km/h in mountainous terrain. The vertical grade in tunnel section, one of the most important geometric design conditions of this project, is a 1.5~2.5% vertical grade as a good condition.

#### 4.2.5.2.2 TUNNEL PORTAL CONDITION

##### WEST PORTAL CONDITIONS (SHOUNTER SIDE)

The west portal of alignment 2 is located at about 106m distance away from the west portal of Alignment 1. Basically, geological condition is same with one of Alignment 1. But colluvium deposit including rock fragments of the portal is thicker than one of Alignment 1 and a large quantity of debris flow toward a tunnel portal are expected. Water ingress from the rock fragment slope is not detected but Baral Nallah scours bottom of mountain slope. Thus, it makes the portal slope dangerous.



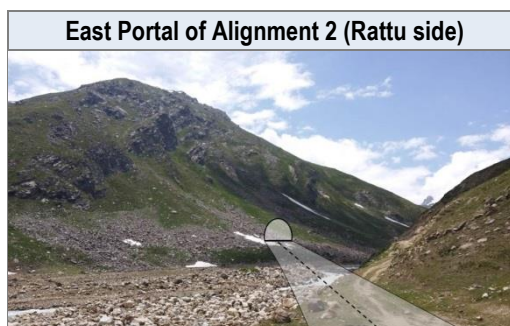
The intersection angle of tunnel axis and the slope face is about 69° and portal condition is rather unfavorable than one of Alignment 1. The horizontal curve is required to align access road to tunnel portal, so that it is not recommended in view of road safety.

A few houses are located near the west portal but farther than the west portal of alignment 1. Thus concern about tunnel blasting affection may be not considered.

Reinforcement of steel pipe with grouting which is umbrella arch method type must be applied to guarantee the tunnel stability because tunnel portal will be constructed in unsymmetrical terrain and frequently changing ground. With respect to the tunnel portal structure, application of retaining-wall-type tunnel portal like one of alignment 1 may be required to avoid interference between tunnel portal and abutment of the bridge overpassing Baral Nallah.

##### EAST PORTAL CONDITIONS (RATTU SIDE)

The east portal location of alignment 2 is located at about 130m distance away from the east portal of Alignment 1. The exposed outcrops were not found at the portal location. Furthermore, thickness of soil layer, alluvium deposit, seems to be thicker than one of Alignment 1. Geology of the east portal area is paragneiss having inclined schistosity as a bed rock.



Water ingress from the slope face of the portal is not detected because of dry season. Intersection angle of tunnel axis and the slope face is about 54° and it means that tunnel will be excavated within unsymmetrical surrounding rock mass in view of terrain-tunnel relationship. Therefore, the geology condition of the portal of alignment 2 is worse than one of Alignment 1 but geomorphological condition is better than one of the portal of Alignment 1. In this case, the geological condition shall be considered in priority for selection of portal positioning.



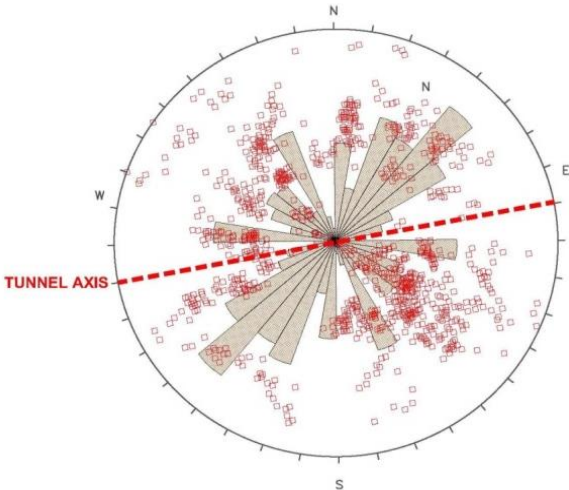
There is no house near the east tunnel to consider hazards due to tunnel blasting, but it is necessary to give careful attention to the tunnel blasting while some livestock such as horses and sheep passes by tunnel construction area.

Reinforcement of steel pipe with grouting which is umbrella arch method type must be applied to guarantee the tunnel stability because tunnel portal will be constructed in unsymmetrical topography. With respect to the tunnel portal structure, application of retaining-wall-type tunnel portal, which can shorten the open cut tunnel length, may be required to avoid interference between tunnel portal construction and abutment construction of the bridge overpassing Mir Malik Gah Nallah to be constructed.

### GEOLOGICAL CONDITION

Main rock type along the alternative 2 (tunnel length L=12.72km) is metaigneous, quartz, amphibolite, metasediment, paragneiss and granite. Geological characteristics of Alternative 2 are that strike direction of joint and tunnel axis are about 35° to the tunnel axis within tunnel section and water ingress would be similar to Alternative 1. According to RMT distribution designated in Tunnel Profile of Excavation Class, Alternative 2 has unfavorable ground conditions comparing with ones of Alternative 1 which are RMT 8 and 11. Thus, Alt.2 has worse condition for tunneling than Alternative 1. In addition to RMT distribution, Alternative 2 has unfavorable conditions for tunneling because 13 faults are crossing the tunnel route.

#### Geological Features of Alternative 2

Characteristic of Alternative 2	Geotechnical Description
	<ul style="list-style-type: none"> <li>• Major Rock Units: <ul style="list-style-type: none"> <li>- Alluvial and glaciofluvial deposit</li> <li>- Meta igneous, quartz, amphibolite, metasediment, paragneiss and granite</li> </ul> </li> <li>• Strike Direction of Joint: <ul style="list-style-type: none"> <li>- The Strike direction runs about 35° to the tunnel axis</li> </ul> </li> <li>• Major RMTs: <ul style="list-style-type: none"> <li>- RMT 3, 4, 7, 8 and 11.</li> </ul> </li> <li>• Faults and Water Condition: <ul style="list-style-type: none"> <li>- 13 faults are crossing the tunnel route</li> <li>- 10 liter to 30 liter/sec of water ingress is anticipated.</li> </ul> </li> <li>• Risk of Tunnel Excavation: <ul style="list-style-type: none"> <li>- West portal site is located in a steep slope</li> <li>- East portal site is located in relatively deep alluvium deposit</li> <li>- Rock burst is anticipated in some high overburden area</li> </ul> </li> <li>• Horizontal alignment: <ul style="list-style-type: none"> <li>-Straight + Curve (with radius 10,000m) + Straight</li> <li>+ Curve(with radius 5,000m) + Straight</li> </ul> </li> <li>• Vertical grade: (+)1.5% ~ (-)2.5%</li> </ul>

### CONDITION OF BRIDGE LOCATION

There is a wooden bridge at the beginning point and two acrow panel bridges in the middle of the route, which are required to be replaced by reinforced concrete bridges with the length of 25m. On the access road to Shounter portal, a new bridge with a length of 420m is required to align the approach road to Shounter tunnel portal. On the access road to Rattu portal, there are four concrete girder bridges which are planned to be widened by the road alignment design.

#### 4.2.5.3 ALIGNMENT 3 (TUNNEL LENGTH 7.51KM)

##### DESCRIPTION OF ALIGNMENT

The length of alignment No.3 is almost 81.60km long (west access road 26.98km + tunnel 7.51km + east access road km=47.11km). It starts from Kel village and culminates at near Gorikot village likewise alignment 1 and 2. The west portal of Alignment No.3 is located at a road distance of approximately 26.98km from Kel village. The Alignment 3 has minimum length of tunnel among the alternative routes. However, the existing access road condition of near north portal is very dangerous due to tight hairpin curve, steep vertical grade, and narrow road width.

##### 4.2.5.3.1 GEOMETRIC ALIGNMENT CONDITIONS

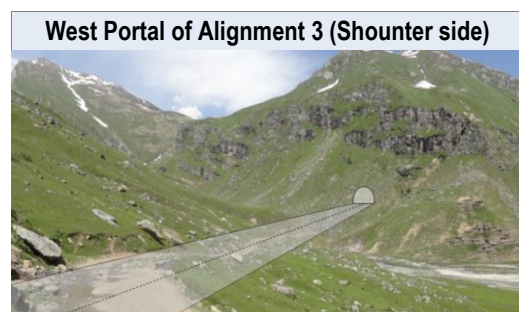
The horizontal alignment of alternative No. 3 traverses' level, rolling and mountainous terrain. Also, the geometric design of horizontal alignment No. 3 meets the design criteria based on the design speed as a 60km/h in level terrain, 50km/h in rolling terrain and 30km/h in mountainous terrain. The vertical grade in tunnel section, one of the most important geometric design conditions of this project, is a 6.5%. The vertical grade does not meet the standard criteria of tunnel design for traffic flow and tunnel ventilation.

Also, the condition of horizontal alignment is relatively worse in comparison with alignment No. 1 and No. 2.

##### 4.2.5.3.2 TUNNEL PORTAL CONDITION

###### WEST PORTAL CONDITIONS (SHOUNTER SIDE)

West portal location of Alignment 3 is located at about 50m distance away from the west portal of Alignment 1. The portal location of Alignment 3 is positioned at almost similar alignment on Alignment 1. But the elevation of the tunnel portal is about 32m higher compared with the portal elevation of Alignment 1.



Tunnel surrounding condition is the same with one of Alignment 1, but upward shift of the portal location will make lots of portal cut because of steep slope. An access road will travel to the slope face of the portal with 65°, so that the portal condition is worse than one of Alignment 1 in a tunnel engineering perspective compared with surrounding regional geological conditions. Nevertheless, overall conditions of the portal site, such as geological, geomorphological conditions and correlation of tunnel axis and slope face, are relatively favorable. And other positional features, blasting concerns and tunnel reinforcement schemes are similar with ones of alignment 1.

### EAST PORTAL CONDITIONS (RATTU SIDE)

The east portal of Alignment 3 is located in middle of Shounter Pass to shorten tunnel length.

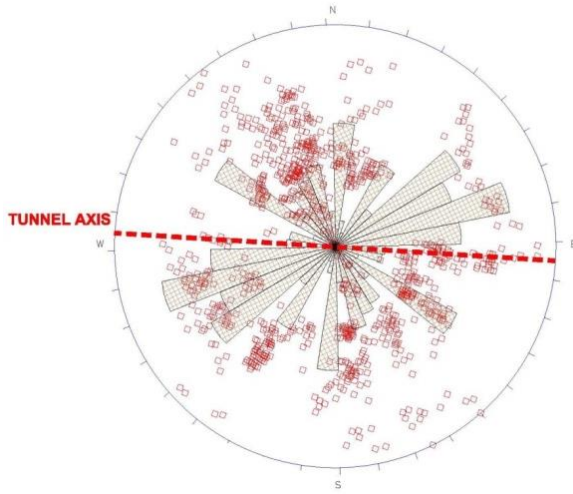
Geology of the east portal is comprised of meta-igneous rock having inclined schistosity as bed rock, and mostly covered with colluvium and rock debris. Near the portal area, a medium size gully is located where water is flowing. The water-flowing gully requires a large size of drainage structures near the portal site. Moreover, an angle of tunnel axis and slope face is about  $22^\circ$ . Thus, the portal site condition is extremely poor, so that a large quantity of reinforcement is required for tunneling and slope stabilization against unsymmetrical portal cut. These are weak points of the east portal. And there is no house near the east portal to concern about hazards of tunnel blasting. With respect to the tunnel portal structure, application of retaining-wall-type tunnel portal may be required because the wall type portal is effective to bear unbalanced earth pressure induced by unsymmetrical terrain. Furthermore, about 300m of NATM tunnel from the portal will be affected by the unbalanced earth pressure so that large quantity of tunnel reinforcement will be required against tunnel deformation.



### GEOLOGICAL CONDITION

Main rock type along the alternative 3 (tunnel length  $L=7.51\text{km}$ ) is metaigneous and metasediment such as mica schist and gneiss. Geological characteristics of Alternative 3 are that strike direction of joint and tunnel axis are about  $20^\circ$  to the tunnel axis within tunnel section and water ingress would be less than one of Alternative 1 and 2. According to RMT distribution designated in Tunnel Profile of Excavation Class, Alternative 1 has similar geological conditions comparing with alternative 1 because its tunnel route corridor goes with similar path until valley of Shounter Pass. According to RMT distribution designated in Tunnel Profile of Excavation Class, Alternative 3 has relatively competent ground conditions for tunneling than Alternative 2. However, the east portal is located in unsymmetrical terrain so that the portal to about 300m of NATM would be affected by unbalanced earth pressure and much of quantities of tunnel reinforcement would be required against tunnel deformation.

### Geological Features of Alternative 3

Characteristic of Alternative 3	Geotechnical Description
	<ul style="list-style-type: none"> <li>Major Rock Units: <ul style="list-style-type: none"> <li>- Alluvial and glaciofluvial deposit</li> <li>- Metaigneous and metasediment such as mica schist and gneiss.</li> </ul> </li> <li>Strike Direction of Joint: <ul style="list-style-type: none"> <li>- The Strike direction runs about <math>20^\circ</math> to the tunnel axis</li> </ul> </li> <li>Major RMTs: <ul style="list-style-type: none"> <li>- RMT 3, 4, 7, 8 and 11.</li> </ul> </li> <li>Faults and Water Condition: <ul style="list-style-type: none"> <li>- 5 faults are crossing the tunnel route</li> <li>- 10 liter to 20 liter/sec of water ingress is anticipated.</li> </ul> </li> <li>Risk of Tunnel Excavation: <ul style="list-style-type: none"> <li>- West portal site is located in a steep slope</li> <li>- From east portal to about 300m of NATM</li> </ul> </li> </ul>



	<p>would be affected by unbalance earth pressure</p> <ul style="list-style-type: none"> <li>• Horizontal alignment: -Straight + Curve (with radius 2,000m) + Straight</li> <li>• Vertical grade: (+) 6.51%</li> </ul>
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### CONDITION OF BRIDGE LOCATION

There are a wooden bridge at the beginning point and two Acrow panel bridges in the middle of the route, which are required to be replaced by reinforced concrete bridges with the length of 25m. On the access road to Shounter portal, a new bridge with a length of 420m is required to align the approach road to Shounter tunnel portal. On the access road to Rattu portal, there are four concrete girder bridges which are planned to be widened by the road alignment design.

### 4.3 TUNNEL ALIGNMENT COMPARISON

The Alignments Corridor Comparison and Selection are shown in the Table-7.

TABLE 7- TUNNEL ALIGNMENT CORRIDOR COMPARISON

Item		Alignment 1	Alignment 2	Alignment 3
<b>Outline of Route Corridor</b>		<ul style="list-style-type: none"> <li>• Route corridor can provide the all-weather season as an avoidance the snow line</li> <li>• Good for horizontal and vertical alignment in tunnel section.</li> </ul>	<ul style="list-style-type: none"> <li>• Route corridor can provide the all-weather season as an avoidance the snow line</li> <li>• Moderate for horizontal and vertical alignment in tunnel section.</li> </ul>	<ul style="list-style-type: none"> <li>• Route corridor can't provide the all-weather season as an avoidance the snow line</li> <li>• Bad for horizontal and vertical alignment in tunnel section.</li> </ul>
<b>Route Length</b>		L = 81,132m	L = 81,052m	L = 81,596m
<b>Major Works</b>	<b>Tunnel</b>	12,680m / 1ea	12,720m / 1ea	7,510m / 1ea
	<b>Bridge</b>	1,306m / 14ea	1,370m / 14ea	1,050m / 12ea
<b>Review Aspects</b>	<b>Traffic Aspect</b>	<ul style="list-style-type: none"> <li>• Easy connection between Shounter to Rattu</li> <li>• VOC (Vehicle Operation Cost) and VOT (Vehicle of Time) savings are significant</li> </ul>	<ul style="list-style-type: none"> <li>• Easy connection between Shounter to Rattu</li> <li>• VOC (Vehicle Operation Cost) and VOT (Vehicle of Time) savings are significant</li> </ul>	<ul style="list-style-type: none"> <li>• Difficult connection between Shounter to Rattu</li> <li>• VOC (Vehicle Operation Cost) and VOT (Vehicle of Time) savings are considerable</li> </ul>
	<b>Socio-Economic Aspect</b>	<ul style="list-style-type: none"> <li>• Reliable and cost-effective access to Rattu</li> <li>• Cost is too high</li> </ul>	<ul style="list-style-type: none"> <li>• Reliable and cost-effective access to Rattu</li> <li>• Cost is too high</li> </ul>	<ul style="list-style-type: none"> <li>• Reliable and cost-effective access to Rattu</li> <li>• Cost is too low</li> </ul>
	<b>Technical Aspect</b>	<ul style="list-style-type: none"> <li>• Horizontal alignment(R=5,000) is good condition in comparison with alt 3</li> <li>• Vertical grade(S=1.5%) of tunnel section is the</li> </ul>	<ul style="list-style-type: none"> <li>• Horizontal alignment(R=5,000) is good condition in comparison with alt 3</li> <li>• Vertical grade(S=2.5%) of tunnel section is</li> </ul>	<ul style="list-style-type: none"> <li>• Horizontal alignment(R=2,000) is bad condition in comparison with alt 1 and 2.</li> <li>• Vertical grade(S=6.5%) of</li> </ul>



Item		Alignment 1	Alignment 2	Alignment 3
		<p>best condition among the alternatives.</p> <ul style="list-style-type: none"> <li>• Long Tunnel (L=12.68km)</li> <li>• Vertical Ventilation Shaft:</li> <li>• Height: 333m</li> <li>• Rock mass condition has more competent ground conditions than ones of Alt 2. for tunneling and portal construction</li> <li>• Because 12 faults are crossing the tunnel route, Alt. 1 has fewer risks than Alt. 2</li> <li>• West portal is located in a steep slope and small gully is located in in Upper-left of east portal site.</li> </ul>	<p>moderate condition among the alternatives.</p> <ul style="list-style-type: none"> <li>• Long Tunnel (L=12.72km)</li> <li>• Vertical Ventilation Shaft:</li> <li>• Height: 271m</li> <li>• Rock mass condition has unfavorable ground conditions compared with Alt. 1 for tunneling and portal construction.</li> <li>• Because 13 faults are crossing the tunnel route, Alt. 2 has more risks than Alt. 1</li> <li>• West portal is located in a steep slope and east portal is located in relatively deep alluvium deposit.</li> </ul>	<p>tunnel section is so steep that heavy vehicles resort to use of their lowest gears, reducing traffic capacity and increasing demand on the ventilation system. Vertical grade should be limited below 3%. And the.</p> <ul style="list-style-type: none"> <li>• Short Tunnel (L=7.51km)</li> <li>• Vertical Ventilation Shaft:</li> <li>• Height: 779m (highest risks)</li> <li>• Rock mass condition has relatively good geological conditions which is similar to first half of Alt. 1.</li> <li>• Because 5 faults are crossing the tunnel route, Alt. 3 has the smallest risks.</li> <li>• East portal will be affected by unbalance earth pressure</li> </ul>
	<b>Economic Aspect</b>	<ul style="list-style-type: none"> <li>• Low economic feasibility due to high construction and maintenance cost</li> </ul>	<ul style="list-style-type: none"> <li>• Low economic feasibility due to the highest construction and maintenance cost</li> </ul>	<ul style="list-style-type: none"> <li>• Good economic feasibility due to low construction and maintenance cost</li> </ul>
<b>Estimated Construction Cost</b>		29.3 Billion Pak. Rs.	30.4 Billion Pak. Rs.	27.1 Billion Pak. Rs.
<b>Review/ Comments</b>		<ul style="list-style-type: none"> <li>• Alternative 1 has the most possible feasibility in terms of traffic, technical, economical and environmental aspects</li> <li>• The reasons are as below; <ul style="list-style-type: none"> <li>- Even though the construction cost of Alt 1 is higher than Alt 3, the horizontal alignment as well as vertical alignment of Alt 1 has good condition in comparison with Alt 3.</li> <li>- The tunnel length of Alt 3 is short compared with Alt 1 and 3. However, the route corridor of Alt 3 can't provide the all-weather season as an avoidance the snow line. Besides, the vertical grade(S=6.5%) of Alt 3 in tunnel section is very steep and fails to meet the geometric design criteria.</li> <li>- Alt. 1 and Alt. 3 have relatively competent rock mass but Alt.2 has many excavation risks which are many faults and poor rock mass quality. Alt 3 has the highest vertical vent shaft so that high risks exist in vertical excavation.</li> <li>- The tunnel and bridge length is short in comparison with alt 2.</li> </ul> </li> </ul>		



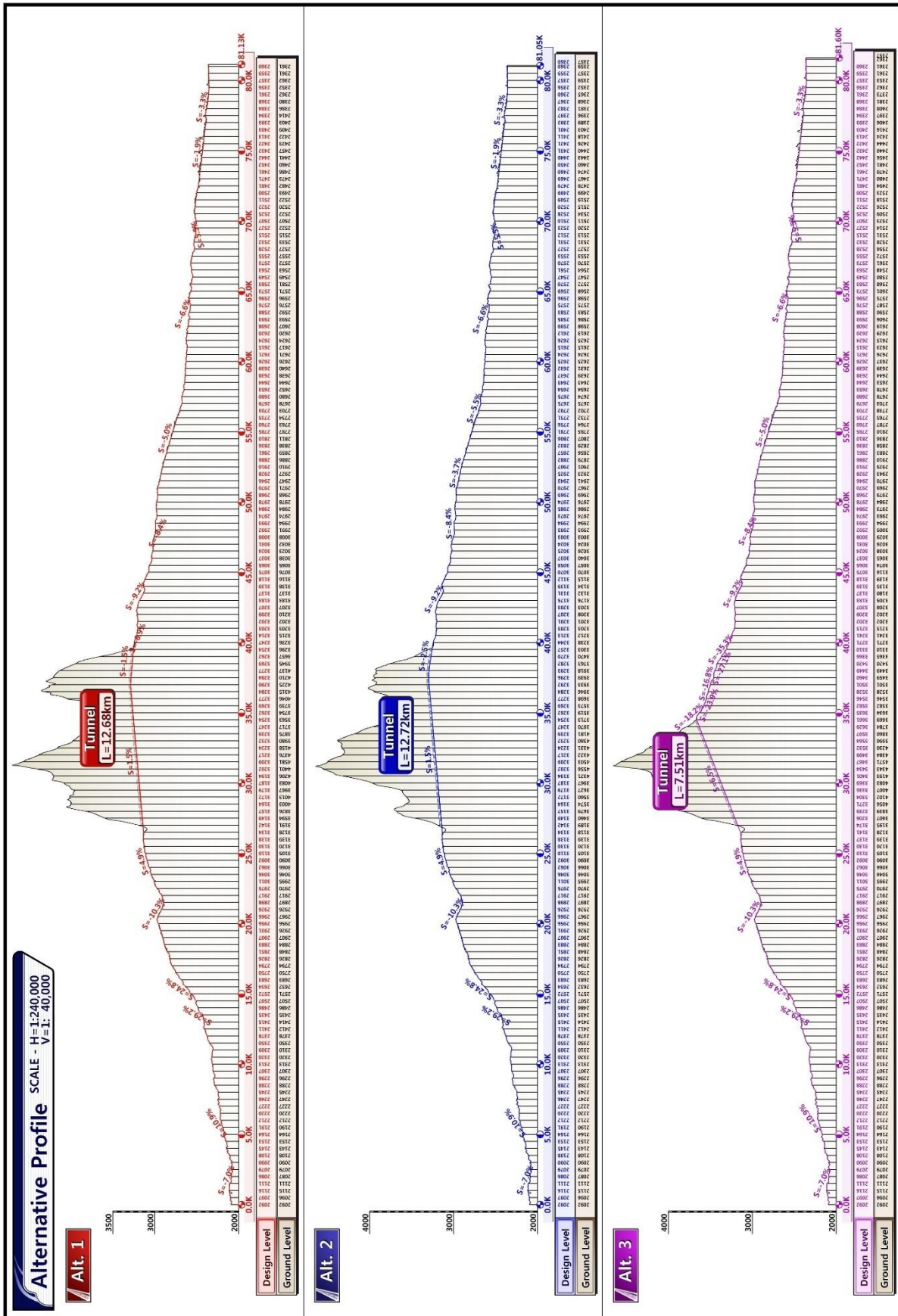


Figure 3- Alignment Drawings Options of Proposed Tunnel Project and Access Road



### 4.3.1 EVALUATION CRITERIA

The sites were evaluated for the proposed project in order to control and mitigate the environmental and socioeconomic impacts at an early stage. The evaluation of sites was based on following criterion:

- Sufficient land should be available for development.
- It should be easily accessible not putting an additional construction/transportation cost to access the proposed tunnel and access road project.
- The shortest route must be selected to reduce the travelling time and construction cost.
- There is no any resettlement requirement.
- No any cutting of the trees within ROW and any other site of project activities.
- Avoiding all the locations/structures of cultural and archeological importance.
- It is better management control and to achieve lower construction and operational cost.

### 4.3.2 SITE SELECTION

Recognizing that the proposed development may have adverse impacts on surrounding environment, site selection exercise was carried out in close consultation with the Divisional Forest Officer and others at Astore, Prime Engineering Design team and environmental team. Option-1 was decided as an appropriate option to achieve a balance between the area to be used for the construction and resources required maintaining the operations. The routes of all the options are presented in figure-2 and 3 above.

## 4.4 ALTERNATIVE-III OTHER TRANSPORT MODES

The alternative transport mode includes using railway and air transport. Air access is not found feasible on financial grounds. The road transport service currently working in the area is insufficient to meet the requirement of transportation and trade.

The terrain through which the project road passes through is very steep and as such is not suitable for the development of a railway track. The gradient is too steep. Thus this alternative was dropped.

## 4.5 SELECTION OF ALTERNATIVE TUNNEL ALIGNMENT

The tunnel alternatives from Gorikot to Morcha Guzair- Shounter were developed, in order to explore the best and most efficient alignment/route that meets the project goals such as time saving, minimum travel time, straighter route, cost efficient etc. Out three alignments developed, Option-1 was selected as the final alignment for the tunnel Option 1 is 12.7Km approx. in length and opted due to the following reasons:

- No resettlement is required for construction of the proposed tunnel project.
- No additional land is required in this Option.
- Low budget as compared to other options
- Follows mostly existing road
- No structures falling in this option
- No people will be affected by this option

## CHAPTER-5 ENVIRONMENTAL & SOCIO-ECONOMIC BASELINE

This chapter defines the prevailing environmental and socioeconomic settings of the project area and surroundings. The project (corridor) in this document is defined as ‘the area where the project related activities to be carried out which include the proposed tunnel corridor and its surroundings area that can interact with the project’s positive and negative externalities in the long run’. The impact of any proposed activity or process will be assessed on the basis of a deviation from the baseline or normal situation. Followings are the main components of the baseline:

- Physical Environment
- Biological Environment
- Socioeconomic Environment

The description provided in this section is acquired from primary and secondary data collection approach based on followings:

- Desk-top study and literature review;
- Field surveys;
- Interviews of local communities;
- Utilization of available information sources and data from Government department such as district census report;
- Meetings and data gathering from various organizations/offices and surrounding villages;
- Divisional Forest office Astore;
- Agriculture Department Gilgit –Baltistan;
- District Wildlife office Astore;
- Livestock Department Astore;
- AKRSP office Gilgit –Baltistan;
- WWF office Gilgit –Baltistan;
- Karakorum International University GB;
- Planning and Development Department GB
- Fishery Department Gilgit – Baltistan etc.

### 5.1 PHYSICAL ENVIRONMENT

This part examines the physical resources such as physical features, topography, geography, soil & geology, climate, air & noise quality, surface & ground water resources quality which is not only limited to the project area but also related the project surrounding to assess whether the project under assessment can or does have any impacts on any of these parameters. The description of physical environment is presented in the following sub sections.

#### 5.1.1 GEOGRAPHY

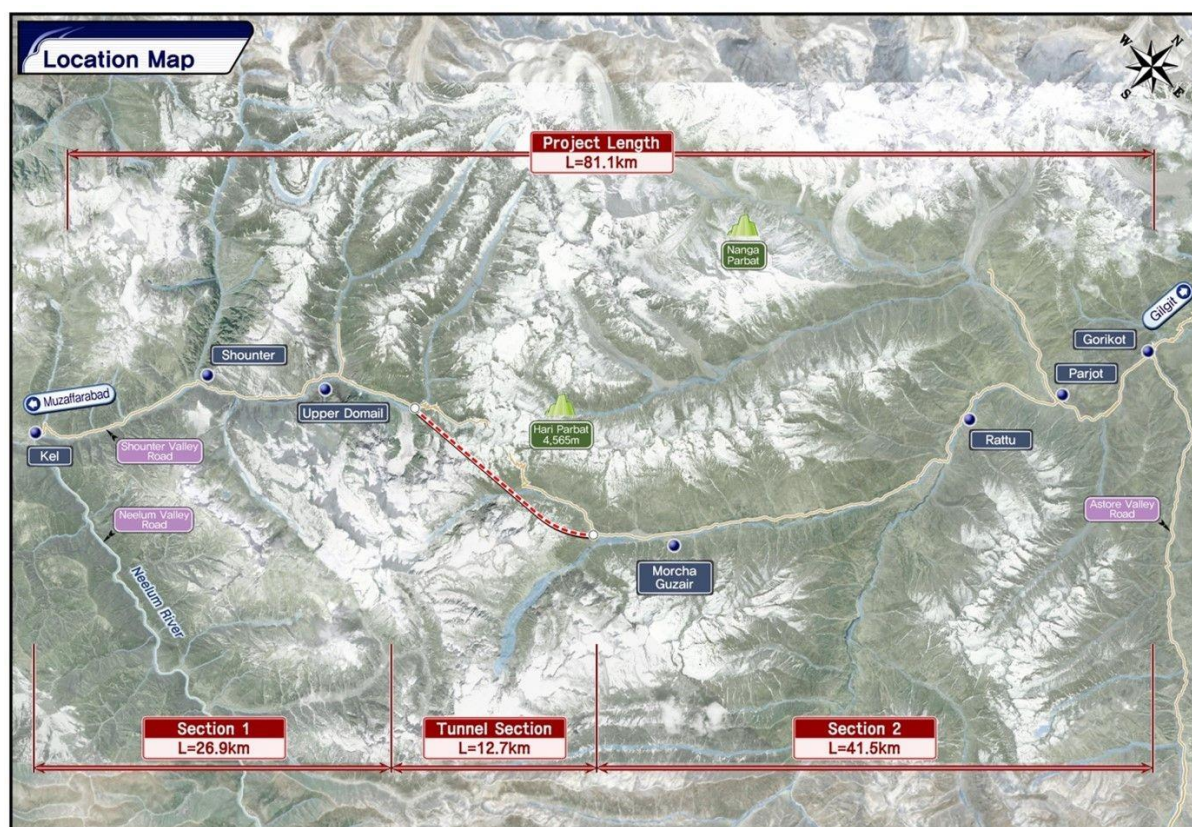
The proposed tunnel project site is mostly fall in tehsil Shounter and district Astore. Astore is located at 35-22-0 N;-74.51-0 E. with elevation from 2,646 meters (8,500feet).The project site is approximate 65km away from Astore. The proposed project construction of the 12.7 km long tunnel and access roads is about 26.9km and 41.5km (from Kel to Shounter and Shounter to Gorikot).The project traverses through two districts Astore (GB) and Neelum (AJK). Proposed project aims are to connect the major towns of Shounter, Morcha Guzair, Mirmalik, Rattu, Nasirabad, Chugam, Rehmanpur and

Gorikot. The proposed location areas shown in Table-8 and the proposed project location map are attached as figure-4.

TABLE 8- PROPOSED PROJECT DISTRICTS AND TEHSILS

Name of Districts	Name of Tehsils
Astore; Gilgit – Baltistan (GB)	Shounter
Neelum; Azad Jammu & Kashmir (AJ&K)	Sharda

FIGURE-4 PROPOSED PROJECT LOCATION MAP



## 5.1.2 TOPOGRAPHY

The project area is mostly fall in tehsil Shounter and district Astore, The project is in the region of three mountain ranges: the Himalayas, the Karakoram, and the Hindu Kush. Most mountain elevations in the region are at least 2,648 m above sea level, with more than half the area above 3,500 m. Three of the world's highest peaks, K2; Nanga Parbat; and Rakaposhi, are located in the region of Gilgit-Baltistan (GB), and Hari Parbat also located in the project area. The area is surrounded by steep mountains with little or no vegetative cover. The topography effectively cuts off the entire province from Pakistan's mainland and, therefore, creates geographical barriers that affect economic and administrative processes in GB. The area generally consists of rugged and precipitous terrain classified as alpine scrub zone and is characterized by heavy snowfall at higher altitudes in winter.

## 5.1.3 GEOLOGY



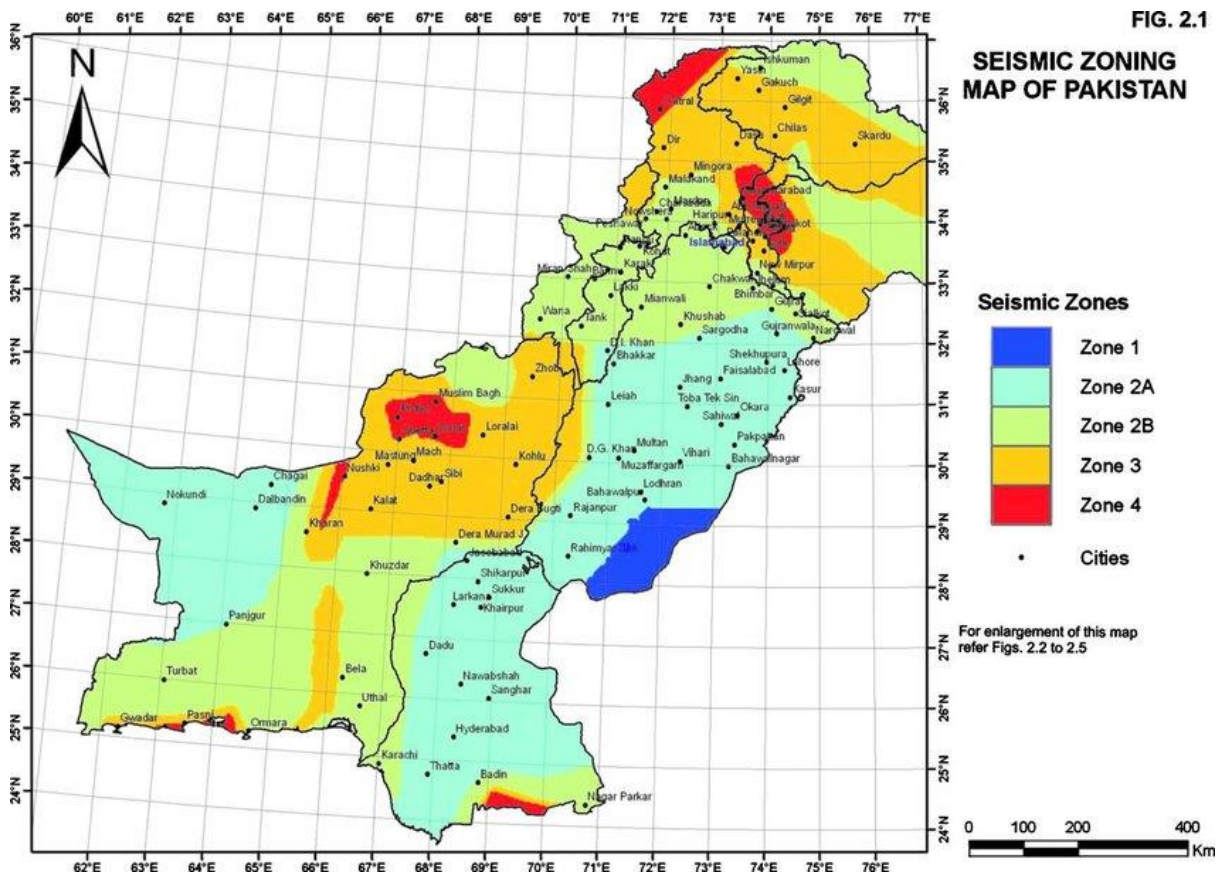
Based on the physical environment and geology, the project area falls in the Himalaya range is a series of several parallel or converging ranges. The geological features have been observed, during geological reconnaissance and geotechnical mapping. Fault zones exist on most of the project area. The Geology Conditions specific to proposed tunnel site is as under:

- Main rock type along the proposed tunnel site (tunnel length L=12.68km) is Meta volcanic, metasediment, metaigneous, amphibolite. Geological characteristics of the project area are that strike direction of joint and tunnel axis are about 34° to the tunnel axis within tunnel section. According to RMT distribution designated in Tunnel Profile of Excavation Class, proposed site has more competent ground conditions than ones of other areas. Thus, proposed site is quite better condition for tunneling than other areas. Furthermore proposed site has challenging condition for tunneling because 12 faults are crossing the tunnel route. However the numbers of faults are fewer than ones of other areas.

### 5.1.4 SEISMOLOGY

The project area lies near the edges of Indian and Eurasian tectonic plates. The plate boundary is considered as part of a seismically active zone. In the past, epicenters of a large number of earthquakes have been located in this region. In October 2005 an earthquake of very high intensity (7.8) hit the area near Muzaffarabad and disturbed the ground to a significant extent in that area. The geological, tectonic and geodynamic conditions of the project area has been assessed and detailed mapping of the ground surface has been done to define the geology and tectonic features of the area. According to the seismic zone map of Pakistan, the Project Area lies in Zone 3 of Modified Mercalli (M.M.) intensity scale, i.e. negligible damage zone as given in map-2.

MAP 2- SEISMIC ZONING MAP OF PAKISTAN



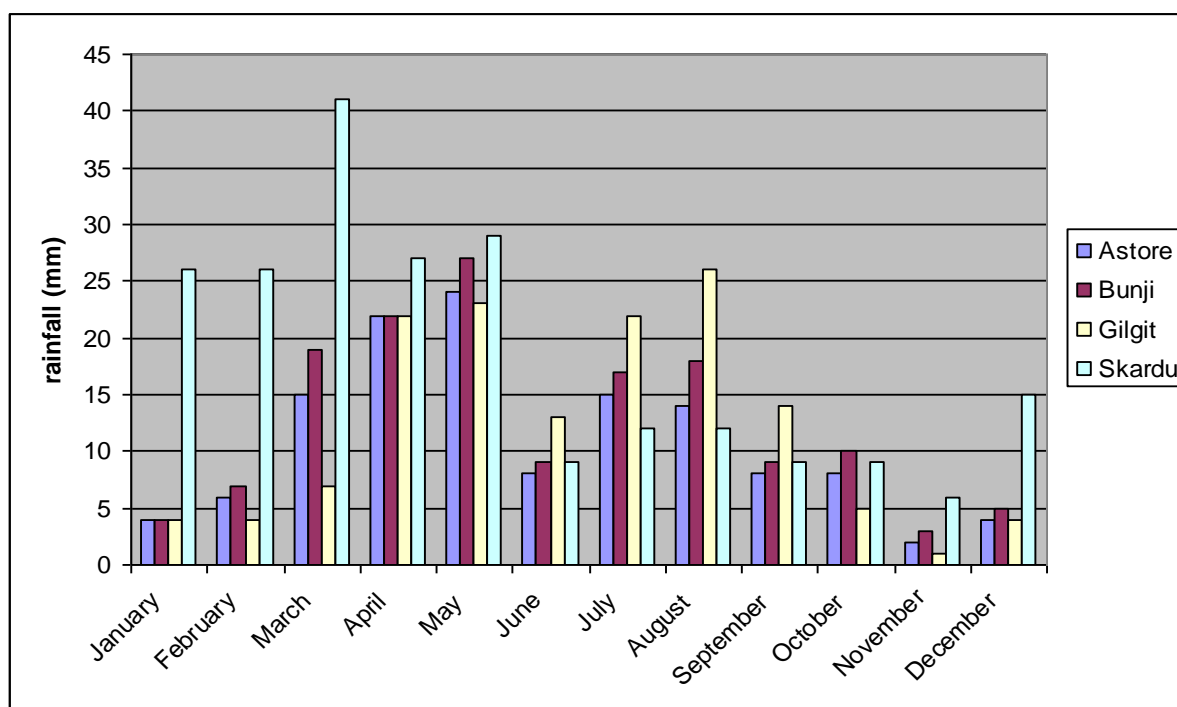
### 5.1.5 WATER SUPPLY

In the project area, the Astore river flows in a deep gorge making it difficult to use the water for drinking, agricultural and other purposes. All the settlements are on the banks of perennial streams (nullahs) and on both sides of the river and some settlements away from river bank. The people use the water from nullahs for drinking, household and agriculture purposes. Generally, there is shortage of potable water in the project area as it is very difficult to fetch the river water due to the very steep slopes. People generally use water from streams, nullahs and springs for drinking, washing and other domestic purposes. Some streams and Nullahs falling in the project area are like mirmalik, parsheen, kalapani, rattu, bulkanand and shounter etc. During the socio-cultural survey of the project area, none of the respondents from any of the villages falling in the project area reported any waterborne disease. Tapped water supply is considered to be the most hygienic source of drinking water which is available in the project area. In project area there is a water supply system which has been built by local people with the help of AKRSP. Water supply is partially available in Astore, Gorikot, Rattu and Shounter valleys.

### 5.1.6 CLIMATE

The climatic parameters that influence the climate of an area include temperature, precipitation, humidity and evaporation. In general, two seasons prevail in the project area:

The climate of the area during summer is moderate and in winters receives 6 inches to 3 feet snow in the area. June, July and August are dry and hot months whereas December, January and February are coldest months. During consultation with metrological officer informed the temperature in Astore may become -9°C in January, 2019 higher than the present level by the end of the 21st century. The Astore is with global warming. River flow due to varying climates can be highly variable and pose threats to the stability of landscape especially in the vicinity of streams. Future temperature projections by Global Climate Models (GCMs). The mean monthly rainfall at selected stations is graphically shown in graph-1.



GRAPH-1 MEAN MONTHLY RAINFALL IN PROJECT AREA

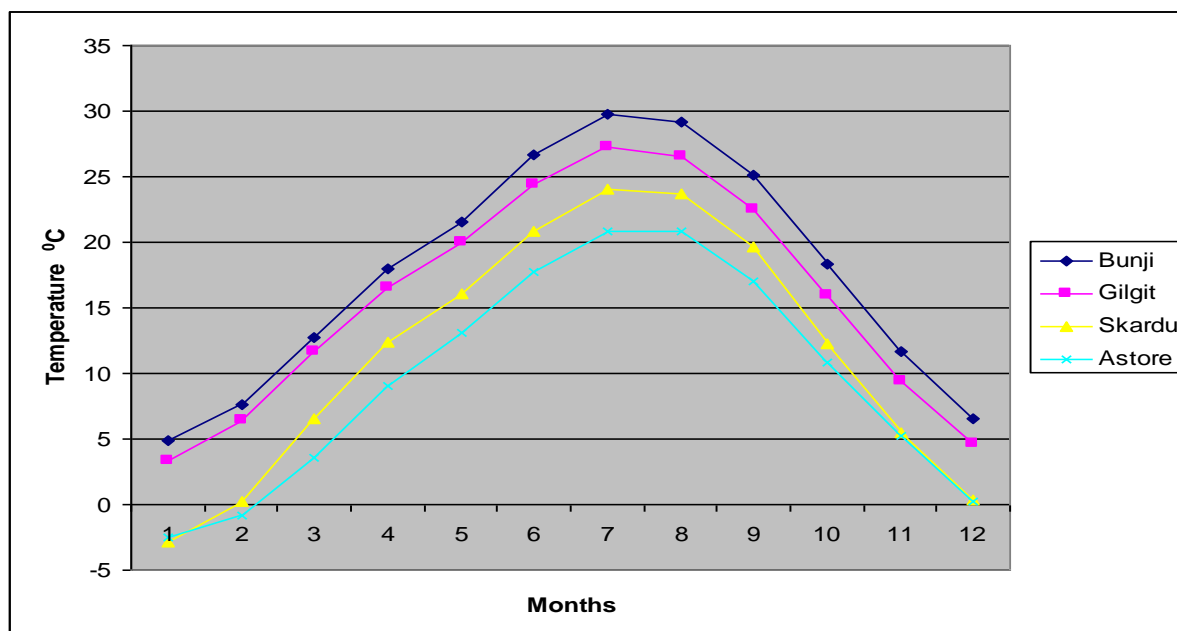
### 5.1.6.1 TEMPERATURES

Air temperature is one of the most important factors of climate of any area. In the river, flows are mostly due to the snow and glacier melt which entirely depend on the air temperature. The temperature data of some sites close to the project area has been collated and presented in Table-9 and graph-2. The summer season is generally dry and precipitation during the winter season is in the form of snow fall. The data shows that hottest month is July with average maximum and minimum temperature of 27.1 °C and 14.5 °C respectively. January is the coldest month with average maximum and minimum temperature of 2.4°C and -7.5°C respectively. The months of June to September are the hot and mean maximum temperature ranges between 23.5°C to 27.1 °C respectively. November to February is very cold and means minimum temperature varies between - 0.7°C to -7.5°C respectively.

TABLE 9- MAXIMUM, MINIMUM AND MEAN MONTHLY TEMPERATURE

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Maximum Temperature (°C)</b>												
Bunji	9.6	12.5	17.9	24	28	33.7	36.2	35.7	32.5	25.7	18.5	11.8
Gilgit	9.2	12.3	17.7	23.7	28	33.9	36.1	35.4	31.9	25.3	18	11.21
Skardu	2.6	5.4	11.7	18.3	22.5	28.2	31.5	31.2	27.2	20	12.7	6
Astore	2.4	4	8.4	14.6	19.2	24.5	27.1	27	23.5	17.2	11.1	5
<b>Minimum Temperature (°C)</b>												
Bunji	-0.1	2.7	7.6	12.1	15.2	19.6	23.4	22.8	18.1	11.3	5.2	1.4
Gilgit	-2.5	0.6	5.7	9.4	11.9	15	18.5	17.9	13	6.8	0.8	-1.9
Skardu	-8.2	-5	1.5	6.5	9.6	13.5	16.6	16.2	12	4.7	-1.6	-5.4
Astore	-7.5	-5.7	-1.1	3.5	7.1	11	14.5	14.6	10.5	4.4	-0.7	-4.5
<b>Mean Temperature</b>												
Bunji	4.9	7.6	12.7	18	21.6	26.7	29.8	29.2	25.1	18.3	11.7	6.5
Gilgit	3.3	6.4	11.7	16.6	20	24.4	27.3	26.6	22.5	16	9.4	4.7
Skardu	-2.8	0.2	6.6	12.4	16.1	20.8	24.1	23.7	19.6	12.3	5.5	0.3
Astore	-2.5	-0.8	3.6	9	13.1	17.7	20.8	20.8	17	10.8	5.2	0.2
<b>Mean Temperature Ranges between Minimum and Maximum (°C)</b>												
Bunji	9.5	9.8	10.3	11.9	12.8	14.1	12.8	12.9	14.4	14.4	13.3	10.4
Gilgit	11.7	11.7	12	14.3	16.2	18.9	17.6	17.5	18.9	18.4	17.1	13.1
Skardu	10.8	10.3	10.2	11.8	12.9	14.8	14.9	14.9	15.2	15.3	14.4	11.4
Astore	10	9.8	9.5	11.1	12.1	13.5	12.7	12.4	13	12.8	11.8	9.6





GRAPH-2 MEAN MONTHLY TEMPERATURES IN PROJECT AREA

#### 5.1.6.2 WIND SPEED AND DIRECTION

Wind affects evaporation and sublimation from soil and glaciers and it is potentially an indicator of the prevailing influence of air masses. The speed and direction data of some stations adjacent to project area are given in Table-10. Wind speeds tend to be higher between April and September and lowest from November to January. However, these averages conceal the fact that often the wind is accumulated over short bursts of gusty convective wind especially during the late spring and summer when heating effects cause strong but short-lived convective winds.

TABLE 10- WIND SPEED AND DIRECTION

Station	Calm	N	NE	E	SE	S	SW	W	NW	Mean wind speed	Maximum observed Speed
Astore	50%	17%	1%	0	0	29%	1%	0	1%	3.0 knots	29.0 knots
Gilgit	74%	0	1%	4%	7%	1%	1%	9%	2%	2.0 knots	28.0 knots
Skardu	80%	0	2%	2%	0	9%	5%	3%	0	2.9 knots	69.0 knots

## 5.2 ENVIRONMENTAL BASELINE MONITORING

To assess the environmental conditions of the project area, following environmental parameters were monitored;

1. Ambient air quality monitoring,
2. Water sampling and analysis
3. Noise level monitoring

Environmental baseline monitoring was conducted at project area. The details of the sampling/monitoring locations along with discussions on results are given in the subsequent sections. Photographic record of environmental monitoring for ambient air Quality, water and noise levels is given in **Annexure- 9** and Monitoring results are attached in **Annexure-10** of report.

## 5.2.1 AMBIENT AIR QUALITY

There is no significant source of air pollution in the project site. The project area is rural, and cultivation is the main occupational activity. The potential existing sources of air pollution in the project area are road traffic, farm machines, agricultural and domestic activities.

Major air pollutants including CO, SO<sub>2</sub>, NO<sub>2</sub>, NO, NO<sub>x</sub>, Particulate Matter (PM<sub>10</sub>) and Suspended Particulate Matter (SPM) were monitored during field visit at 04 points of the proposed project site.

The results of all ambient air quality monitoring were observed below the standards.

Results of ambient air monitoring are presented in **Table 11**.

**TABLE 11- RESULTS OF AMBIENT AIR QUALITY MONITORING AT PROSPED PROJECT AREA**

Parameters	Methodology	Limits as per NEQS	Unit	Monitoring Locations			
				Gorikot	Rattu	Mirmalik	Morcha Guzahir
Carbon Monoxide (CO)	Non-Dispersive Infrared Spectrophotometry (NDIR)	5	mg/m <sup>3</sup>	0.45	0.41	0.39	0.44
Sulfur Dioxide (SO <sub>2</sub> )	UV Fluorescent	120	µg/m <sup>3</sup>	31.48	30.9	20.90	12.53
Nitrogen Dioxide (NO <sub>2</sub> )	Chemiluminescence	80	µg/m <sup>3</sup>	24.08	29.7	27.25	14.25
Nitric Oxide (NO)	Chemiluminescence	40	µg/m <sup>3</sup>	7.85	0.53	8.90	8.91
Oxides of Nitrogen (NO <sub>x</sub> )	Chemiluminescence	120	µg/m <sup>3</sup>	31.93	31.6	36.13	23.17
Particulate Matter (PM <sub>10</sub> )	Beta-Attenuation	150	µg/m <sup>3</sup>	14.71	43	25.22	13.56
Suspended Particulates (SPM)	Gravimetric Sampling	500	µg/m <sup>3</sup>	39.13	56.34	35.1	34.91

## 5.2.2 WATER SAMPLING AND ANALYSIS

Number of water nallahs and springs are present in the vicinity of the proposed project area. The local community mostly used these sources for domestic as well as agricultural purposes.

During site visit, water samples have been collected at five different locations along the project alignment.

The samples were analyzed for 20 parameters. The analysis results for the water samples are provided in following Table 12.

**TABLE 12- RESULTS OF WATER QUALITY ANALYSIS**

Parameters	Testing Method	Unit	NEQS Limit	Water Sampling Locations				
				Gorikot	Rattu	Mirmalik	Morcha Guzahir	Nasirabad
pH	ASTM-D-1293	--	6.5-8.5	7.51	7.8	7.32	7.94	7.2
Total Dissolved Solids (TDS)	APHA 2540-C	mg/L	<1000	80	90	58	30	110



Chloride	APHA 4500 Cl- B	mg/L	<250	25	5	13.6	9.8	29
Boron	Lovibond Azomethine Method	mg/L	≤0.3	<0.2	<0.1	<0.1	0.2	<0.1
Cadmium	Lovibond Cadion Method	mg/L	≤0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	Lovibond 4-(2-Pyridylazo)-resorcin	mg/L	≤0.05	<0.02	<0.02	<0.015	<0.02	<0.02
Copper	Lovibond Biquinoline Method	mg/L	≤2	<0.05	<0.05	<0.05	<0.05	0.5
Total Hardness	ASM D-1126	mg/L as CaCO <sub>3</sub>	<500	40	90	35	40	90
Coliform bacteria (total)	APHA9222-B	No./100 mL	0	5	90	3	2	11
E. Coli	APHA 9222-D	No./100 mL	0	0	2	0	Nil	0
Aluminum	Lovibond Eriochrome Cyanine R	mg/L	≤0.2	0.01	0.02	0.05	0.02	0.09
Antimony	APHA 3111 B	mg/L	<0.005	0.0017	0.001	0.002	0.001	0.0024
Turbidity	Lovibond Attenuated Radiation Method	NTU	<5	<5	<5	<5	19	<5
Chromium	Lovibond 1,5-diphenyl-Carbohydrazide Method	mg/L	≤0.05	0.03	0.036	0.026	0.04	0.016
Cyanide	Lovibond Pyridine Barbituric Acid Method	mg/L	≤0.05	<0.02	<0.02	<0.01	<0.02	<0.02
Fluoride	Lovibond SPADNS Reagent Method	mg/L	≤1.5	0.31	0.61	0.21	0.45	0.28
Manganese	Lovibond Formaldoxime Method	mg/L	≤0.5	0.08	0.1	0.18	0.1	0.31
Nitrate	Lovibond chromotropic acid	mg/L	≤50	15	12	7	5	19
Nitrite	APHA 4500-B	mg/L	≤3	0.20	0.14	0.6	0.11	0.8
Barium	ASTM D-4382	mg/L	≤0.7	0.05	0.09	0.1	0.04	0.13

### 5.2.3 NOISE MONITORING RESULTS

There is no industry and any other source of noise pollution in the project area and only source of noise within the project area is associated with vehicular traffic. Traffic vehicles moving in the area are also very low. Noise level exceeding 75 dB is harmful to the human health. The noise levels in the project area are shown in the Table-13.

TABLE 13- NOISES LEVEL RESULTS WITHIN THE PROPOSED PROJECT AREA

Sr.	Location	Unit	Sound (dB)	NEQS* (Day Time)
1	GoriKot	dB	54.9	75
2	Rattu	dB	53.2	75
3	Mir Malik	dB	53.7	75
4	Morcha Guzair	dB	51.5	75

#### 5.2.4 SOIL

Soils provide moisture, nutrients and a foothold to plants. The soils of the project area are the most unstable and subject to active water erosion. The intensity, however, depends upon the vegetation cover and the slope gradient. The mountains on both sides of the river have steep slopes and hold very little vegetation. Alluvial fan deposits are created as a result of glaciated materials carried by stream flows or where these streams create space due to meandering within the valley. The fertile lands in the project area are located in the fans and the terraces close to streams and Nullahs. All the farmlands and orchards are irrigated by streams as rainfall in the area is very meagre. Soils are well drained and medium texture. The soil fertility of the area is low for the crop production as it contains a low quantity of organic matter. A variety of crops and vegetables could be grown in such soils subject to water availability and the use of fertilizers. There is very thin cover of soil on the mountainous terrain and it supports sparse shrubs and trees.

#### 5.2.5 GREENHOUSE GASES

Greenhouse gases are those gases (CO<sub>2</sub>, CH<sub>4</sub>, O<sub>3</sub>, CFCs and NO) which contribute to global warming. The main sources of these gases are industries and vehicles using fossil fuel as fuel. At present there is no industry in the project area that emits greenhouse gases and vehicles intensity is also very low. The main sources of carbon and nitrogen oxide emissions are the automobiles being operated in the project area. The traffic count data (Table-11) shows that the greenhouse emissions from these vehicles may not be in a quantity to have a significant contribution to global warming. Similarly, there is no volume of stagnant water body in the project area which could trap significant amounts of organic matter that could cause emissions of methane or other greenhouse gases.

#### 5.2.6 SLOPES FAILURE

The slope is comprised of mainly metamorphic and sedimentary rock. Some section of the existing road is covered with rock fragments due to weathering and erosion. Nevertheless, fewer landslide prone areas are identified in the project area. Most of landslides are mainly debris flow and rock falls due to the geological weak formation and a steep slope. A section from Gorikot to Rattu needs to clear slope surface where rock falls are ongoing sporadically. After Rattu village, sweeping away due to rainfall /snow melting is the same problematic issue of debris-flow within the project area, but the existing route passes apart from the unstable slope at a distance. The landslides are very common features in the project area because of the high steep terrain image-2. Erosion and sediment input to the river is a function of landslides and riparian erosion processes. There are frequent talus accumulations along the side slopes of the river and road. These are typically in a state of stable equilibrium at their current slope angle and environment, but become unstable when the equilibrium is disturbed. Excess water and earthquake shakings often triggers landslides in the project area.

#### IMAGE-2 SLOPE FAILURE IN THE PROJECT AREA



### 5.2.7 LAND USE

A few human settlements exist on alluvial fans and terraces on either side of the Astore and its tributaries where water is available for human consumption and agriculture. The Mountains on both sides of the project area have steep slopes and many streams and nullahs join the river in the area. The nullahs span out near the project road, forming some cultivable land masses. The alluvial fans contain clay silt layer with an undulated topography over hard bedrock. The available flat land is used for residential purposes as well as for agriculture, orchards and grazing for cattle, goats and sheep etc. Summary of land use in the Gilgit Baltistan and District Astore is shown in Table-12 and Table-13 respectively.

**TABLE 14-LAND USE OF THE GILGIT BALTISTAN**

S.No.	Land Use	Area (ha)	Area (%)
1	Agricultural Area	48	0.68
2	Commercial Area	1601	22.74
3	Residential Area	9.4	10
4	Forest Cover	666	9.46
5	Barren Land	27	0.38
6	Water Bodies	1	0.01
7	Unclassified Land	4697	66.72
	<b>Total</b>	<b>7040</b>	<b>100</b>

**Source:** Forestry Master Plan Astore District (GB)

**TABLE 15-LAND USE OF THE DISTRICT ASTORE**

S.No.	Land Use	Area Km <sup>2</sup>	Area (%)
1	Conifer Forest	213.36	4.29
2	Broadleaved Forest	74.17	1.5
3	Mix Forest	10.9	0.22
	<b>Forest Area</b>	<b>298.43</b>	<b>6.01</b>
4	Grasslands/Rangelands	1131.03	22.71
5	Agriculture Lands	80.52	1.62
6	Barren Land	2851.36	57.26
7	Snow/Glaciers	322.37	6.47
8	Water Bodies	201.87	4.05
9	Unidentified/Shades/Cloudes	93.74	1.88



<b>Total</b>	<b>4979.32</b>	<b>100</b>
<b>Forest</b>	<b>29843ha (6.01%)</b>	
<b>Agriculture</b>	<b>Area in Hectares</b>	
<b>Total Farm Area</b>	<b>4075 ha</b>	
<b>Total Area per Family</b>	<b>0.46ha</b>	
<b>Farm Area per Capita</b>	<b>0.56ha</b>	
<b>Households depending upon farming</b>	<b>98%</b>	
<b>Average Farm Size</b>	<b>0.83ha</b>	
<b>Source:</b> Forestry Master Plan Astore District (GB)		

## 5.2.8 NATURAL DISASTERS

Astore and its surrounding valleys are highly susceptible to natural disasters such as landslides, flash floods and avalanches, which affect civic life in the town and areas within its vicinity. According to the Pakistan Meteorological Department (PMD), Astore is located in a seismically active zone with a shake potential equivalent to an earthquake of magnitude 6 to 7 on the Richter scale. A recent example of the types of natural hazards facing region is the Ata Abad Lake, which formed due to a massive landslide in 2010 and dammed the Hunza River. The unstable lake poses a threat to the downstream populations of region More than 90% of inhabitants engaged in agriculture and 70% in livestock are likely to be highly affected by natural disasters there. With agriculture making up 23% of the source of livelihood for region inhabitants, the economy of the area is at a significant risk of being adversely affected by natural disasters.

## 5.2 BIOLOGICAL ENVIRONMENT

In this section, the baseline environmental conditions pertaining to biological environment have been described on the basis of primary and the secondary data. These conditions have subsequently been used to identify the potential impacts on the biological environment that are likely to arise from the project activities.

### 5.2.1 FLORAL ATTRIBUTES OF THE PROJECT AREA

Based upon observations during the field visit; many species of plants were directly observed in the project area. The vegetation of the region has also been grouped as trees, shrubs, herbs, grasses and fruit trees shown in the Annex 2.

#### 5.2.1.1 FOREST IN THE AREA

The project area is fall under Montane Temperate Forests the groups of Himalayan dry temperate. The area fall between 1,500 to 3,600 meters and form the most important timber resources of the area. The Dominant species include Chilgoza (*Pinus geradina*), dry deodar (*Cedrus deodara*), and dry spruce (*Picea smitiana*). The climate is severe, resulting in ideally spaced, free standing, low branching and comparatively low tree cover. The vegetation is xerophytic and includes *Artemisia* spp., *Rosa* spp. and *Dephne oleoides*. The type of also include dry forests oak (*Olea cuspedata*), deodar (*Cedrus deodara*), blue pine (*Pinus wallichiana*), spruce (*picea simthiana*), fir (*Abies webbiana* and juniper (*Juniperus marcopoda*) etc. The grasses species are *Chrysopogon* spp., *Cymbopogon* spp., *Dichanthium annulatum*, *Pennisetum orientale*, *Aristida* spp., *Oryzopsis* spp., *Dactylis glomerata*, *Poa* spp., *Bromus inormis*, *Agropyron dentatum*, *A. caninum*, *Agrostis* spp., *Rottboellia exaltata*, *Phacelurus speciosus* and *Eragraostis* spp. The forbs species are *Iris* spp., *Tulips* spp., *Iolygonum*

spp., Sambucus ebulus, Lotus comiculatus, Medicago spp., Plantago lanceolata, Lathyrus spp., Thymus serpyllum, Nepata spicata, Viola spp., Taraxicum officinalis, Ferns, etc. The fruit species are Apricot, Apple, Grapes, Pears, Peaches, Pomegranate, Cherry, Mulberry, Walnut and Almond etc. The agriculture crops are Wheat, Maize, Potato and also vegetables grown in the project area. Area under Protected forests (Conifers) in Astore is 184,454 ha but further classification into private or protected forests is not reported. The Distribution of forests is shown in the Table-15.

**TABLE 16-DISTRIBUTION OF THE FOREST IN PROJECT AREA**

Name of Forest	Name of Plant Species	Status	Forest Area
Gorikot/ Bulashbar	Blue Pine, Sliver Silver Fir, Spruce and Birch	Very Good	1010
Chaurit	Sliver Silver Fir, Spruce and Juniper	Poor	9
Bullan	Blue Pine, Sliver Silver Fir, Spruce and Birch	Poor	67
Chugam	Blue Pine, Sliver Silver Fir, Spruce and Birch	Very Good	437
Rehmanpur/Zaipur	Blue Pine, Sliver Silver Fir, Spruce, Birch and Juniper	Very Good	903
Rattu	Blue Pine, Sliver Silver Fir, Juniper, Spruce and Birch	Poor	510
Mirmalik	Juniper, Sliver Silver Fir, Spruce and Birch	Very Good	714
Finna	Birch and Juniper	Poor	210
Pakora/Nogam	Blue Pine, Sliver Silver Fir and Spruce	Poor	126
Gudai	Blue Pine, Sliver Silver Fir, Spruce, Birch and Juniper	Very Good	893
Bobin	Blue Pine, Sliver Silver Fir, Spruce, Birch and Juniper	Good	671
Kalapani	Sliver Silver Fir, Spruce and Juniper	Very Good	3180
Minimarg/Domail	Blue Pine, Sliver Silver Fir, Spruce, Birch and Juniper	Very Good	3690
Qamri/Zian	Blue Pine, Sliver Silver Fir and Spruce	Very Good	5530
Dirlay	Blue Pine, Sliver Silver Fir and Spruce	Poor	1368
<b>Total</b>			<b>29843</b>
<b>Source:</b> Forest Department District Astore (GB)			

### 5.2.1.2 MEDICINAL PLANTS

The project area is very rich in the wealth of medicinal plants. The following medicinal plants are located at different forest area within the project. Some common and so far of commercial value are (Jadwar) Aconitum heterophyllum, (Besh molo) Aconitum chasmanthum, (Rhainh) Abies webbiana, (Saibooma) Aconitum napellus, (Zoon) Artemisia maritima, (Sumlo) Berberis lycium, (Zeera) Carum bulbocastanum, (Khampoosh) Colchicum iuteum, (Kamsal zeera) Cumium cyminum, (Soom) Ephedra intermedia, (Suff) Ferula foetida and Ferula asafetida, (itchmaday) Fragaria vesca, (Buru) Hippophae rhamnoides, (Bazarbhang) Hyoscyamus niger, (Padum) Juniperus macropoda, (Gugal Dhup) Jurinea macrocephala, (Chhama) Lavatera kashmiriana, (Gaozaban) Onosma bracteatum, (Salap Misri) Orchis latifolia, (Ispander) Peganum harmala, (Kurro) Picrorhiza kurroa, (Shilete) Plantago major, (Podophyllum emodi, (Rono badam) Prunus amygdalus, (Jaro chuntal) Rheum emodi, (Menal) Sassurea lappa, (Mumiri) Swertia petioiata, (Hookero) Tamarix gallica, (Tumuro) Thymus serpyllum, (Jomi) Urtica dioica, (Ganesh pawrobati) Valeriana wallichii, (Tamakusak) Verbascum thapsus, (Lillo) Viola serpens, (Jonjii) Betula utilis, (Goglimoolo) Geum urbanum, (poshkar) Inula racemosa, (Khakai) Juglans regia, (Suranjan sherin) Merendera persica, (Toot) Morus alba, (Yunij) Pinus Gerardiana,

(Byer/Kail) Pinus wallichiana, (Chinar) Platanus orientalis, (Ratanjot) Potentilla nepalensis, (papler) Populus alba, (Falchoa) Populus nigra, (Badiyane khatai) Prangos pabularia, (Mori bayao) Salix willow and (Byao) Salix tetrasperma. (Source: Medicinal Plants of the NA of Pakistan by Ghulam Rasool)

### 5.2.1.3 PASTURES AND GRAZING LANDS

Rangelands are an important natural resource and ecosystem of ecological roles which include provision of feed for livestock and wildlife, food for human, habitat for wildlife, support to biodiversity, watershed values, provision of medicinal plants and pollution buffer. These are primary resource for rural economy due to being major and most economical source of forage for livestock, particularly for sheep and goats. These are defined as the land on which the native vegetation is predominately grasses, grass like plants, forbs and shrubs. Their productivity and vegetation depend upon types of soil, relative elevation, climatic variations and patterns of use. The project area is generally mountainous and rainfall is meagre. Therefore, pastures and grazing lands are very limited and are scattered in small patches where the area is relatively flat. The main reason for this is that the majority of the villagers are employed by the government or private organizations and also in the Pakistan Army. Some pasture is available on top of the mountains adjacent to the project area. However, the people of the project area move along with their livestock during the summer and in the winter, they come back again to their original places. The Customary Rights of Communities according to valley shown in the Table-16, and the type of rangelands shown in the Table-17. The average number of livestock per household is about 17 to 18, which is comparatively better from other areas of the Gilgit Baltistan. The livestock population in the area, as recorded during the 1998 census and estimated in 2012, is shown in the Table-18.

TABLE 17-CUSTOMARY RIGHTS OF LOCAL COMMUNITIES

Name of valley	Name of vcc	Name of major villages	Customary rights of communities
Gorikot/Bulashbar	Gorikot	Gaiynike, Dingoat, Domosur, Gariki, Duedas, Kutaan, Shring-Darr, Sargale, Ahmadabad, Hillbich, Majini, Kamarote, Sakaliat, Peridot, Gotomo, Jail, Dangaat, Trezay Pakoroye, Daryaal bala, Kinidas, Daryaal Paeen, and Pariot.	Fuel wood, timber, medicinal plants, tophy hunting, ecotourism and grazing
Gudai	Gudai	Gudai, Shikaang, Khuma, Karbay, Bomray and Booban	Fuel wood, tourism, construction wood and grazing
Bubin	Bubin	Kharbey, Bumurai, Yagham, Bubin and Muraat	Fuel wood, tourism, construction wood and grazing
Qamri/Zian	Qamri	Gishat paeen, Pishwari 1, Pishwari-2, Gishat bala, Nasirabad, Naigon 1, Naigon 2, Darban-1, Darban-2, Darban-3, Qamri khas, Thail paeen, Thail bala, Gorikot, Banglaban, Dodakhas and Zian etc.	Fuel wood, grass collection, timber, medicinal plants, tophy hunting, ecotourism and grazing
Rattu	-	Kolalot, Salehabad, Rattu khas, Dado jail, Nasirabad, and Saahabad etc.	Fuel wood, timber, medicinal plants and grazing
Mirmalik	Mirmalik	Mirmalik and Foffon	Fuel wood, grass collection, timber, medicinal plants and grazing



Name of valley	Name of vcc	Name of major villages	Customary rights of communities
Chorit	Chorit	Chorit, Naakay and Gagay etc.	Fuel wood, tourism, construction wood and grazing
Minimarg/Domail	-	Minimarq-1, Minimarg-2, Minimarg -3, Nagai, Mapno -1, Mapno -2 and Mapno-3	Fuel wood, medicinal plants and grazing
Kalapani	-	Chorit, Chaeen, Facirtct, Gomat and Mamrai etc.	Fuel wood, timber and grazing
Pakora/Nogam	Pakora	Makial, Naugaam, Nagaam, Pakora, Kushunat Zial, Komaydas and Khomay	Fuel wood, construction wood, grass collection and grazing
Finna	Finna	Abbas town, Aliabad, Eildar, Central finna, Gromain, Maja-fuchung and Gorichi fuchung	Fuel wood and grazing
Bullan	Bullan	Bulan paeen and Bulan bala	Fuel wood, timber, grass collection and grazing
Choguam	Choguam	Chomguam paeen, Chogaam bala, Pari het, bulan paeen and Bulan bala	Fuel wood, construction wood, grass collection and grazing
Rehmanpur/Zaipur	Rehmanpur/Zaipur	Dadsheri het Hussini het, Sulemani het and Shamtti het	Fuel wood, timber, construction wood, grass collection and grazing
Thinging	Thinging	Majini het, Numberdar mohalla, darri mohalla, Thooko mohla, Tarishing bala and Rupal	Fuel wood and grazing
Chilim/Khiram	Chilim	Khiram, Khiram Dddri, kakan, Das peen, Das bala, Parinaat, Dairlay, Chilim, Chillim das and Sherquilli	Fuel wood, timber grass collection and grazing
<b>Source:</b> Forest Department District Astore (GB)			

TABLE 18-TYPE OF RANGELANDS IN THE REGION

Rangeland Category	Mountain Ranges	Area (million ha)
Foothill grassland	Karakoram – Hindu Kush	0.02
Dry temperate grazing lands	Himalaya-Karakoram-Hindu Kush	0.28
Valley grazing areas	Himalaya-Karakoram-Hindu Kush -Alpine	0.21
Pastures	Himalaya-Karakoram-Hindu Kush	1.83
<b>Total</b>		<b>2.34</b>
<b>Source:</b> Forest Department District Astore (GB)		

TABLE 19-LIVESTOCK POPULATION OF THE PROJECT AREA

Name of Villages/Dispensary	Cattle	Goat	Sheep	Yak	Zoh/Zmoh	Horse	Donkey	Mule	Poultry	T. Population
Astore	7717	5314	6050	103	546	14	210	0	7985	<b>28439</b>
Gorikot	3013	4150	2262	2	266	8	432	9	2454	<b>12596</b>

Name of Villages/Dispensary	Cattle	Goat	Sheep	Yak	Zoh/Zmoh	Horse	Donkey	Mule	Poultry	T. Population
Chorit	4190	1884	6576	49	1426	289	1141	0	2407	17971
Chugam	2171	1959	1550	0	290	0	48	0	1235	7253
Rattu	2720	2536	255	0	497	0	94	0	2380	8482
Mirmalik	1459	1518	2875	4	526	420	148	0	677	7627
Dirlah	1097	1430	3533	0	543	5	227	0	1099	7934
Shankergarh	919	2219	3619	4	610	2220	343	7	873	10814
Gudai	2214	3229	3989	3	599	0	142	0	3268	13444
Bobin	298	1283	721	9	415	0	625	0	578	3929
Daskhrum	1009	752	2272	0	513	63	133	0	1536	6278
Minimarg	1228	2389	2304	270	406	296	15	30	2275	9213
Qamri	3371	4185	4388	15	941	80	13	26	3335	16354
Kilishi	659	837	2265	0	0	42	80	73	1996	5952
<b>Total</b>	<b>32065</b>	<b>33685</b>	<b>42659</b>	<b>459</b>	<b>7578</b>	<b>3437</b>	<b>3651</b>	<b>145</b>	<b>32098</b>	<b>156286</b>

**Source:** Department of Livestock & DD Astore 2012

## 5.2.2 FAUNA ATTRIBUTES OF THE PROJECT AREA

The district Astore falls under Himalayan Highlands where a large variation in climatic factors results into variation of fauna and flora. The diversity in large mammal's species include Markhor, Himalayan Ibex, Ladakh Urial, Musk Deer, Snow Leopard, Brown and Black Bear. The project area is not very rich in natural fauna because of hilly, bare, dry and hard climatic conditions but some very special type of wildlife is found on the tops of the hills. Wildlife and other fauna generally consist of mammals, reptiles, amphibians, insects, butterflies, vectors, livestock and poultry, freshwater fish, birds and fowls. The biodiversity of the GB is believed to include some 230 species of birds, 54 species of mammals, 20 species of freshwater fish, 23 species of reptiles and 6 species of amphibians. The common fauna of the project area is discussed as under:

### 5.2.2.1 MAMMALS IN THE PROJECT AREA

Some mammals reported in the project area are shown in Table-20. The wild mammals in the project area and surrounding are mostly trespassers and seldom enter the settlements.

TABLE 20-MAMMALS FOUND IN THE PROJECT AREA

Scientific Name	Common Name	Local Name
Canis lupus	Wolf	Shahnel
Vulpes vulpes	Fox	Loyian
Capra falconeri falconeri	Astore markhor	Bumb mairoo
Capra siberica	Ibex	Kel mairoo
Moschus Chrysogaster	Musk deer	Roz
Uncia uncial	Snow leopard	Dee
Ursus srctos	Brown bear	-
Ursus thibetanus	Black bear	-
Lepus capensis	Hare	-
Marmota caudate	Marmot	Turshon



Scientific Name	Common Name	Local Name
Eupetaurus cinerius	Woolly flying squirrel	Gillo
Hylopetes cinerius	Kashmir flying squirrel	-
<b>Source:</b> Wildlife Department District Astore (GB)		

### 5.2.2.2 BIRDS WITHIN THE PROJECT AREA

Birds are not common in the project area due to the specific terrain characteristics, scattered population and limited agricultural activities. A list of birds generally found in the area is given in Table-21. The project area falls within the “Indus Flyway” which is used by a variety of migrating birds, especially duck travelling from Siberia to Pakistan and India. On their return in spring to Europe, these birds also follow the north before turning to the west and heading north over Afghanistan to avoid the high Himalayan mountains. The main migration times are around December when the southwards migration commences and in April when the flocks again return to the north. Main migratory birds reported in the project area are Buteo rutinus (pintail) Garrulous sp. (common teal) Nucefraga caryocatactes (coot) Corvus macrorhynchos (gray heron) and Troglodytes troglodytes (sand piper).

TABLE 21-BIRD SPECIES IN THE PROJECT AREA

Scientific Name	Common Name	Scientific Name	Common Name
Falco peregrinus	Peregrine falcon	Myiophonus careuleus	Whistling thrush
Pyrrhocorax graculus	Alpine chough	Tichodroma muraria	Wall crapper
Corvus macrorhynchos	Jungle crow	Accipiter nisus	Sparrowhawk
Passer domesticus	House sparrow	Gypactus barbatus	Bearded vulture
Alectoris chukar	Chukar partridge	Motacilla alba	White wagtail
Aquila chrysaetos	Golden eagle	Lerwa lerwa	Snow partridge
Upupa epops	Hoopoe	Apus melba	Alpine swift
Tetraogallus himalayensis	Himalayan snow cock	Apus apus	Common swift
Bubo bubo	Northern eagle owl	Hirundo daurica	Red rumped swallow
Cinclus pallasi	Brown dipper	Lanius schach	Long tailed shrike
Columba rupestris	Hill pigeon	Anas acuta	Northern pintail
Falco tinnunculus	Kestrel	Streptopelia orientalis	Oriental turtledove
Garrulax lineatus	Laughing thrush	Marmaronetta angustirostris	Marbled teal
Dendrocopos mahrattensis	Wood pecker	Anas crecca	Common teal
Pica pica	Black billed magpie		
<b>Source:</b> Wildlife Department District Astore (GB)			

### 5.2.2.3 INSECTS

The GB is rich in biodiversity of insects including butterflies found in the project area, particularly during the humid months of July and August. In addition, caterpillars, bugs, beetles, black bees, weevils, mosquitoes, ants, green aphids, codling moths, leaf miners, mites, fruit flies, woody aphids, stray grasshoppers, leafhoppers, mealy and woolly bugs, peach leaf curling aphids, scale insects,

walnut weevils, blister mites, and dusky veined aphides are all found in the Gilgit Baltistan including the project sites.

#### 5.2.2.4 ENDANGERED, THREATENED AND VULNERABLE SPECIES OF FAUNA

The IUCN Red List of endangered, threatened and vulnerable species in the Gilgit Baltistan is shown in Table-22. However, none of these species have been recorded within the project area.

TABLE 22- ENDANGERED, THREATENED AND VULNERABLE SPECIES OF THE AREA

Category	Species
Endangered Species	Astore Markhor ( <i>Capra flconeri</i> )
	Snow leopard ( <i>Unica unica</i> )
	Ladakh urial ( <i>Ovis vignei</i> )
	Woolly flying squirrel ( <i>Eupegaurus cinereus</i> )
Threatened Species	Musk deer ( <i>Moschus chrusogaster</i> )
	Marmot ( <i>Matmota caudate</i> )
Vulnerable Species	Black bear ( <i>Ursus thibetanus</i> )
	Brown bear ( <i>Ursus srctos</i> )
Source: Wildlife Department District Astore (GB)	

#### 5.2.3 PROTECTED AREAS

A protected area is an area of land dedicated to the protection and maintenance of biological diversity of natural and associated cultural resources managed through legal or other effective means. Under Pakistan's current provincial and territorial legislation, three categories of protected areas have been established: Wildlife Sanctuaries, National Parks, and Game Reserves. In this area, one protected area has been declared so far, the Gorikot/Tarashing CCHA. The protected area is planned to be managed with the local communities' active participation and spread over 151sq.km area but no land exists within the project area.

#### 5.2.4 WETLANDS

Wetlands are vital part of ecosystem and having global importance as these are source of many ecosystem services like regulation of water, support biodiversity, provide livelihoods, produce food and possess potential for tourism. From social and economic aspects these resources have direct impact upon agriculture, industry, power generation and tourism but no important wetlands exist within project area. Some valley wise wetlands are shown in the Table-23.

TABLE 23-WETLANDS OF THE AREA

Name of Area	Glaciar Area (ha)	Water Bodies (ha)	Name of Wetlands
Gorikot/ Bulashbar	4.82	0.46	Two lakes, Domosar glacier and Stream, three ponds and bulashbar glacier
Gudai	8.19	0.65	Gudai nullah, Shikan lakes-2 and glacier and Thoika glacier
Kalapani	6.96	28.31	Riaat lake
Minimarg	0.39	13.24	Domail lake, Minimerg stream and sattar nullaha



Name of Area	Glaciar Area (ha)	Water Bodies (ha)	Name of Wetlands
Mirmalik	30	12.9	Main stream water
Pakroa/Nogam	4.39	0.97	Naugaam nullaha
Parishing	62.57	38.44	Kachali harayo glacier, rangdano glacier, kino wal glacier and parishing nullaha
Qamri	0.01	7.8	Gaagai nullaha glacier,
Rattu	2.11	0.44	Snowmelt water and main rattu nullaha
Rehmanpur	32.03	9.43	Cheecha nullaha
Tarishing	125.17	9.57	Tarishing glacier, Rupal top glacier and top nullaha
Chugam	0.31	0.07	Chugam Nallaha/Stream
Chorit	N/A	N/A	Somaill Glacier
Bubin	18.15	43.67	Bubin Glacier and Stream
Bullan	0.53	0.09	Bullan Nallaha and Glacier
<b>Source:</b> Forestry Master Plan Astore District			

### 5.2.5 AQUATIC ECOLOGY

The aquatic ecology of the Astore River and its tributaries within the project area has been studied to assess the prevailing aquatic ecology. The survey has shown that the diversity and composition of aquatic life vary throughout the system. The prominent aquatic life include fish, phytoplanktons (spirogyra) and zooplanktons (Paramecium), benthic insects, larvae of mayfly, caddis flies, mosquito larvae, stone fly and water mite.

#### 5.2.5.1 FISHERIES

The GB possess large cold-water resources with a variety of habitat ranging from shallow torrent and deep gorged rivers to gently flowing streams and then from semi to completely stagnant perennial waters in lakes and reservoirs. The common fish species found in the Gilgit Baltistan are given in Table-24. Clear water is suitable for trout and turbid water is suitable for local fish. Since the stream waters are fed by snowmelt, only cold-water fish are found in the area.

TABLE 24- FISH SPECIES IN THE PROJECT AREA

Name of Area	Name of species	Fishing
Gorikot/ Bulashbar	Trout fish	Fishing throughout license
Chugam	Trout fish	License issues
Chillim/Khiram	Trout fish	Regularized by Govt.
Rattu	Trout fish	License issues
Pakora/Nogam	Trout fish	Regularized by Govt.
Gudai	Trout fish	License issues by Govt.
Kalapani	Trout fish	License issues
Qamri/Zian	Trout fish and local carp fish	Not regularized
Minimarg/Domail	Trout fish and local carp fish	Not regularized



Dirlay	Trout fish	Fishing throughout license
<b>Source:</b> Fishery Department District Astore (GB)		

There is no commercial fishing in the project area. A trout fish hatchery under the Pakistan Agricultural Research Council is functioning at Sai Nullah near Jaglot town. Sport fishing is a popular and dominant feature of the project area. The market price of fish is about PKR 300 per kg for local fish and PKR 1000 per kg for trout; while the price of trout in big cities of Pakistan is in the range PKR 1500 to 1800 per kg. Fishermen also reported the presence of masher and rainbow trout in the River Astore. Fish caught by the local people is usually consumed in the household, but it is also offered for sale in the market at Astore. It is not a regular part of food for the local people. Only rod and line are permitted for trout fishing by the Fisheries Department. However, cast netting is also allowed in main rivers.

## 5.3 SOCIO-ECONOMIC ENVIRONMENT

### 5.3.1 METHODOLOGY

This section describes the key socioeconomic features of the study area, including the administrative setup, population, education, health, infrastructure, occupations, and cultural resources. Primary and secondary data sources were used to develop the socioeconomic baseline of the area. Secondary data was collected using published data in the form of literature, research journals and internet. Primary data was collected through community meetings. Stakeholder consultation was carried out with local community and Government departments. There were two basic aims of the study; first to inform and consult with the local communities about what is the proposed project and what would be the likely impacts and second to carry out an in-depth socio-economic survey of the villages/towns falling in the project area. To this end, a detailed study of the area was conducted. Focused group discussion and field survey was carried out to arrive at community needs and their concerns regarding the proposed activities. The socio-economic survey questionnaires for data collection from project area is include as Annexure: 3.

### 5.3.2 STRUCTURES OF AUTHORITY

#### 5.3.2.1 FORMAL STRUCTURE

The two areas like Neelum (AJK) and Astore (GB) falling in project work are under the general charge of the Deputy Commissioner, who combines the functions of the District Magistrate as well as the District Collector. He is also responsible for the co-ordination of the functions of all nation building departments in the district. As District Magistrate, he is responsible for maintaining law and order in their district. For the purpose, the Executive Magistrate and the police assist him.

### 5.3.3 DEMOGRAPHICS

#### 5.3.3.1 POPULATION

During field visit approximately 65km distance was covered along the proposed project alignment. Population at and near vicinity of the proposed project area was consulted in order to get socioeconomic profile of the area. The average household size of the consulted population was found 9.13 persons per household in tehsil Shounter District Astore.

The Proposed Project is located in two districts: Neelum (AJK) and Astore (GB) and the mostly area fall in Astore district. There are some villages (Gorikot, Chorit, Chugam, Rattu, Mirmalik, Dirlah,

Shankergarh, Gudai, Bobin, Daskhrum, Minimarg, Qamri, Morcha Guzair, Shoenter and Kilishi) in the project area which are expected to be affected directly or indirectly by the implementation of the project. The actual population of these settlements for the year 1998 and the estimated population for the year 2012 are given in Table-25.

**TABLE 25- ESTIMATED POPULATION OF THE SETTLEMENTS IN THE PROJECT AREA**

S.No.	Name of Villages	Total Population
1	Gorikot	6995
2	Chorit	7779
3	Chugam	1521
4	Rattu	2623
5	Mirmalik	2983
6	Dirlah	3569
7	Shankergarh	2761
8	Gudai	8286
9	Bobin	1402
10	Daskhrum	2339
11	Minimarg	9213
12	Qamri	2040
13	Kilishi	5952
<b>Total</b>		<b>57463</b>
<b>Source:</b> Department of Livestock & DD Astore 2012		

### 5.3.3.2 HOUSING

All villages in the project area have mostly Kacha and some semi-pakka houses were observed but majority of the families live in Kacha houses. About 70% of Kaccha and 30% of semi-pakka, houses were found are in the project area. The total area of housing units varied from 5 marlas to 20 marlas with an average of 10marlas. The area reported included both covered and uncovered areas. The average age of housing units was 15 years and varied from 8 to 18 years. During the social survey it was observed that all respondents were living in self owned houses. The total cost including the cost of land and construction of housing units varied between PKR 375,000 to PKR 533,000 per house. The approximate value of a house according to the respondents was higher in Gorikot (PKR 533,000) and lowest at Morcha Guzair (PKR 375,000). The housing characteristics of project area are given in Table-26.

**TABLE 26-HOUSING STATUS OF SAMPLE VILLAGES IN THE PROJECT AREA**

Name of Villages	Average Area			Type of Houses		Age	Value (PKR)
	Total	Covered	Uncovered	Kacha	Semi-pakka		
Gorikot	9	4	5	50%	50%	15	533,000
Paroit	15	8	7	70%	30%	10	375,000
Chugam	5	3	2	80%	20%	12	350,000





Rattu	10	7	3	60%	40%	20	420,000
Mirmalik	20	15	5	75%	25%	11	385,000
Batbash	5	3	2	65%	35%	18	430,000
Rehmanpur	7	4	3	70%	30%	10	380,000
Guzair	6	4	2	85%	15%	15	365,000
<b>Notes:</b> 1. One marla = 21 m <sup>2</sup>							
2. Kacha House = Made of mud, Semi Pacca House = made of stones, blocks and mud							

### 5.3.3.3 AGE STRUCTURE

During field survey, public consultation was carried with different age group of community members. A total of 60 community members were interviewed during field survey, 25% of the respondents were below 25 years age, 35% between 26-35, which is an active group of community members; 20% between 36-50 and 20% above 50 years of age. The age distribution of population surveyed is presented in Table-27.

TABLE 27- AGE DISTRIBUTION OF SURVEYED POPULATION

Age Distribution	Number of Persons	%
<25	15	25
26 – 35	21	35
36 – 50	12	20
>50	12	20

### 5.3.3.4 HEALTH PROFILE

The health facilities are not adequate in the project area. The ten beds hospital operational at Gorikot and 10 beds are at Rattu that provides health facilities mainly to the residents of the project area villagers. A qualified doctor is posted here, but shortage of medicine, lack of X-ray machine and clinical laboratory adversely affect the performance of the hospital. There is a dispensary in Mirmalik but due to shortage of qualified staff and medicine this is not working effectively. The people of Morcha Guzair and Shounter have to travel to Gorikot and Astore for serious illnesses. In case of emergency, the patients visit Basic Health unit at Gorikot and District Government Hospital at Astore and Lack of adequate medical facilities is the main cause of illness, mortality and infertility. In Astore 50 beds Hospital and the common diseases reported from the project area are joint problems, diarrhea, dysentery, and skin problems. The main reasons for such diseases are poverty, poor diet and unhygienic living conditions.

### 5.3.3.5 EDUCATIONAL FACILITIES

As with the health services, better educational facilities are available in district Astore including project area. In Astore Government Collage for Boys, two government high schools (each for boys and girls) and five primary schools are functional in Astore and One High School and one Middle School in Gorikot and one High School at Rattu and also two private School in operation. These institutions provide educational facilities not only to the local population but also to the surrounding areas. It may be concluded that primary education facilities are available in all villages but there are only very limited places available a high school stage. For higher education, people consider moving to major

areas like Gilgit, Muzaffarabad (AJK), Islamabad, Lahore and Karachi etc. Table-28 shows the number of schools in the project area.

TABLE 28- EDUCATIONAL FACILITIES IN THE PROJECT AREA

Village	Government Schools						Non-Formal / Private		Dine Maddresa
	Primary		Middle		High		Co-education		
	Boys	Girls	Boys	Girls	Boys	Girls	High	Primary	
Astore	1	1	-		2	2	7	9	1
Gorikot	1	1	1	-	-	-	-	1	1
Rattu	1	1	-	1	1	-	2	2	1
Mirmalik	1	-	-	-	-	-	-	1	
Morcha Guzair	1			-	-	-	-	1	
Parort	1	-	-	-			1	1	
Source: Consultant Environmental team of SRT									

#### 5.3.3.6 LITERACY RATE

According to the social survey the overall literacy rate in the project area is about 45%, with a minimum (25%) in Morcha Guzair and maximum in Astore (62%). Literacy rate in project area is shown in Table-29.

TABLE 29- LITERACY RATE IN PROJECT AREA

Village	Literacy Rate (%)
Astore (In all District)	62
Gorikot	45
Rattu	42
Mirmalik	27
Paroit	33
Morcha Guzair	25
<b>Source:</b> Forestry Master Plan Astore District	

#### 5.3.3.7 LANGUAGE

Shina is the main spoken language (a local language) in the project area followed by Urdu, Hindko and Pashto in Table-29 shows ethnic groups, affiliation and language spoken in the project area.

TABLE 30- ETHNIC GROUPS, RELIGION AND SPOKEN LANGUAGE IN THE PROJECT AREA

Village	Ethnic Groups	Affiliation	Spoken Language by the Majority
Astore	Sheen, Yashkoon Kashmiri, Pathan, Syed. Raja and Derked	Seha, Sunni	Shina
Gorikot	Sheen	Sunni	Shina
Rehmanabad	Sheen	Sunni	Shina



Chugam	Sheen	Sunni	Shina
Nasirabad	Sheen	Sunni	Shina
Rattu	Sheen	Sunni	Shina
Mirmalik	Sheen	Sunni	Shina
Morcha Guzair	Sheen	Sunni	Shina
<b>Source:</b> Consultant Environmental team of SRT			

### 5.3.4 COMMUNITY STRUCTURE

In all villages, the majority of the people belong to Sheen tribes who are relatives to each other with the same origin and language. In Tehsil shounter, some people belong to other tribes, who have migrated from other parts of the country. Efforts on community-based projects such as irrigation channels, tracks and roads, education and conservation of nature are made jointly. Important issues and disputes are solved by the heads of families and village elders. However, there is no major role of women in the decision-making process.

### 5.3.5 FAMILY STRUCTURE

The joint family system is very much prevalent in the project area which is traditional and considered to be Islamic. The eldest male member is the head of the family, male members dominate in decision making in most of family matters, whereas women have no or little role in the decision-making process. The members in a family include parents, their children and grandchildren. From the household survey, the average family size in the project area is about 10 members.

### 5.3.6 VULNERABLE GROUPS

The vulnerable groups identified in the project area are disabled person (person who depend on other family members because of loss of any body part), widows and some landless people. 61 disabled people were identified in the social survey of the project area in Table-31. There were 8 widows in Rattu area; therefore, these widows will require special attention. They are most vulnerable and will require appropriate rehabilitation. Sheen and Yashkun are generally local and are big landowners while landless people belong to non-local tribes. The under-privileged position and many social conflicts are basically the outcome of uncertain ownership of land and other immoveable properties. The local tribes (Sheen Yashkun) represent the majority of the population in the project area and claim to be the original owners of the land. The poorest groups are therefore those non-local people, who are not owners of any land, but are working as tenants or only as agricultural workers.

TABLE 31- DISABLED PERSONS IN PROJECT AREA

Village	Disabled Persons
Astore (In all District)	8
Gorikot	4
Nasirabad	3
Mirmalik	6
Chugam	5
Rattu	5
Morcha Guzair	4

<b>Total</b>	<b>35</b>
<b>Source:</b> Consultant Environmental team of SRT	

### 5.3.7 ETHNIC GROUPS AND RELIGIONS

Sheen and Yashkoon are the main ethnic groups residing in the project area. The whole population of project area belongs to the Yashkoon tribe. In Astore, Gorikot, Nasirabad Rattu and Mirmalik the majority of the people belong to Sheen and some are Yashkoon tribes. Kashmiris, Syeds, Rajajpoot, Derked and Pathans reside in project addition to the Yashkoon and Sheen groups. All the peoples are in the project area belong to religion of Islam. However, affiliations vary from village to village and the whole population of the project area is Muslim. The people have lived in ethnically mixed populations for hundreds of years and have very close relations with each other. They observe all the festivals and customs together.

### 5.3.8 SAFETY

The project area is located in the settled parts of the country that are controlled by the local governments. The provision of security to the people in the project area rests with the administration of each district. The police posts established in the area provide security to the people as well as to the public property. The present crime rate is very low and the records show that no murder case has been registered at Gorikot police station since 1998. Travelling in the area is secure and safe as the people are peaceful and helpful.

### 5.3.9 RECREATION FACILITIES

The project areas are located in narrow valleys and space for extensive recreational facilities is not available. Small patches in the settlements are present which are used mainly for playing cricket and volleyball. There are no cinemas or clubs in the entire project area. As mostly people are religiously minded, the use of television, radio and music is very limited. Polo is a popular sport in Astore and GB but it is not being played in the project area because of poor socio-economic conditions.

### 5.3.10 BASIC INFRASTRUCTURE AND FACILITIES

The GB of Pakistan possesses one of the most rugged landscapes on earth. For centuries, this mountainous landscape made the GB one of the most remote and inaccessible regions of the sub-continent. At the time of independence, the GB had only nine pony tracks, 13 suspension bridges and a small airport. The existing infrastructure facilities in the project area are given in Table-32.

TABLE 32- EXISTING INFRASTRUCTURES FACILITIES IN THE PROJECT AREA

Villages	Distance from		Access Road		Health Facilities	
	Astore	Project Site	Metalled	Not metalled	Dispensary	Hospital
Gorikot	10 km	40 km	Yes	-	-	Yes
Rattu	40 km	20 km	Yes	-	-	Yes
Mirmalik	50 km	10 km	Yes	-	Yes	-
Nasirabad	25 km	30 km	Yes	-	Yes	-



Chugam	23 km	27km	Yes	-	-	-
Rehmanpur	30 km	20 km	Yes	-	Yes	-

**Source:** Consultant Environmental team of SRT

### 5.3.11 ELECTRIC POWER

Electricity is available at throughout the Project area. The whole project area is short of power supplies. The communities of the area totally depend on fuel wood. The project area villagers are lack of Natural Gas facility.

### 5.3.12 DOMESTIC WATER SUPPLIES

Tapped water supply is considered to be the most hygienic source of drinking water which is available in the project area. In project area there is a water supply system which has been built by local people with the help of AKRSP. Water supply is partially available in Astore, Gorikot, Rattu and Shounter valleys.

### 5.3.13 TELECOMMUNICATION

The telecommunication services in the Throughout the GB are provided by the Special Communication Organization which is a wireless and satellite telephone company. This organization is managed by the Signals Corps of the Pakistan Army. Telephone facilities in the project area are available at Project area. The mobile service of S.com is also available within the project area.

### 5.3.14 TRANSPORTATION

Northern Areas Transport Corporation provides transport services from Rawalpindi to Gilgit, Astore and Skardu. The KKH is an all-season road which was built by FWO, Pakistan Army and China from 1966 to 1978. In addition, several other private transport companies provide services in the Gilgit, Skardu and Astore areas. The transport service between Astore and other villages of the project areas are usually by private taxi, jeeps, coster and vans etc.

### 5.3.15 POST OFFICE

Postal facilities in the project area are very poor. There is one Sub-post office at Astore which provides services to the residents of Astore and adjoining areas. Postal service is also available at project areas only one person is deputed here for collection and distribution of letters and parcels.

### 5.3.16 BANKING

Banking services are available in District Astore where there are branches of NBP, ZTB, MFB, NRSPB, PBL, KKB and HMB etc. The residents of project area go to Astore, Gorikot, Gilgit and Skardu for banking services.

### 5.3.17 INDUSTRIES

There is no important industry in the project area. However, a number of flour mills have been running for the past six to seven years in Project area and also Jaglot on the opposite bank of the Indus from the link road of Astore. Few water power operated wheat grinding machines (flour mills)



have been installed in the past in some villages but presently some are in operation. These mills have been gradually converted to electricity and are milling wheat and maize. The farmers deliver the grain to the mills and pay the charge in kind at the rate of 4 kg flour per 40 kg grain. The mills can grind on average about 40 kg of grain per hour.

### 5.3.18 LAND HOLDING AND TENANCY STATUS

The majority of the farmers in the area are owner operators; only 3% are owner cum tenants. In tehsil shounter, most of the respondents do not cultivate their land which is being cultivated by tenants on a  $\frac{1}{3}$  share basis. The average land holding in the project area is 20 kanal with the maximum in tehsil shounter 30 kanal and the minimum in Morcha Guzair 10 kanal.

### 5.3.19 COST OF AGRICULTURAL LAND

The average price of land in the project area is PKR 350,000 per kanal. In Gorikot the land price is PKR 400,000 per kanal. In Shounter valley average price of land is PKR 300,000 per kanal.

### 5.3.20 FOOD HABITS AND FOOD SUPPLY

Wheat, maize, potato is the staple food of people in the project area. However, wheat produced in the area is not sufficient and does not meet the demand of local population. Wheat is provided to the people at subsidized rates through the Food Supply Department of the GB. The Food Supply Department purchases wheat from which some is given to flour mills and the remainder is distributed among people in the GB through the Sales Depot Network. The wheat quota is fixed for each household at 200 kg per month. The Government of Pakistan gives a 50% subsidy on the purchase of wheat for the GB. The Food Supply Department has an established sale depot for wheat and small utility stores in the area.

### 5.3.21 OCCUPATIONS AND INCOME, LIVELIHOOD

The socio-economic survey shows that agriculture is the main source of income for 60% of the respondents and for the remaining the main source of income was employment and services. Other sources of income include small scale businesses, village shops and roadside hotels, mining, labor and private services in Table-33. About 05% households have an income below PKR 10,000 monthly, 30% between PKR 10,000 and 15,000 per month, however, a small portion of respondents (05%) have a monthly income equal or more than PKR 50,000. It can be concluded that the monthly earnings of majority of population in the project area are less than PKR 15,000. Residents of tehsil shounter are mainly involved in government jobs as at least one person from each family is engaged in government service, mostly people in the army and education sectors.

TABLE 33- OCCUPATIONS IN THE PROJECT AREA

Occupation	Nos. of Households	Proportion
Business	4	4%
Agriculture	60	60%
Government service	30	30%
Private service	2	2%
Shop or hotel business	4	4%
<b>Source:</b> Consultant Environmental team of SRT		

### 5.3.22 FAMILY EXPENDITURE

The total monthly expenditures reported by households are summarized in Table-34 which shows that about 40 % of the respondents spend up to PKR 10,000 per month, whereas monthly expenditure of 23.48 % and 13.91 % of the respondents was between PKR 10,001 to 15,000 and PKR 15,001 to PKR 20,000 respectively. About 14.78 % of the respondents were spending monthly PKR 20,001 to PKR 30,000. The remaining 7.84 % spend more than PKR 30,000. The average monthly expenditure in project area was about PKR 16,756.

About 53.91 % of the respondents in the project area spend up to PKR 6,000 on food items, whereas the kitchen expenditure of 20% and 11.3 % of the households was between PKR 6,001 to PKR 9,000 and PKR 9,001 to PKR 12,000 per month respectively. While 7.83 % of respondents are spending PKR 12,001 to PKR 15,000 on food items, the remaining 6.96 % are spending more than PKR 15,000 per month as kitchen expenses. The average monthly expenditure on food items was estimated as PKR 7,822 in the project area. The proportion of expenditures on food items is about 46 % of total monthly expenditure of a family.

TABLE 34- TOTAL MONTHLY HOUSEHOLD EXPENDITURE

No. of Households	Proportion	Amount (Rs)
8	6.95%	Below 5,000
38	33.04%	5,001 to10,000
27	23.48%	10,001 to 5,000
16	13.92%	15,001 to 20,000
7	6.09%	20,001 to 25,000
10	8.69%	26,001 to 30,000
2	1.74%	31,001 to 35,000
7	6.09%	35,001 to 50,000
<b>Source:</b> Consultant Environmental team of SRT		

### 5.3.23 POVERTY

The Project area communities are particularly susceptible to the shocks and stresses created by economic, governance, social and environmental causes, which make the poor especially vulnerable. Major issues related to poverty in the project area are identified as under:

- Lack of improved physical infrastructures i.e. roads, communication, irrigation and drainage and delivery of utility services.
- Absence of a social security system for the effective coverage of vulnerable populations and the poor.
- Lack of horizontal and vertical social mobility among ethnic groups.
- Unequal employment and access to economic resources for rural women folk.
- Gender inequality in access to formal educational opportunities and health facilities.

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### 5.3.24 CREDIT AVAILABILITY

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Credit practices are a regular part of the lives of poor families. The main sources of loans are shopkeepers, relatives and well-off families in the village. Debts are mainly used for the domestic expenditures such as marriages, deaths and education. The institutional credit is very limited in the project area mainly due to lack of banking services and secondly due to the high interest rates charged by the banks.

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### 5.3.25 SOCIAL ORGANIZATIONS AND NGO INVOLVEMENT

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Social organizations refer to group dynamics, role playing and conflict resolution mechanisms in a given social situation aiming at making functional networks and linkage prevail in a given community. Essentially, the tribal system in the project area is the guiding force in social interaction processes, group dynamics, institutional arrangements and economic activities at village level. Tribal and village elders command respect and hold higher status compared to an ordinary village inhabitant. His opinion and wish is considered final in development activities in the area.

The GB has been at the center of the NGO movement in Pakistan. The NGO Sector has made an enormous contribution to sustainable development in the GB. About 500 NGOs have been registered under the voluntary Social Welfare Agencies (Registration and Control) Ordinance 1961. The Aga Khan Rural Support Programme (AKRSP), in particular stands out for its contribution to physical infrastructure, poverty alleviation, agricultural production and development of women. In addition to these NGOs, many local support organizations and women organizations are working under the supervision and guidance of AKRSP in the project area.

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### 5.3.26 TOURISM

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The scenic beauty and adventurous terrain of the GB attract a variety of tourists throughout the year. However, tourist activities in project area are limited. After the completion of the proposed tunnel project the tourist visit this area. The only tourist spot in this region is at the junction of the three highest mountain ranges, i.e. Hindukush, Himalayas and Karakoram near Partab Bridge at KKH. A large number of local and foreign tourists visit this site every year. The Gilgit to Skardu and also Astore road is used by tourists to visit most of the peaks in the Himalayan region. The Pakistan Tourism Development Corporation (PTDC) has constructed a motel at different areas of GB.

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### 5.3.27 ARCHAEOLOGY AND CULTURAL HERITAGE

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The GB of Pakistan has a long and turbulent history. The history of the earliest inhabitants of this area can be traced back to about the 5th millennium BC. The locals could be termed as “People of Rock Art”, as they started the tradition of “rock engraving” in the GB. The GB has special characteristics in cultural and historical construction. The forts at Hunza, Nagar and Baltistan especially Baltit, Altit and Ganish have a cultural heritage of international importance. The historical buildings and houses designed by the people of the area belong to Tibet and Central Asia. The GB has a number of cultural heritage and archaeological sites. All the artefacts, petrography, monuments and buildings of historical importance are part of archaeological heritage. No other historical or archaeological site is located in the project area.

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### 5.3.28 COMMUNITY PERCEPTIONS ABOUT THE PROJECT AREA

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The community consultation process conducted in the project area and the outcome of the social survey findings both revealed that there was a complete consensus on implementation of the

Proposed Project. There were no over-intra- or inter-group rivalries, hostilities, disputes or tensions on the execution of the proposed project.

### 5.3.29 STATUS OF WOMEN

An independent “Gender survey” was conducted through applying the random sampling technique as used for the socio-economic household survey. A total of 50 women representing of households covering Gorikot, Rehmanpur, Chugam, Nasirabad, Rattu, Mirmalik and Morcha Guzair and Shounter, were selected for the interviews. The survey was conducted through a female numerator by using a separately developed questionnaire. Almost all the respondent women were mature between the ages of 20 and 50 years and 82% of them were married. A general observation during the survey was that the women of the project are being contacted for the first time in connection with shounter project. Therefore, before commencing the interview, they were briefed about the project components in detail. The outcome of this survey is given in subsequent sections.

### 5.3.30 OFFSPRING

Among the married women, the average number of children per respondent woman comes to 5.0, which was minimum at Morcha Guzair (3.4) and maximum at Gorikot (8.7). 3.19% of the respondents did not have any child and 12.77 % had 1 or 2 children, 24.47 % had 3 or 4 children, 27.66 % had 5 or 6 children, 21.27 % had 7 or 8 children while the remaining 10.64 % had more than 8 or 10 children. The majority of the women (52.13 %) had between 6 and 7 children shown in Table-35. Out of the total number of living children reported by the respondents, 55 % were boys and 45 % were girls. The overall sex ratio of the project area comes to 107 males per 100 females which is nearly equal to the sex ratio of Pakistan.

TABLE 35- NUMBER OF CHILDREN OF RESPONDENT WOMEN

No. of Children	No. of Respondents	Proportion
None	3	3.19%
1	7	7.45%
2	5	5.32%
3	13	13.83%
4	10	10.64%
5	12	12.77%
6	14	14.89%
7	9	9.57%
8	11	11.70%
9	3	3.19%
10	5	5.32%
11	2	2.19%
<b>Total</b>	<b>94</b>	<b>100%</b>
<b>Source:</b> Consultant Environmental team of SRT		

### 5.3.31 OCCUPATION

The majority of the respondent women (75 %) were housewives. A small portion (about 15 %) was engaged in different occupations while 10% were students. Table-36 shows the occupations of the respondent women in the project area.

**TABLE 36- OCCUPATIONS OF RESPONDENTS IN THE PROJECT AREA**

Village	Morcha Guzair	Mirmalik	Rattu	Paroit	Nasirabad	Astore	Gorikot
Occupation							
Housewife	100%	100%	85.71%	83.33%	62.96%	70.21%	<b>74.78%</b>
Teacher	-	-	7.14%	5.56%	7.41%	10.64%	<b>7.83%</b>
Voluntary Teacher	-	-	-	-	-	6.38%	<b>2.61%</b>
Tailor	-	-	-	-	-	4.26%	<b>1.74%</b>
Shopkeeper	-	-	-	-	-	2.13%	<b>0.87%</b>
Shepherd	-	-	-	-	-	2.13%	<b>0.87%</b>
Student	-	-	7.14%	5.56%	29.63%	4.26%	<b>1.30%</b>
<b>Source:</b> Consultant Environmental team of SRT							

### 5.3.32 HEALTH STATUS

About 15 % of respondent women in the sample villages enjoy a healthy life in good environmental conditions. The majority of the respondents (about 65%) feel better health with minor and occasional illness. However, the remaining 20% of respondents were suffering from different diseases. In case of illness, the majority of the respondent women (72%) take medical treatment from hospitals at Astore and Gorikot, while the remaining 28% take treatment from dispensaries at Rattu and Mirmalik. About half (55%) of respondents go with their husbands for treatment, 30% respondents get treatment with their fathers or brothers while the remaining 17 % women go for treatment with their sons or any other relative. A trained child birth attendant is available in Astore and Gorikot only. The most common diseases reported among women are gastric problems, headache, ulcer, joint pains (in elder women only) and asthma. The most common diseases among children are reported to be simple fever, cough, flu, diarrhea, dysentery and pneumonia. The health status, place of treatment and who accompanies women for treatment are presented in Table-37.

**TABLE 37- WOMEN HEALTH CONDITIONS**

Villages	Health status			Place of treatment		Who takes for Treatment		
	Good	Better	Bad	Hospital	Dispensary	Husband	Father or brother	Other
Astore	17.70%	66.60%	17.70%	66.70%	33.30%	50.00%	16.70%	33.30%
Gorikot	-	33.30%	66.70%	100.00%	-	-	33.30%	66.70%
Rattu	-	100%	-	100.00%	-	78.60%	14.30%	7.10%
Mirmalik	11.10%	55.60%	33.30%	50.00%	50.00%	72.20%	11.10%	16.70%
Paroit	18.50%	37.00%	40.70%	25.90%	74.10%	48.10%	33.30%	18.50%
Rehmanpur	17.60%	76.60%	6.40%	97.90%	2.10%	46.80%	42.60%	10.60%
Morcha Guzair	13.90%	65.20%	20.90%	72.20%	27.80%	53.90%	30.40%	15.70%
<b>Source:</b> Consultant Environmental team of SRT								



### 5.3.33 DECISION MAKING PROCESS AND SKILL DEVELOPMENT

According to the survey, the majority of the respondents (60%) have no role in decision making process except at Gorikot where 50 % of respondents have expressed their views that they have some role in decision making process in the family. However, final decisions are taken by the male members of the family, either by the husband or by the family head. In the project area about 15 % respondent women have ownership and rights of selling the property. About 75% of the respondents reported that they have some sort of skill. The most common skills were embroidery and knitting. However, none of the respondents reported about the use of these skills for income generation. Women are interested in obtaining training in knitting, embroidery, woolen fabrics and modern agricultural techniques for sowing of vegetables.

### 5.3.34 PRESSING NEEDS

The respondents tried to identify the pressing needs of the women and their village or community. Table-38 shows the pressing needs most frequently mentioned by the respondents. According to these results, the most important need (32%) was to improve the education and health facilities in the area, followed by a well-equipped girl's school or college (20%), agriculture training center for vegetable growing techniques (20%) and water supply (17%).

TABLE 38- PRESSING NEEDS (MULTIPLE RESPONSES)

Needs	Respondent (Nos.)	Proportion
Improvement in health, education facilities	50	31.60%
Water supply	26	16.50%
Vocational/computer training center	4	2.60%
Lady doctor/LHV/ maternity home	6	3.80%
Agricultural training center for growing vegetables	30	18.90%
Well-equipped girls school and college	31	19.90%
Handicraft training center	5	3.20%
Adult education training center	6	3.80%
<b>Total</b>	<b>158</b>	
<b>Source:</b> Consultant Environmental team of SRT		

### 5.3.35 ACTIVITIES

In rural areas of Pakistan, the majority of the women work in the fields along with their male family members. This pattern was also prevalent in the project area. Almost all the respondents said that they work in their fields except at Rattu valley where about 20% of respondents replied that their routine activities are usually limited to indoor activities. Women are engaged in looking after the fields, hoeing the vegetables and watering them. However, their participation was also reported in the seasonal activities of picking of vegetables, fruits and harvesting of wheat and maize. The majority of the respondents (80%) participate in income generating activities by selling poultry products, vegetables and livestock. Among these women about 10% of respondents are engaged in off-farm activities such as teaching, shop keeping, and tailoring.

### 5.3.36 AWARENESS AND PERCEIVED IMPACTS OF PROJECT AREA

Almost all the respondent women were aware of the fact that proposed tunnel project is likely to be constructed in their area. It was observed during the survey that the women had come to know about the project from the male members of their families and relatives. Respondent women were asked about the foreseeable effects of the project on their community and life. The majority of the respondents (about 90%) were of the view that project has both positive and negative effects. However, about 10% of the respondents were of the view that project has no negative affects; on the contrary, they considered that it will be very beneficial for the whole country in general and for the project area and GB of Pakistan in particular.

According to the perception of the women the impacts of the project would be:

- Better facility of transport for the area
- More job opportunities
- Increase in land values
- Improvement in infrastructure
- Noise, air and traffic pollution
- Threat of dislocation and disturbance of livelihood
- Crops damage due to employees during construction
- Social and cultural life disturbance due to increase in population
- Free movement of women and children may get disturbed due to project activities
- Access to pastures and grazing lands may be disturbed
- Slope distribution due to construction of tunnel and access road.

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### 5.3.37 SECONDARY CONSULTATION

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Stakeholder consultation was also carried out with Government departments. The following Government departments were visited in the Project Area.

- Environment Protection Agency, Gilgit Baltistan,
- AKRSP office, Gilgit Baltistan,
- Agriculture Department, Gilgit Baltistan,
- P&D Department, Gilgit Baltistan,
- WWF Office, Gilgit Baltistan,
- Karakorum University, Gilgit Baltistan,
- Divisional Forest Offices, Astore and Gilgit Baltistan,
- Wildlife Divisional Forest Offices, Astore and Gilgit Baltistan,
- Livestock Office, Astore Gilgit Baltistan,
- Climate Department, Astore Gilgit Baltistan and
- District Health Officer, Astore Gilgit Baltistan.

The participation of project stakeholders in project planning, design and implementation is now universally recognized as an integral part of environmental assessment. During the discussion, the brief project description and details were communicated with the concerned departments and their comments and suggestions were noted. None of the government official expressed any serious issue regarding the implementation of the proposed project. In general, all of the officials welcomed the project as it will bring development in the area and betterment for the community. Detailed on Secondary stakeholder consultation is presented in Chapter-6 of the report.

## CHAPTER-6 STAKEHOLDER CONSULTATION & DISCLOSURE

### 6.1 GENERAL

This section describes the outcome of the impact assessment survey and public consultation sessions held with different stakeholder groups that may be impacted by the project. The consultation process was carried out in accordance with the guidelines laid by EPA. The objectives of this process were to:

- Share information with stakeholders on proposed project and expected impacts on the physical, biological, and socio-economic environment of the project area,
- Understand stakeholder concerns regarding various aspects of the project and the likely impact of construction and operation related activities,
- Identify the weaknesses and problems of the projects; Find out valuable suggestions by the stakeholders to improve the project area,
- Understand the perceptions, assessment of social impacts and concerns of the communities of the project area; and find out the awareness level and situation of acceptability to identify any issues for the implementation of the proposed project.
- To invite people to express their views about the positive / negative impacts on their life styles / environment of the villages by the project area.
- To disclose information about contact offices/officers for any complains/queries

This report includes all the comments, which were taken into account in preparing the definitive development concept for the tunnel and access road project.

### 6.2 IDENTIFICATION OF MAIN STAKEHOLDERS

There are two types of stakeholders related to the project i.e. primary and secondary stakeholders. Primary stakeholders are those which are directly affected by the Project activities and secondary stakeholders are those which are affected indirectly. The proposed project does not have direct impacts on any individual; therefore, no primary stakeholders are identified. Secondary stakeholders are institutional stakeholders, which includes local Government representatives, Government Officials of the relevant departments, NGO, general public, local residents, shop keepers, vendors, hospital owners/staff, teachers, pedestrians, and businessmen/traders of the area. All those stakeholders have different types of stakes according to their involvements in various aspects of the project. The consultant tried to contact all the stakeholders and shared their views and concerns and also interacted with the community-based organizations that can support the community.

### 6.3 CONSULTATION PROCESS

In the consultation process for EIA, following key stakeholders were consulted:

- Primary Stakeholders i.e.
  - Local communities;
- Secondary Stakeholders i.e.,
- Environment Protection Agency, Gilgit Baltistan,
- AKRSP office, Gilgit Baltistan,

- Agriculture Department, Gilgit Baltistan,
- P&D Department, Gilgit Baltistan,
- WWF Office, Gilgit Baltistan,
- Karakorum University, Gilgit Baltistan,
- Divisional Forest Offices, Astore and Gilgit Baltistan,
- Wildlife Divisional Forest Offices, Astore and Gilgit Baltistan,
- Livestock Office, Astore Gilgit Baltistan,
- Climate Department, Astore Gilgit Baltistan and
- District Health Officer, Astore Gilgit Baltistan.

Meetings with stakeholders consisted of community consultation meetings, focus of the meetings, the process followed, and the outcomes are discussed in this section. The list of respondents, participants of socio-economic survey and list of the Government of Gilgit Baltistan Departments/Line Agencies, NGOs visited and persons Contacted are included as Annexure: 1.

## 6.4 PRIMARY STAKEHOLDER

The findings of the Community consultations are given as follow. All these have been addressed in various sections of the EIA, and the mitigation plans have been incorporated into the EMP. There is no any primary stakeholder identified.

## 6.5 COMMUNITY CONCERNS

### 6.5.1 PROJECT APPROVAL

The community consultations demonstrated that goodwill towards the project proponents indeed exists; approval for project activities by the communities was evident. The consultations were considered a good gesture and appreciated, especially by the men and village elders. The poverty level is such that communities are looking to any project proponent to improve their financial well-being to a great extent. Project proponent recognizes that benefits from the project should be distributed judiciously and equitably especially among local community of the project area, and will continue to ensure that this principle is followed in its projects and community development program.

### 6.5.2 LOCAL EMPLOYMENT

Communities in the project area emphasized that local villagers should be given priority when employing people for various project-related works and activities according to their skills.

### 6.5.3 INTERACTION WITH LOCAL COMMUNITY

Non-Local work force coming in the project area that will not be aware of the local customs and norms may result in conflicts with the local community. Most of the project area people welcomed the project idea and showed their comfort-ability in case of non-local work force. The local communities are in favor of proposed project. They said this proposed project will have positive impacts on their life.

## 6.6 SECONDARY STAKEHOLDERS CONSULTATION

The secondary stakeholder consultation was conducted in order to provide details about the proposed project and get suggestions if any about the proposed project and its activities. Some of the main offices are mentioned as follow:

- Environment Protection Agency, Gilgit Baltistan,
- AKRSP office, Gilgit Baltistan,
- Agriculture Department, Gilgit Baltistan,
- P&D Department, Gilgit Baltistan,
- WWF Office, Gilgit Baltistan,
- Karakorum University, Gilgit Baltistan,
- Divisional Forest Offices, Astore and Gilgit Baltistan,
- Wildlife Divisional Forest Offices, Astore and Gilgit Baltistan,
- Livestock Office, Astore Gilgit Baltistan,
- Climate Department, Astore Gilgit Baltistan and
- District Health Officer, Astore Gilgit Baltistan.

Meetings were held with all above mentioned stakeholders. Brief detail about the project was provided to all available officers. All the stakeholders welcomed the idea of proposed tunnel and access road project.

A meeting was held with EPA officers: Mr. Shehzad Hasan Shigri (Director) and Mr. Manwar Hussain Shah (AD). Both were pointed out due to the construction of tunnel and access road may be the slope failure and should be mitigate the measure through bioengineering approach and methodology, also Proper EMP should be followed during construction.

A detail meeting was held with Divisional Forest Officer, Astore: Mr. Jabran Haider (DFO): During the construction of proposed project, the contractor should be avoiding no cutting of trees from any area of construction activities within the project. The DFO was pointed out that after the completion of proposed tunnel and access road project proponent, plantation should be carried out along the access road and other areas where space available in the area.

A meeting was held with Divisional Forest Officer Wildlife, Astore: Mr. Zahid highlighted no hunting rule and said that hunting shall not be allowed in the project area and its vicinity.

A meeting was held with Livestock Office, Astore: Mr. Altaf Hussain welcomed the idea of proposed project and suggested that proponent should do some welfare work for local communities. He added. Further he said this project will have need of this region. Further he gave positive view regarding proposed project. Also, he asks generally, all of the secondary stakeholders were in favor of proposed project. Further, the proposed project should be executed with appropriate mitigation measures to reduce the environmental and social impacts. The Photographs of consultations are included as Annexure: 6.



## CHAPTER-7 IMPACT PREDICTION, EVALUATION & MITIGATION MEASURES

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This chapter discusses the potential environmental and social impacts of the proposed activities, predicts the magnitude of the impact and assesses the significance. The proposed mitigation measures to minimize adverse impacts, resulting residual impacts of the project and environmental management plan (EMP) are discussed in the next chapter. The discussion of the environmental and socioeconomic impacts is then organized in the following manner:

### Impacts Associated with Proposed Project Activities:

- Environmental Impact—Construction and Operation Activity
- Socioeconomic Impact—Construction and Operation Activity

### 7.1 IDENTIFICATION OF POTENTIAL IMPACTS

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In the first step, potential impacts of the project are identified by desktop screening exercise, using checklist during field visits for collection of baseline data, professional judgment, published literature on environmental impact of similar projects and standard environmental guidelines. A critical step in identifying potential impacts is discussion with project proponent, consultation with stakeholders and communities to identify their concern. Public consultation was carried out to identify the concerns of primary and secondary stakeholders. The main aspects associated with potential impacts are as follow;

- Geomorphology, soil
- Water resources
- Ambient air quality
- Waste discharges
- Noise pollution
- Greenhouse gases emissions
- Ozone depleting substance
- Protected areas
- Ecology of the area, including flora and fauna
- Vehicle movement
- Socio-economic conditions; and
- Archaeology

### 7.2 IMPACT CLASSIFICATION

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The potential impacts are classified according to the type of potential receptors. The following receptor categories were used:

- Community (people, their social and cultural values, aspirations and archaeological sensitivity)
- Land and soil (land resources, soil resources)
- Air quality (ambient air quality, GHG emissions, Ozone depletion)
- Water resources
- Ecosystem (vegetation, wildlife, and biodiversity).

### 7.3 IMPACT SCOPING CRITERIA

- Identified potential impacts are evaluated on the basis of following criteria;
- The present baseline conditions, the change in environmental parameters likely to be affected by proposed project related activities,
- Is there an impact that environmental standards or environmental guidelines applicable to the project will be breached? This includes the National Environmental Quality Standards (NEQS) and guidelines such as the World Bank, International Finance Corporation (IFC) and WHO environmental guidelines.
- Is there a high risk of a permanent, irreversible, and significant change to environmental conditions due to the particular project activity? Some impacts are transitory; they last until the activity that is the cause of the impact is there. Others may last much longer than the activity. After a long period, the environmental parameter may or may not revert back to its natural state.
- Did the community express any concern about this aspect? An impact scoping matrix is described in below Table-39.

TABLE 39- IMPACT SCOPING MATRIX

Project Phase	Environmental Impact	Social Impact
<b>Construction Activity</b>	<ul style="list-style-type: none"> <li>• Water resources depletion, contamination.</li> <li>• Dust Emission During Construction</li> <li>• Vegetation Loss</li> <li>• Vehicle and Equipment Exhaust</li> <li>• Soil Contamination</li> <li>• Drainage and Storm Water Run-off</li> <li>• Camp Effluent</li> <li>• Hazardous and Non-Hazardous Waste</li> <li>• Management</li> <li>• Wildlife</li> </ul>	<ul style="list-style-type: none"> <li>• Traffic disturbance, unrest, road accident</li> <li>• Land acquisition</li> <li>• Employment conflicts</li> <li>• Archaeological resources damage</li> <li>• Safety and security</li> <li>• Mobility and transportation</li> <li>• Project and Community Interface</li> <li>• Cultural and religious sites</li> <li>• Local Economy</li> <li>• Local Employment</li> </ul>
<b>Operation Activities</b>	<ul style="list-style-type: none"> <li>• Air Pollution</li> <li>• Noise Pollution</li> <li>• Wastewater</li> <li>• Green House Gas emissions</li> <li>• Water Resources Depletion</li> <li>• Hazardous and non-hazardous substances</li> <li>• Waste Management</li> </ul>	<ul style="list-style-type: none"> <li>• Unskilled labor jobs</li> <li>• Occupational Health and Safety</li> <li>• Economic Activity (Primary and multiplier effects)</li> <li>• Human Rights</li> </ul>

### 7.4 IMPACT ASSESSMENT METHODOLOGY

The impacts have been assessed following standard international guidelines and best available practices. The method defines three levels of consequence (or severity) and likelihood (or probability of occurrence) - High, Medium or Low - of an impact. A standard risk-based approach has been used in which;

The significance of an impact is determined on the basis of the level of consequence and likelihood of the impact e.g. an impact of medium severity is assigned a low significance if the likelihood of occurrence of the impact is low and high significance if the likelihood of occurrence is high or almost certain. The definition of consequence and likelihood is illustrated in Table-39 and impact significant matrix is provided in Table-40.

TABLE 40- DEFINITIONS FOR CONSEQUENCE AND LIKELIHOOD OF IMPACTS

Level	Consequence (Severity of Impact)	Likelihood
High	<ul style="list-style-type: none"> <li>Serious/catastrophic damage to local and regional environment</li> <li>Direct legislative requirements of EPA and World Bank</li> <li>Corporate requirement</li> <li>Serious threat to corporate reputation/profitability/ability to do business</li> </ul>	<ul style="list-style-type: none"> <li>High likelihood of occurrence during lifetime of operation</li> <li>Regular/continuous part of operations</li> <li></li> <li></li> <li></li> <li></li> </ul>
Medium	<ul style="list-style-type: none"> <li>Measurable damage to the environment</li> <li>Subject to potential future legislation</li> <li>Potential to affect reputation/cost</li> <li>Implication/reduced efficiency</li> </ul>	<ul style="list-style-type: none"> <li>Moderate possibility of occurrence during life time of operation</li> <li>Periodic/occasional part of operations</li> <li></li> </ul>
Low	<ul style="list-style-type: none"> <li>Negligible damage to the environment</li> <li>No risk to business</li> </ul>	<ul style="list-style-type: none"> <li>Unlikely to occur during life time of operation</li> </ul>

TABLE 41- IMPACT SIGNIFICANT MATRIX

Items	Likelihood		
Consequence	High	Medium	Low
High	High	High	Medium
Medium	High	Medium	Low
Low	Medium	Low	Low

The prediction of impacts also include the duration of impacts (in terms of long-medium and short-term), nature of impact, geographical location of the impact and reversibility of the impact. Impact assessment criteria for the above mention parameters are illustrated in Table-42.

TABLE 42- IMPACT ASSESSMENT CRITERIA

Impact Characteristics	Categories
Nature of the Impact	<b>Direct:</b> The environmental parameter is directly changed by the project. <b>Indirect:</b> The environmental parameter changes as a result of change in another parameter.
Duration of the impact	<b>Short term:</b> Lasting only till the duration of the project such as noise from the construction activities. <b>Medium term:</b> Lasting for a period of few months to a year after the project before naturally reverting to the original condition such as contamination of soil or water by fuels or oil. <b>Long term:</b> Lasting for a period much greater than medium term impacts before naturally reverting to the original condition such as loss of soil due to soil erosion.
Geographical Location of the impact	<b>Local:</b> Within the area of project i.e. operation site, tunnel and access road. <b>Regional:</b> Within the boundaries of the project area. <b>National:</b> Within the boundaries of the country.
Reversibility of the impact	Defined as <b>Reversible:</b> When a receptor resumes its pre-project condition. <b>Irreversible:</b> When a receptor cannot resume its pre-project condition.

**Identification of the mitigation measures:** If it is determined that the predicted impact is significant, suitable mitigation measures are identified. There is a range of mitigation measures that can be applied to reduce impacts. This is discussed in following sections.

**Evaluation of the residual impact:** Incorporation of the suggested mitigation measures reduces the adverse impact of the project and brings it within the acceptable limit. This step refers to the identification of the anticipated remaining impacts after mitigation measures have been applied the residual impacts. This is discussed in following sections.

**Identification of the monitoring requirements:** The last step in the assessment Process is the identification of the monitoring requirements. The scope and frequency of the monitoring depends on the residual impacts. The purpose of monitoring is to confirm that the impact is within the predicted limits and to provide timely information if unacceptable impact is taking place. An environmental management plan (EMP) will be developed with identification of monitoring requirements. This is discussed in next chapter.

## 7.5 POTENTIAL IMPACTS AND MITIGATION MEASURES DURING DESIGN PHASE

### 7.5.1 TOPOGRAPHY

The topography along the project area will change to some extent because of construction of project related structures such as embankments, culverts etc. Visual changes to the topography will be of permanent and minor in nature and do not require any mitigation measures, except that the project design should consider aesthetic concerns.

### 7.5.2 LANDSCAPE

The proposed project of Shounter Tunnel and access road passes through two Districts, Astore of Gilgit Baltistan and Neelum of Azad Jammu & Kashmir (AJ&K). The project area consists mainly of hilly terrain with steep slopes. The interventions of the Shounter tunnel project are not likely to impact the topography of the area on a large scale except for those areas where the physical activities of excavation, and movement of heavy machinery will take place. Similarly, areas where excavated material from tunnel will be disposed, dumped or stored will be negatively affected. The proposed Shounter tunnel and the access road is existing road.

However, after the construction of proposed project, the landscape of the project area will be changed in terms of better road infrastructure, construction of bridges and planned plantation of trees along the RoW and will have a positive impact in terms of socio-economic development of the project area.

There are many methods to increase the stability of a slope and to stabilize a failed slope. These methods may be adopted singly or in combination. In general, common adopted remedial measures can be grouped into three main categories.

#### A. Geometrical method

This method is usually simple and cost effective. By changing the slope geometry from a steep slope to a gentler slope, the stability of the slope can be increased. This method can be done by cutting the

slope and removal of any external load on top of the slope or to backfill the toe of the slope. However, this method can only be adopted if there is sufficient space.

## B. Drainage method

One of the slope failure factors is saturation and pore water pressure building up in the subsoil. If drainage system is to be provided, the chances of building up pore water pressure and saturation of subsoil can be minimized. This method can be very effective. However, the drainage system must be maintained in order to perform effectively. It is easy to maintain the surface drains, but it is difficult to maintain the subsoil drains. In general, this method is used in combination with other methods.

## C. Retaining structures method

This method is generally more costly. However, due to its flexibility in a constrained site, it is always the most commonly adopted method. The principle of this method is to use a retaining structure to resist the downward forces of the soil mass. The retaining structures include gravity types of retaining wall, cantilever wall, contiguous bored piles, caisson, steel sheet piles etc. Ground anchors or other tie back system may be used together with the retaining structures if the driving forces are too large to resist.

### 7.5.2.1 PROPOSED SOLUTIONS FOR THE SLOPE INSTABILITY PROBLEMS

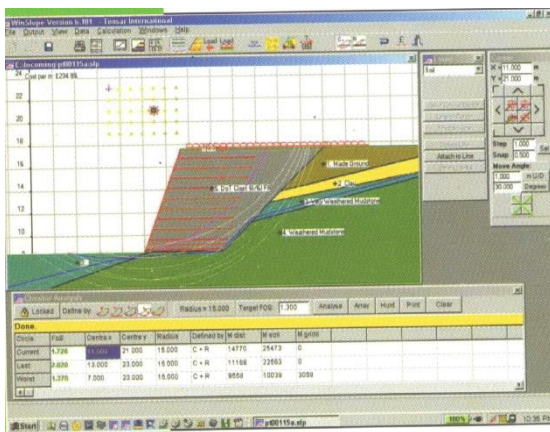
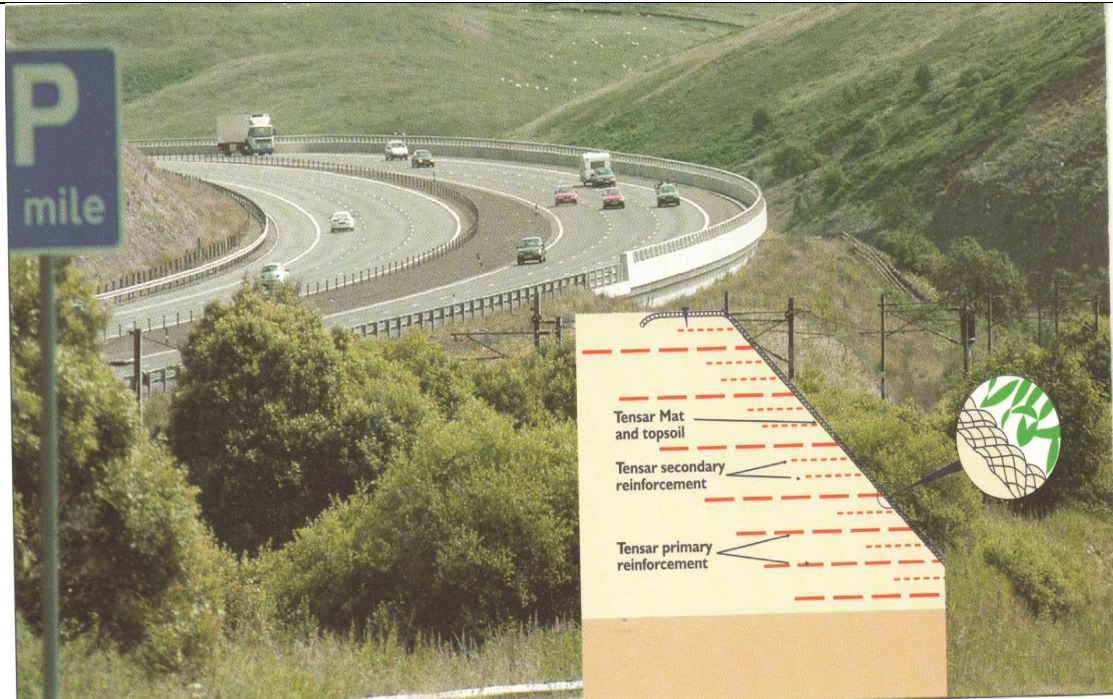
The Consultants will review the remedial measures only if the existing road sections seem to be closed by potential landslides. In addition, the Consultants will give top priority to low-cost and labour-based remedial measures.

TABLE 43 PROPOSED SOLUTIONS FOR SLOPE INSTABILITY PROBLEMS

Sr #	Slope Instability Problems	Remedial Measures
1	<b>Falls:</b> Different type of falls e.g. Earth fall, rock fall, debris fall are frequent in hilly areas. The rock fall can be treated in most cases but the rockslide is like a landslide and may become difficult to stabilize. Falls generally occur along steep slopes.	Stabilization work is carried out only at those sites where treatment is possible. For earth debris fall, series of <b>gabion check dams</b> are constructed and the water is diverted by surface and subsurface drains to the safer location. For rock fall, <b>gabion retaining walls</b> are built. Besides, combination of <b>vegetative turfing</b> and <b>jute &amp; coir netting</b> are also used to control falls.
2	<b>Topple:</b> It is a type of fall. It generally involves pivoting or forward motion of rocks, debris or soil.	Generally it is difficult and expensive to stabilize the topple falls. Hence such sites are usually avoided for treatment.
3	<b>Rotational Landslide:</b> Rotational slide is that form of failure which occurs along a distinct more or less semi-circular or curved shear slip surface (spoon shape), and usually occurs in shales, mudstones and clays (Homogeneous mass). These usually have a steep scarp at the upslope end and a bulging "toe" of the slid material at the bottom of the slide. These may creep slowly or move large distances suddenly. They usually develop after prolonged rainfall.	It usually consists of a combination of slope dressing, surface and subsurface drainage and provision of restraining structures (such as soil nailing, bolting, and anchoring). Mostly soil anchors, horizontal gravity drains, surface drains, toe protection walls (retaining wall), sealing of surface cracks, use of live plants (vegetative turfing) are used to control the Rotational slide. Retaining wall (cement masonry I gabion wall) application at the toe of the landslide area are quite common in roadside slopes.
4	<b>Translational Landslide:</b> Translational	It usually consists of a combination of slope



	Slides or Plane failure are those in which the moving material slides along a more or less planar surface. These occur on surfaces of weaknesses, such as faults and bedding planes or at the contact between firm rock and overlying loose soils. Plane failure may creep slowly or move large distances rather suddenly. The shallow deposit above the bed rock slips down due to the loss of interface shear strength.	dressing, surface and subsurface drainage and provision of retaining structures (gabion wall, breast wall). Use of live plants (vegetative turving) , jute coir & netting are used to control this slide. In special cases, soil nailing followed by shotcreting and stone pitching is in use. Shotcreting of the slope surface is recommended to protect the slope from infiltration of rainwater as well as from direct impact of the intense rainfall and runoff to prevent excessive erosion. However shot-creting is expensive, hence its use is limited to big projects.
5	<b>Debris Flow:</b> It is a common landslide in the project area. It is usually associated with the high intensity of rainfall. Debris Flows (also called debris torrents) are movements in which loose soils, rocks and organic matter combine with entrained water to form slurries that flow rapidly downslope or within a stream channel. Generally in steep slopes, they become more powerful and dangerous as they move down further.	Management of surface and sub-surface water comes under the first priority to control all type of landslides. Gabion Check dams at suitable locations are usually built to control debris flows. Sometimes concrete check-dams are also built, especially when there is excessive quantity of debris flow with big boulders.
6	<b>Bio-engineering Mitigation Measure:</b> The use of living plants either alone or in combination with small scale civil engineering structures (gabion wall, check dams, surface drains, retaining walls, etc.) or non-living plant material for reducing the shallow seated instability and controlling erosion on slope is called bio-engineering. It is cost effective and involves no high tech. The main advantage in bio-engineering technique is that civil engineering structures (gabion wall, retaining wall, check dams) function very well for the first few years. Then their strength slowly decreases with time, while live plants gain strength with time and they perform very well in the end when civil engineering structures become almost functionless with time. Thus the combination of these two makes a perfect solution for long-term slope stabilization.	
7	<b>Reinforced Earth Retaining Walls using Geogrids:</b> Use of Geogrid Retaining Walls is illustrated with the following Pictures	



Vegetation develops quickly on slopes constructed with soil-filled bags (Taiwan). Such structures can be designed to withstand seismic loadings.

### 7.5.2.2 COLLAPSE TYPE OF SLOPE AT PROJECT SITE

Various scales of collapses are displayed due to slope surface sliding from small to large scale. Dominant failure type is circular and wedge failure. In addition, risk of rock fall is exhibited, and significant damage might be happened. Sample images for reference are shown in table – 44.

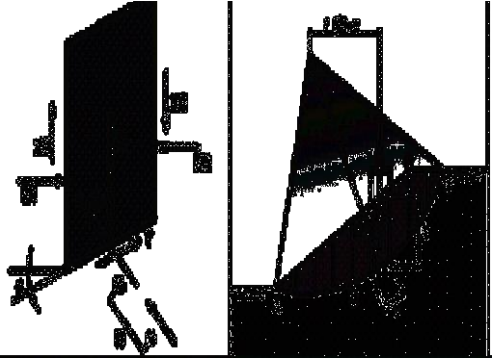
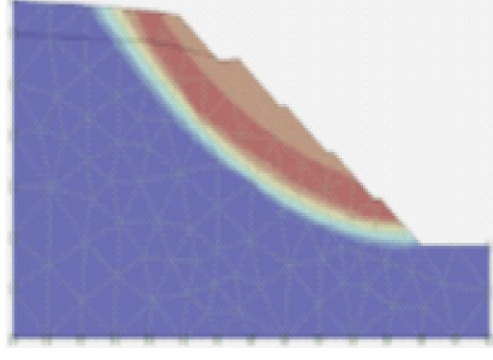


TABLE 44 SAMPLE IMAGES FOR DIFFERENT TYPES OF SLOPE COLLAPSES

Small Scale Collapse	Medium Scale Collapse
	
Large Scale Collapse	Rock Fall
	

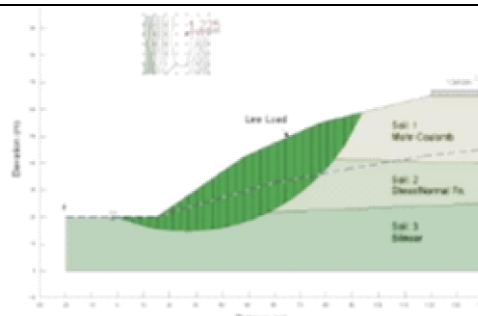
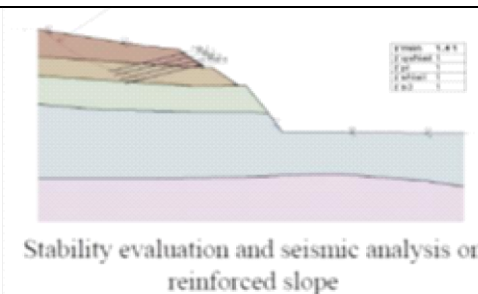
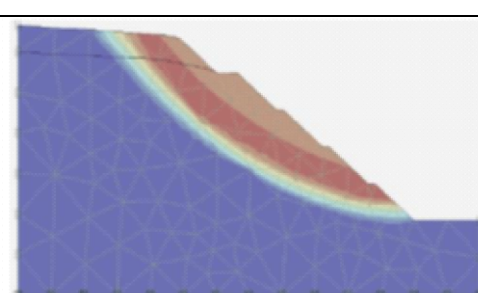
### 7.5.2.3 STABILITY ANALYSIS METHOD OF THE SLOPE

TABLE 45 STABILITY ANALYSIS METHOD OF SLOPE

Section	Limit Equilibrium Analysis	Numerical Analysis
Feature	Stability Analysis on soil body at failure along virtual plane.	Stress-Strain analysis can determine displacement and stress condition in soil
Diagram		 (Analysis program PLAXIS)

### 7.5.2.4 STABILITY ANALYSIS METHOD OF SOIL

TABLE 46 STABILITY ANALYSIS METHOD OF SOIL

	Analysis program	Stability Analysis
<b>SLOPE/W</b>	<ul style="list-style-type: none"> <li>Formulated in terms of moment and force equilibrium factor of safety equations. 2D</li> <li>Limit equilibrium methods (Morgenstem-price, GLE, Spencer, Bishop, Ordinary, Janbu)</li> <li>GEO-SLOPE International Ltd. Canada</li> </ul>	 <p>Stability Consideration at dry and wet season</p>
<b>TALREN</b>	<ul style="list-style-type: none"> <li>Failure calculations (no stress-strain or displacement calculation), 2D</li> <li>Slice methods (Fellenius, Bishop), Global method (Perturbations), Yield Design method (Logarithmic Spirals)</li> <li>Stability Evaluation on reinforced slope</li> <li>TERRASOL, France</li> </ul>	 <p>Stability evaluation and seismic analysis on reinforced slope</p>
<b>PLAXIS</b>	<ul style="list-style-type: none"> <li>Analyse deformation and stability in geotechnical Engineering using FEM.</li> <li>Simulates non-linear, time dependent and anisotropic behaviour of soils or rock.</li> <li>PLAXIS BV. Netherlands</li> </ul>	 <p>Stability and displacement characteristics by strength reduction methods</p>

### 7.5.3 FORMATION WIDTH IN BUILT-UP AREAS

The formation width in built-up areas may result in creating hindrance to market opportunities, loading and vending activities for the locals. This impact is temporary and minor negative in nature. The impact of formation width on built-up area with respect to effects as discussed above may be in the area where the alignment is passing through major areas are Muzaffarabad to Neelum valley Azad Kashmir and Astore to Gilgit Baltistan which are the hub of economic activities. The mitigation measures will include:

- Flexibility in design is adopted in built-up area to avoid any activities;
- Incorporate technical design features that allows flexible shoulder width in villages; and



- Explore the incorporation of additional parking lots.

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#### 7.5.4 IMPACTS ON LAND USE

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After construction and during the operation phase, some positive changes in land use are expected as areas under construction camps and other auxiliary services will revert to their pre-project use.

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#### 7.5.5 FLORAL ATTRIBUTES

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The proposed tunnel project and access road are not passing through any forest. Hence no loss of forest is anticipated. The few shrubs are getting affected along alignment, and at other activity areas. There are no mature trees observed along the alignment and at other proposed project construction activity areas.

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#### 7.5.6 ROAD SAFETY

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The increased vehicular traffic and speed on the road may result in road safety issues like traffic accidents. The accidents may also be due to tiredness of the drivers. This impact will be major and negative in nature. The mitigation measures include:

- These impacts will be mitigated by providing traffic signs to facilitate road users about speed limits for light and heavy vehicles.
- All lanes and sharp bends will be reflectorized to facilitate travelers at night.
- Phone numbers to be contacted in an emergency shall be displayed at intervals.
- Necessary road safety features have been incorporated in design to address safety issues.

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#### 7.5.7 PUBLIC UTILITIES

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There is no any public utilities will be affected creating disruption of public services and inconvenience to the local residents Due to the proposed project.





## 7.6 IMPACTS ASSOCIATED WITH CONSTRUCTION ACTIVITIES

In this section the environmental and socioeconomic impacts associated with the proposed project construction activities are discussed. Construction activities here mean construction of camp site, road, tunnel, and associated activities. The identified impacts assessment is detailed in the below Table-47.

TABLE 47- IMPACT ASSESSMENT OF CONSTRUCTION ACTIVITIES

Environmental Aspects	Potential Impact	Project Phase	Description	CSR	LF	NOI	GLOI	DOI	ROI	SOI
<b>Tunnel construction</b>	Proper spoil disposal	C	To the extent possible reuse spoils as embankment /sub grade or other facilities of the railway Consultation with local government and community as to reuse spoils for urban or community infrastructure construction	Medium	Low	Direct	Local	Short term	Reversible	High
<b>Tunnel excavations: Blasting operations</b>	Fossil finds may be disturbed Disturbance of rock formation, rock movements and fragmentation	C	Finding of mineralized zones & fossil finds along the tunnel alignment will be brought to the notice of the Department of Geology and Mining of the State Government for directions from their end Procurement of boulders from authorized suppliers	Medium	Low	Direct	Local	Short term	Reversible	High
<b>Earth-stone excavation, borrowing</b>	Loss of vegetation Soil erosion issues	C	Woodland take will be conducted in compliance with relevant laws. Top soil to be reserved for future reclamation. Temporary drainage system will be built during dumping operation. Cutting/filling slopes will be timely protected with engineering or green education on environmental protection and identification of key Slopes, borrow / disposal sites, stations and green belt along the alignment. Protected plants will be provided to construction personnel. Education on environmental protection and identification of key.	Medium	Low	Direct	Local	Short term	Reversible	High
<b>Geology and Soils</b>	Soil erosion, soil contamination by the spillage of fuel, oil and chemicals	C	The construction activity will involve clearing of land for the purpose of construction of proposed Tunnel and Road. No any other land will be acquired. During construction, there is a potential for spills of fuel, lubricating oils and chemicals that could lead to soil contamination.	Medium	Low	Direct	Local	Short term	Reversible	High



Environmental Aspects	Potential Impact	Project Phase	Description	CSR	LF	NOI	GLOI	DOI	ROI	SOI
<b>Slope Failure/Landslide</b>	Clearing and levelling for tunnel and road construction, Physical scarring of the landscape, Accelerated soil erosion, Disturbance caused by the earthquake and aftershocks, Reconstruction and rehabilitation activities and Aggravated the landslides etc.	C	The existing route passes apart from The unstable slope at a distance in the area. The landslides are very common features in the project area because of the high steep terrain. Erosion and sediment input to the river is a function of landslides and riparian erosion processes. There are frequent talus accumulations along the side slopes of the river. These are typically in a state of stable equilibrium at their current slope angle and environment, but become unstable when the equilibrium is disturbed. Excess water and earthquake shakings often triggers landslides are in the project area. This issue is temporary within the area.	Medium	Low	Direct	Local	Short term	Reversible	High
<b>Water Resources</b>		C	During Construction activity surface water resources are used so there is no chance of over exploitation or depletion of water resources in the project area. Groundwater source in the proposed project area is stream/Nullahs used by locals, so proposed project activities will not impact on local water resources. The main water resources are springs, streams and Nullahs within the project area. so no major issue will be raised due to water resources.	Medium	Medium	Direct	Local	Short term	Irreversible	Medium
<b>Air Quality</b>		C	Construction activities can generate locally exhaust emission and dust during activities such as 'earthmoving' operations by using tower cranes, bulldozers etc. and other pollutants emission from heated asphalt, generators and vehicles.	Medium	Medium	Direct	Local	Short term	Irreversible	Medium
		C	The main source for GHG asphalt, generators and emissions will be heated	Low	Low	Indirect	National	Long term	Irreversible	Low
		C	HCFC and CFC's if any of them used during project activities, can deplete ozone layer.	Low	Low	Indirect	National	Long term	Irreversible	Low
<b>Noise</b>	Impacts at nearest community, Disturbance to the wildlife	C	There is a potential of disturbance to nearby community due to noise. There is also potential of wildlife temporary relocation because of noise.	Medium	Medium	Direct	Local	Short term	Reversible	Medium
<b>Waste</b>	Liquid waste: Risk of liquid waste contaminating aquifer, or surface water	C	The proposed project activity would generate liquid waste from campsite.	Medium	Low	Direct	Local	Short term	Reversible	Low



Environmental Aspects	Potential Impact	Project Phase	Description	CSR	LF	NOI	GLOI	DOI	ROI	SOI
	Solid Waste (Non-hazardous): Aesthetic issues	C	The proposed project works will result in the generation of a range of non- hazardous solid wastes.	Low	Low	Direct	Regional	Short term	Reversible	Low
	Hazardous waste: soil, surface and aquifer contamination	C	Hazardous waste such as waste oil / asphalt, batteries, chemicals and clinical waste generated during construction and fabrication activities.	Medium	Medium	Direct	Local	Short term	Reversible	Medium
<b>Traffic</b>	Disturbance to local community	C	During the project activities, the traffic movement on the linked/nearby roads and project site will increase. These roads are having appropriate movement, so no major issue will be raised due to movement of vehicles.	Medium	Medium	Direct	Local	Short term	Reversible	Medium
<b>Wildlife and Habitat</b>	Direct habitat loss and migration of wildlife, Temporary Disturbance to Fauna, Hunting, Accidental killing of wildlife	C	The operation under consideration can result in short term displacement of wildlife species along work areas corridors. There is also potential of habitat loss because of clearing of area during construction activities.	Medium	Low	Direct	Low	Short term	Reversible	Low
<b>Natural Vegetation</b>	Clearing of vegetation	C	There are no any mature trees cut and uprooted within the corridor. If the any plants cut and uprooted from the alignment. Every single tree being cut for road construction will be replaced by 10 trees	Medium	Low	Direct	Local	Short term	Reversible	Low
<b>Socio-economic Environment</b>	Local Procurement of Goods and Services and Local Employment	C	Local Procurement of Goods and Services will be Procured from local market, so it is benefit for locals. Due to Proposed Project activities there will be employment opportunities for locals. Almost 250 to 300 personal will be required during construction activities unskilled jobs which will generate work opportunities for locals	Positive Impact						Positive Impact
	Disturbance to communities from material and equipment transport	C	The project area located near the existing road of Shounter to Astore, there will be low medium traffic on average so there will be no major issue for disturbance for local due project.	Low	Low	No impact	Local	Short term	Reversible	Low
	Employment of Conflicts	C	The Potential employment related issue includes dissatisfaction among local communities over the number of job offered to them, disagreement of on definition of local and also on distribution of jobs with the local communities.							
	Project and Communities interference	C	Intra-cultural differences between project staff and other areas and the local communities can result in frictions.	Low	Low	No Impact	No impact	No impact	No impact	Low

Consequence Severity Rating (CSR) Likelihood/Frequency (LF) Nature of Impact (NOI) Geographical Location of Impact (GLOI) Duration of Impact (DOI) Reversibility of Impact (ROI) Significance of Impact (SOI)

## 7.7 DISCUSSION ON KEY ENVIRONMENTAL ASPECTS

### Mitigation Measures and Residual Impacts during Construction Phase of Project

The potential impacts of the proposed project have been discussed in the following sections. Where appropriate, mitigation measures have also been included to reduce the unacceptable impacts. This section includes a priority list of the most important measures that the project proponent should adopt to ensure a practical, cost-effective and sufficient approach to impact mitigation. Information is included as to how the recommended mitigation measures should be incorporated into detailed project design and in the contract documents. Broadly, these measures can be classified into following categories:

- Avoiding the impact altogether by not taking certain proposed activity or parts of an activity, for example, using Halon, HCFC and CFC-free equipment to avoid impact on ozone layer.
- Minimizing impacts by limiting the degree or magnitude of the activity, for example, minimizing dust emission by using water sprinkler.
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
- Compensating for the impact by replacing or providing substitute resources or environments.
- The project proponent plays a vital role in developing the mitigation plan by identifying possible mitigation measures and assessing the feasibility of proposed measures.
- This section provides a summary of the residual effects that are likely to be present following implementation of the mitigation measures.

#### 7.7.1 TUNNEL CONSTRUCTION

Impacts on tunnel and road may arise from the following project activities:

- Clearing and levelling for tunnel and road construction,
- Contamination of soil due to spillage of fuels, oils, asphalt or chemicals. Likely impacts of these activities can include:
  - Physical scarring of the landscape,
  - Accelerated soil erosion,
  - Alteration of soil quality by loss of topsoil,
  - Soil contamination,
  - Blast on community safety concern and impact on wildlife.

#### Potential Impacts

The following Impacts on project activities as under:

- Ground water contamination can take place only if chemical substances get leached by precipitation of water resources.
- This is not the case with the present project, as the activity does not use any harmful ingredients, which could leach down to water resources.

- The tunneling is to be done in hard strata by Tunnel Boring Machine (TBM), which is widely used throughout the world. The tunneling underground portion of proposed project alignment will be done through hard strata hence no major impact on flow of water resources.
- The physical scarring caused by clearing and levelling during construction activities.
- The total area affected would include approximately 12.7km of tunnel and 41.5km of access road, it is expected that the project crew will use existing roads and tunnel for transportation of goods.
- Construction should follow good industry practices to avoid unnecessary clearing outside of the work corridors and likelihood of soil erosion along or across natural drainage paths.
- Loss of topsoil may take place along the alignment of the proposed project.
- The spillage and leakage of fuels, oils, asphalt and other chemicals may lead to soil contamination. Possible contaminant sources include fuel, lubricant oil, asphalt and chemical storage areas at sites, and all project vehicles.
- A spill prevention plan will be developed and implemented.

The mitigation measures listed in following section of the report are adhered with.

### **Mitigation Measures**

- The extent possible reuse spoils as embankment /sub grade or other facilities of the tunnel and road Consultation with local government and community as to reuse spoils for community infrastructure construction and proper disposal of remain spoils in the identified spoils sites. Geological advanced probe boring and prediction will be adopted.
- Grouting will used to seal the leakage, and water discharge will limit.
- Tunnel liner will be timely and properly installed.
- Sedimentation and filtration ponds will be adopted at tunnel construction sites to treat wastewater before discharged to nearby irrigation ditches strictly follow blast operation and safety codes.
- Prior notice will be announcement to local community Prior safety inspection of nearby buildings for determination of blasting method and dosage.
- Presplitting blasting, perimeter Blasting and millisecond blasting technique will be used for tunnels in sensitive areas to minimize blasting impact on wildlife Blast time arranged in daytime to minimize disturbance on wildlife.
- Finding of mineralized zones & fossil finds along the tunnel alignment will be brought to the notice of the Department of Geology and Mining of the State Government for directions from their end Procurement of boulders from authorized suppliers Woodland take will be conducted in compliance with relevant laws.
- The top soil is also to be reserved for future reclamation. Temporary drainage system will be built during dumping operation. Cutting/filling slopes will be timely protected with engineering or green education on environmental protection and identification of key Slopes, borrow / disposal sites, stations and green belt along the alignment.
- Protected plants will be provided to construction personnel.
- Education on environmental protection and identification of key Crushers and Batching Plants should be sited sufficiently away from settlements and agricultural operations or any commercial



establishments.

- Such plants will be located at maximum distance away from the nearest village/settlement preferably in the downwind direction. The Contractor shall submit a detailed lay-out plan for all such sites and approval of Environmental Expert of Site Engineer shall be necessary prior to their establishment.
- Arrangements to control dust pollution through provision of windscreens, sprinklers, and dust encapsulation will have to be provided at all such sites.
- Specifications of crushers and batching plants will comply with the requirements of the relevant current emission control legislations for all such plants shall be submitted to the Site Engineer and NHA.
- The Contractor shall not initiate plant/s operation till the required legal clearances are obtained and submitted.

### **Residual Impact**

The land use will change as a result of construction of the tunnel and road project. The nature of impact is direct and its duration is short term in nature but takes time to rehabilitate the natural environment of the area, so the overall significance of impact is high. If the mitigation measures are effectively implemented, the residual impact of the proposed activities on the area's geophysical environment is expected to be reduced in significance.

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## **7.7.2 GEOMORPHOLOGY AND SOILS**

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### **Potential Impacts**

Impacts on geomorphology and soils may arise from the following project activities:

- Clearing and levelling for tunnel and road construction.
- Contamination of soil due to spillage of fuels, oils, asphalt or chemicals. Likely impacts of these activities can include:
  - Physical scarring of the landscape,
  - Accelerated soil erosion,
  - Alteration of soil quality by loss of topsoil,
  - Soil contamination.

### **Assessment of Potential Impacts**

The physical scarring caused by clearing and levelling during construction activities could lead to alteration of soil quality by removal of topsoil, losses of plant cover and limited soil erosion induced by disturbance to native soil.

- The total area affected would include approximately 12.7km of tunnel and 41.5km of access road, it is expected that the project crew will use existing roads and tunnel for transportation of goods. Construction should follow good industry practices to avoid unnecessary clearing outside of the work corridors and likelihood of soil erosion along or across natural drainage paths.
- Loss of topsoil may take place along the alignment of the proposed project. The spillage and leakage of fuels, oils, asphalt and other chemicals may lead to soil contamination. Possible contaminant sources include fuel, lubricant oil, asphalt and chemical storage areas at sites, and all project vehicles. A spill prevention plan will be developed and implemented. The mitigation

measures listed in following section of the report are adhered with.

### **Mitigation Measures**

The proposed mitigation measures to reduce the impacts on geology, topography, and soil during the proposed construction activities are:

- Vegetation clearing will be kept minimum;
- Unnecessary clearing of vegetation and offset clearing shall be strictly prohibited; Vehicle speeds shall be regulated and monitored to avoid excessive dust emissions;
- Off-road travel should be avoided and observance of this should be monitored during the operation;
- Use of tunnel and existing road for transportation of goods.
- Vehicles and equipment would not be repaired in the field. If unavoidable, impervious sheathing / drip trays will be used to avoid soil and water contamination.
- Waste oils should be collected in drums and disposed-off through recycling / waste contractors.
- Regular inspections would be carried out to detect leakages in construction vehicles and equipment.
- Fuels, lubricants, and chemicals will be stored in covered and with bunded walls, underlain with impervious lining.
- Appropriate arrangements for spill control, including shovels, plastic bags and absorbent materials, will be available near fuel and oil storage areas.

### **Residual Impact**

The land use will change as a result of construction of the tunnel and road project. The nature of impact is direct and its duration is short term in nature but takes time to rehabilitate the natural environment of the area, so the overall significance of impact is high. If the mitigation measures are effectively implemented, the residual impact of the proposed activities on the area's geophysical environment is expected to be reduced in significance.

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## **7.7.3 SLOPE FAILURE**

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### **Potential Impacts**

Impacts on slope failure may arise from the following project activities:

- Clearing and levelling for tunnel and road construction,
- Physical scarring of the landscape,
- Accelerated soil erosion,
- Disturbance caused by the earthquake and aftershocks,
- Reconstruction and rehabilitation activities and
- Aggravated the landslides etc.

### **Assessment of Potential Impacts**

The slope is comprised of mainly metamorphic and sedimentary rock. Some section of the existing road is covered with rock fragments due to weathering and erosion. Nevertheless, fewer landslide

prone areas are identified in the project area. Most of landslides are mainly debris flow and rock falls due to the geological weak formation and a steep slope. A section from Gorikot to Rattu needs to clear slope surface where rock falls are ongoing sporadically. After Rattu village, sweeping away due to rainfall /snow melting is the same problematic issue of debris-flow within the project area, but the existing route passes apart from the unstable slope at a distance. The landslides are very common features in the project area because of the high steep terrain. Erosion and sediment input to the river is a function of landslides and riparian erosion processes. There are frequent talus accumulations along the side slopes of the river. These are typically in a state of stable equilibrium at their current slope angle and environment, but become unstable when the equilibrium is disturbed. Excess water and earthquake shakings often trigger landslides in the project area.

### Mitigation Measures

The following proposed mitigation measures to reduce the impacts on during the proposed construction activities are:

- Hard Engineering (Protection wall, Check drawing, Diversion channels, Breast walls, Surface drains and Retaining walls)
- Bio-Engineering (Contour Watling, Hedges laying and Bruch hedge laying),
- Soil Cover (Vegetative cover by synthetic materials, Reforestation and Green grid with plantation,
- Preventive Measure (Fencing/Hedging, By-passing of road, ceasing the construction, cutting to reduce load and Slope creeping.

### Residual Impact

The nature of impact is direct and its duration is short term in nature but takes time to rehabilitate the natural environment of the area, so the overall significance of impact is high. If the mitigation measures are effectively implemented, the residual impact of the proposed activities on the area's geophysical environment is expected to be reduced in significance.

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## 7.7.4 WATER RESOURCES

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### Potential Impacts

Proposed activities could affect the area's water resources in two ways:

- Reduction due to overuse, and
- Contamination (surface or groundwater)

Estimate demand in water resources to meet the requirements would be fulfilled from Sperings and Streams/Nullahas within the project area. The main source of water is Gorikot, Rehmanpur, Chugam, Nasirabad, Rattu, Mirmalik and Morcha Guzair and Shounter, and top nullahas and streams and springs of the project area. The surface water resource of the project area is snow melt and streams/nullaha. Groundwater is also available in the majority of the area springs and streams/nullahs etc. Tapped water supply is considered to be the most hygienic source of drinking water which is available in the project area. In project area there is a water supply system which has been built by local people with the help of AKRSP. Water supply is partially available in Astore, Gorikot, Rattu and Shounter valleys.

### Assessment of Potential Impacts

Water will be required during construction activities. Water will be procured from both ground and surface water resources. Water conservation practices will be utilized to reduce the overall water consumption during proposed project activities. The water is fit for construction process while ground water resources will be utilized at camp sites. Surface or groundwater quality may deteriorate if pollutants are mixed with surface runoff during rain and snowmelt carried to water resources in the vicinity, or seeped in the ground. Potential sources of pollution in such cases may include:

- Domestic waste (sanitary and kitchen discharge);
- Oil and grease from vehicles and machinery;
- Stored fuel, oil and other chemicals;

Sewage from the camp should go into an impermeable septic tank. The impermeable septic tank will prevent untreated sewage from polluting surface water.

### Mitigation Measures

The mitigation measures described below will ensure that the project area's surface and aquifer resources are not significantly affected by project activities.

- The water extraction will be kept at minimum;
- A water management plan will be developed. The plan will also include strategies to minimize water use (and therefore volume of discharge) and maintain reserves;
- Follow good housekeeping practices with all machinery that may potentially discharge wastewater;
- No untreated effluents will be released to the environment
- Effluents from the camp offices and the residential camps will be treated in the septic tank before its disposal. The treated water (if confirming to NEQS) will be used for tree plantation or will be disposed-off through waste contractor (if effluent does not confirm to NEQS). The septic tank will be completely covered, so that surface runoff may not come in contact with the effluent.
- Fuels, lubricants, and chemicals will be stored in covered and with bund walls, underlain with impervious lining.
- Spill prevention plan shall be followed to mitigate any kind of spill.

### Residual Impact

Water is available along the entire alignment of proposed project. Some locations surface water will be used and some locations ground water will be used. The main sources of the project area are springs and stream/nullas. The streams and Nullahs are main source of irrigation system in the project area. Further, proper implementation of the required mitigation and monitoring techniques will prevent any adverse water quality impacts. Residual impacts are foreseen to be negligible / low in this case.

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## 7.7.5 AIR QUALITY

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### Potential Impacts

Air emissions from proposed project-related activities are likely to include:

- Dust emissions produced during construction activities;



- Combustion products (nitrogen oxides, sulfur dioxide, particulate matter, carbon monoxide, and volatile organic compounds) from generators;
- Combustion products from vehicles used for project-related activities;
- Combustion products from molten asphalt

### Assessment of Potential Impacts

The sources of emissions during construction activities will not be significantly enough to alter the ambient air quality at a regional level. The emissions will disperse quickly with the prevalent wind currents. All generators, vehicles, equipment and machinery will be properly maintained during the operation to minimize emissions. Other factors that support the insignificant nature of the impact are:

**Dust Emissions:** Dust emissions during construction can be an issue. Potential sources of dust emission during construction activities include earthworks (dirt or debris pushing and grading), exposed surfaces, exposed storage piles, truck dumping, hauling, vehicle movement, blasting, and concrete mixing and batching. Dust emitted during construction activities can result in deterioration of ambient air quality in the vicinity of the source, and be a nuisance to the communities, bad for agriculture fields and construction workers itself. Dust clouds also reduce road visibility, creating a traffic hazard.

**Vehicle and Equipment Exhaust Emissions:** Combustion processes in generators and other construction equipment result in exhaust gases that can affect the ambient air quality locally. Emissions produced by vehicles and equipment will be in terms of the resulting pollutants (SO<sub>2</sub>, NO<sub>x</sub>, PM, etc.). However, the environmental issue can be avoided by using properly maintained equipment.

**Emissions from Heated Asphalt:** Raw asphalt may be heated at site (open burning) during the road asphaltting process. This process results in exhaust gases that can affect the ambient air quality locally. Emissions produced by open burning will be in terms of the resulting pollutants (SO<sub>2</sub>, NO<sub>x</sub>, CO<sub>2</sub>, etc.). However, the environmental issue can be avoided by using prepared heated asphalt.

### Mitigation Measures

The mitigation measures given below will further reduce their impact, and ensure that they remain within acceptable limits.

- Water will be sprinkled daily or when there is an obvious dust problem on all exposed surfaces to suppress emission of dust. Frequency of sprinkling will be kept such that the dust remains under control, particularly when wind is blowing towards the receptors.
- All equipment, generators, and vehicles used during the project will be properly tuned and maintained in good working condition in order to minimize exhaust emissions;
- Construction materials that are susceptible to dust formation will be transported only in securely covered trucks to prevent dust emission during transportation.
- All project vehicles will be checked regularly to ensure that engines are in sound working condition and are not emitting smoke;
- Open burning of Asphalt should be avoided as much as reasonably practicable

### Residual Impact

Implementation of the proposed mitigation measures is likely to leave no long-term residual impact on the ambient air.



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### 7.7.6 GHG EMISSIONS

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The main source for GHG emissions will be generator and vehicle emissions and emission from the preheated asphalt during the project activity. The overall rating given to impact is low because the GHG emissions generated will be less and to minimize the impact all vehicles, generators and other equipment used during the construction will be properly tuned and maintained in good working condition. By implementing the mitigation measures. Ambient Air Quality, the residual impact of the proposed activities is expected to be insignificant.

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### 7.7.7 OZONE DEPLETION

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The proposed project will not use any source of ozone depleting compounds such as Halon, CFC, HCFC or any other source which deplete the ozone layer, so the overall assessment of the impact is significantly low.

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### 7.7.8 NOISE POLLUTION

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#### **Potential Impacts**

Potential sources of noise pollution will include operation of generators, machinery, construction equipment, and vehicles during the project activities. The potential noise related issues during construction activities would disturb workers and the surrounding communities of proposed ROW Project.

#### **Assessment of Potential Impacts**

The potential sources of significant noise during the construction period include the construction machinery, generators at camps and construction related traffic. There is no continuous major source of noise in the communities. Intermittent sources of noise found during the field survey included farm tractors and road traffic. Increased noise levels during construction activities can be a source of nuisance for locals and a source of disturbance to wildlife. The main exposure of noise pollution will be on crew members. To minimize exposure to noise, personal protective equipment (PPE) will be used by the workers.

Construction noise levels at the nearest receptor in the nearby village, located from the proposed alignment, would fluctuate depending on the type, number, distance from receptor, and duration of use of various construction equipment. In this analysis, the noise level due to each equipment likely to be used in the construction of the tunnel and access road, would initially be calculated. The noise level results would be compared with National Environmental Quality Standards for Noise to meet the permissible limits.

There is also a potential of temporary wildlife relocation because of noise, so to reduce this impact, night work will be minimized thus reducing the disturbance to wildlife. The overall impact level is medium in significance as the likelihood of occurrence is medium.

#### **Mitigation Measures**

All on-site personnel will use required PPEs in high noise areas that will be clearly marked.

- Proper engineering control will be applied to noise producing sources like generator.
- It will be ensured that generators, vehicles and other potentially noisy equipment used are in good condition. Noise from generators, vehicles, other equipment and machinery will be kept to the minimum through regular maintenance.

The strategy to minimize the noise in the community to within acceptable limits will be based on the following:

- Reduce equipment noise at source,
- Before the start of the operations conduct a noise survey of the equipment and prepare a noise control plan,
- Use noise-abating devices wherever needed and practicable and
- Blowing of horn will be prohibited on the access road to the project site and inside the site

### Residual Impact

By implementing the above mitigation measures the overall impact will be significantly low. Residual noise impact is expected to be low from the construction activities of the proposed project corridor.

## 7.7.9 WASTE DISCHARGES

### Potential Impacts

The expected waste generated during construction activities and their proposed methods of disposal are discussed below Table-48.

Likely impacts from Hazardous and non- hazardous waste generated by construction activities (if disposed-off improperly) can include:

- Surface and groundwater pollution;
- Soil contamination;
- Air pollution, odor;
- Health hazards;
- Aesthetic issues.

TABLE 48- CONSTRUCTION ACTIVITIES WASTE

Category	Waste Generated and Point Source	Mitigation Measures
Hazardous	Batteries, rubber, tire, used oil filters, chemical containers, Contaminated soil, grease trap sludge, Pac, contaminated soliciting waste paper, textiles.	Used oil and ferrous/non-ferrous materials will be provided to approve contractor for recycling. Batteries will be hauled away by contractor for recycling. Combustible materials such as paper, card board, textiles will be burnt on-site.
Non- Hazardous	Cardboard, rubber, wood, glass, tin cans, Food waste.	Non-combustible materials such as glass, plastics, tin and aluminum cans will be hauled away by contractor for recycling. Food waste will be provided to waste contractor.
Non-hazardous Recyclable	Cable drums, wood, packaging, scrap metal, recyclable plastic sheeting, debris, plastic, aluminum cans etc.	Will be hauled away by contractor for recycling.
Non-recyclable	Demolition Waste: Concrete, spent asphalt, plaster, plumbing, heating and electrical parts	Concrete and plaster will be utilized for filling of depressions / pits. Plumbing, heating and electrical parts will be hauled away by the contractor for recycling.
<b>Liquid Waste</b>		
Hazardous	Sewerage water	Wastewater from kitchen and washing areas will be collected for reused for



Category	Waste Generated and Point Source	Mitigation Measures
		plantation. Sewerage will be treated by using septic tank and treated water will be reused for water sprinkling.

### Assessment of Potential Impacts

All the waste generated during construction activities will be disposed-off through implementation of an effective waste management plan. By proper implementation of a waste management plan, the overall potential risk/impact will be significantly low.

**Domestic Wastes:** Domestic wastes generated during construction activities will include sewage or black water, grey water (from kitchen, laundry, and showers), kitchen wastes, and recyclable wastes. Sewage or black water will be treated and disposed by means of a septic tank and will be reused for plantation. Grey water will also be collected for reuse in garden or plantation. Organic waste or compostable material including vegetation waste, food waste and leaves of trees will be utilized for bin composting. Compost would be used as soil conditioner or fertilizer for plants. Recyclable materials such as paper, card board, textiles, plastics, tin and aluminum cans will be hauled away by contractor for recycling.

**Oil Stains and Spills:** Fuel or oil stains, leakage or spill during construction operations can result in contamination of soil and water. Consequently, spill containment will be used for all fuel and lubricant storage. All spills to ground will be remediated as soon as reasonably practical. The waste management plan will be developed to include this.

### Mitigation Measures

A waste management plan will be developed before the start of the project activities. Key elements of the waste management system will be the following:

#### On-site handling

- The recyclable waste will be sent to approve waste contractors.
- Waste bins will be placed inside the boundary. All waste removed from the site will be under license and handled by an approved contractor. All hazardous waste will be separated from other waste.

#### Audits

On-site audits of the waste management will be undertaken on a regular basis during the project activity;

- Audits of the waste disposal contractors and waste disposal facilities will be undertaken on a regular basis to ensure the implementation of waste handling and disposal procedures.

#### Records

Records of all waste generated during the project activity period will be maintained. Quantities of waste disposed, recycled, or reused will be logged on a waste tracking register.

#### Disposal

- All non-hazardous waste material that cannot be recycled or reused will be disposed of as per waste management plan;
- Depending on the nature and quantity of the hazardous waste, it will be disposed of by licensed hazardous waste contractors as per the waste management plan;

### Other Management Measures

- Training will be provided to personnel for identification, segregation, and management of waste;
- An emergency response plan will be developed for the hazardous waste (and substances)
- All containers of hazardous waste will be labelled appropriately;
- Equipment and material containing asbestos, poly-chlorinated biphenyls (PCBs), and ozone depleting substances (ODSs) will not be used.

### Residual Impact

Even after implementation of the above measures, it is possible that some littering may take place. Monitoring will be undertaken to minimize the residual impact.

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## 7.7.10 TRAFFIC

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### Potential Impacts

Following will be the potential impacts from the traffic;

- Disturbance to local community,

### Assessment of Potential Impacts

The nearest community settlement is located along the assess road and also 05km from the proposed tunnel project at various locations. The proposed project final alignment option is to use existing road along the respective stretches of the road, so all the proposed project related traffic will use existing road and thus ensuring that the community will be least influenced by the construction vehicle movement.

### Mitigation Measures

- Journey management plan will be developed;
- To the extent possible, peak traffic times will be avoided for project traffic;
- Vehicles will remain confined to defined access;
- Parking at NO PARKING areas shall not be allowed

### Residual Impacts

By implementing the above mitigation measures the overall impact will be significantly low, so the residual impact is low.

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## 7.7.11 WILDLIFE AND HABITAT

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### Potential Issues

Impacts on wildlife may arise from the following project activities:

- Noise generated from project activities;
- Movement of personnel and vehicles;
- Lights used at the project facilities;
- Clearing of vegetation;
- Improper disposal of wastes;
- Removal of crucial habitats

Likely impacts of these activities can include:

- Temporary migration of mammal and bird from the area
- Accidental killings of wildlife
- Loss of existing habitats i.e. aquatic and terrestrial

### Assessment of Potential Impacts

There is no any landuse will be affected due to the proposed project. The construction of the proposed project, better transport facilities and opportunities will be available to the local communities and tourism industries.

During the construction activities, there will be possible disturbance to wildlife which will be due to disturbance and loss of habitat, clearing and levelling of construction site. Wildlife may also be disturbed due to sensory disturbance from earthwork, blasting, construction; movement of vehicles and crew personnel. This can possibly result in changes in distribution and abundance.

To minimize the impact, vegetation loss will be kept to an absolute minimum. Cutting of trees will be avoided. No-hunting and no-trapping policy will be strictly enforced, unless human life is under threat. Most of the animals in the region are common to the area. Birds are least susceptible to the long-term impact of temporary activities, as they are highly mobile and tend to avoid areas of project activity. There are some endangered or vulnerable species are observed in the proposed project area. So, the overall significant impact but this is temporary nature.

### Mitigation Measures

The following mitigation measures will reduce the adverse impact on the wildlife of the project area:

- Vegetation loss will be kept to an absolute minimum. Cutting of large trees will be avoided;
- Compensatory planting for ten trees against each fallen tree of similar floral function will be followed;
- Compensation for the loss of trees owned by the affected people will be provided;
- Introduction of invasive/ exotic species and native species will be recommended for plantation;
- Animal corridors for the free movement of faunal species, especially, near the wildlife protected areas, grazing lands, and water bodies will be arranged. Care will also be taken for provision of crossings for the free movement and access to streams/nullas in the area of influence of the project during different seasons;
- Open Fires will not be allowed;
- 'no-hunting, no-trapping, no-harassing' policy will be strictly enforced, unless threatening to human life.
- Uncontrolled discharge of waste of any kind shall be controlled in the area; discharging firearms will be explicitly prohibited;
- General awareness of the crew will be enhanced regarding the wildlife, through environmental training, notice board postings, tool box talks etc.;
- The project staff will be educated and instructed to avoid killing. Feeding or harassment of wildlife will not be allowed;
- Physical disturbance to areas outside the work corridors will be avoided; The total duration of



activities will be minimized by good management;

- All mitigation measures to minimize noise levels, dust emissions, air emissions, and waste management required by the EIA will be adhered to;
- Food wastes will not be disposed-off in the open;
- Movement of all project personnel will be restricted to work areas and day time;
- Night travelling will be kept to a minimum.

The proper pathway will be provided at major water bodies for the movement of both terrestrial and aquatic species in the proposed alignment of ROW project.

### **Residual Impact**

Once the mitigation measures given above are implemented, it is expected that the project will have lesser significant impacts on the area's wildlife.

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## **7.7.12 NATURAL VEGETATION**

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### **Potential Impacts**

Clearing of or damage to vegetation due to camp road construction activities will occur due to:

- Clearing of land for road tunnel sites
- Clearing of land for camp sites
- Off road travel

### **Assessment of Potential Impacts**

For the establishment of proposed tunnel, road and camps; different areas will be cleared, there are no any mature trees within the project activity area but few small plants are observed. No rare, sensitive or vulnerable species are recorded or reported in the study area. To minimize the impact; camp sites and access routes will be constructed on those areas where vegetation loss may be avoided and unnecessary damage to vegetation will be avoided. Moreover, the small vegetation will be removed only in the alignment of tunnel construction while area along the road side will be avoided for any extra cutting of trees. After the completion the project tree species will be planted as per ecological conditions of the respective project area. The significance of the impact is reduced and any loss of vegetation is reversible.

### **Mitigation Measures**

The following mitigation measures will reduce any adverse impact on vegetation:

- Small vegetation clearing from tunnel, road site and camp sites will be kept to a minimum;
- Fuel-wood will not be used during project activities;
- When developing new access roads, and tunnel routes that minimize vegetation loss will be chosen, avoiding unnecessary damage to vegetation;
- Clearing of land for road site
- Clearing of land for camp sites
- Off road travel

### 7.7.13 SOCIO-ECONOMIC IMPACT

#### Potential Impacts

Potential sources of positive and meditative impacts on local communities can include:

- Safety and security
- Mobility and transportation
- Project and Community Interface
- Cultural and religious sites
- Archaeological Sites
- Local Economy
- Local Employment.

#### Assessment of Potential Impacts

**Safety and Security:** The operations may affect the safety and security of the inhabitants of the areas in the following ways: conflicts between residents and the construction contractors, carriage of fire arms on the site will be banned. Community sensitive project planning and implementation as prescribed through the recommended mitigation measures will minimize the occurrence of any such impacts. Further project vehicles will use the existing road to extent possible and there will be least road safety issues.

**Mobility and Transportation:** The project activities may affect mobility of local women. Project personnel will be given gender sensitization briefings and will be instructed to respect local norms, the local culture, particularly in relation to the women folk of the area. Moreover, arrangement of the workers from the local communities will also help to follow the local norms in better way.

**Project and Community Interface:** Inter-cultural differences between the project staff from other areas and the local community could result in frictions.

- To mitigate these issues locals will preferred for unskilled jobs. Also with proper management of the workforce, it is possible to avoid any complaints.

**Cultural and Religious Opportunities:** Cultural sites in the form of mosques and graveyards etc.; exist in the proximity of proposed project area. It will be assured to avoid such places in order to maintain respect for such places.

**Archaeological Sites:** There are no documented sites of archaeological, historical, or cultural significance within the proposed alignment.

**Local Economy:** There will be positive impact on local economy due to project activities:

- Increased turnover of local businesses and shops due to an increased demand from project contractors and their employees. During the proposed project activities such as construction, material such as the gravel, aggregate, steel, cement, sand for site construction will be procured from local market. General supplies which include camp supplies (food, etc.), fuels and oils etc. will also be procured from nearest urban areas.
- An increase in the income of locals may occur due to employment in the project.

#### Local Employment

- Distribution of employment opportunities during construction activities. Local people will be hired for unskilled jobs. When hiring local people, preference will be given to people living within the close proximity of project site, as they will be the most directly influenced by the project.

## Mitigation Measures

The following mitigation measures will be implemented:

- Limit the social interaction between the workforce and the local communities;
- All vehicle drivers will be trained in community safety aspects. Drivers will be trained in responsible and safe driving practices; safe speed limits for vehicles will be followed;
- The construction crew's interaction with the local population will be minimized.

The project proponent and the contractor will maintain liaison with the local community. The communities will be informed of the construction activities well in advance.

- There will be no interaction with the local women folk.
- The company will maintain a social complaint register at the site to document all complaints received from local communities. The register will also record the measures taken to mitigate these concerns.
- Awareness and cultural inductions to educate the contractor workforce on the requirement of minimizing social interaction with local communities;
- Project staff will respect cultural norms.
- The non-local project staff will be sensitized to local culture and norms.
- Unnecessary interaction of local population with the non-local project staff will be avoided.
- Residents of the area will be informed at least two weeks before project activities commence.

Maximum number of unskilled and semi-skilled jobs will be reserved for the local communities.

### 7.7.14 IMPACTS ASSOCIATED WITH OPERATION ACTIVITIES AND MITIGATION MEASURES

In this section, the environmental and socioeconomic impacts associated with the proposed project operation activities are discussed. The impacts that are discussed are as follows:

#### Environmental Impacts

- Air Emissions
- Water Resources
- Green House Gas Emissions
- Hazardous Material
- Ozone Depletion
- Noise
- Wastewater
- Waste Management
- Occupational Health and Safety

#### 7.7.14.1 AIR EMISSIONS

#### Potential Impacts

Impacts on local air quality may arise from the following project activities:

- Biomass Combustion due to traffic
- Particulate matter emissions results from unburned carbon and impurities in fuels Likely impacts of these activities can include:
- Deterioration of local and regional air quality
- Respiratory diseases in local community
- Global Warming (Increase in CO<sub>2</sub> and NO<sub>x</sub> in the atmosphere can cause global warming)
- Acid Precipitation (impact on aquatic ecosystem of surface water and ground water through acidification)

### Assessment of Potential Impacts

Road activities can have a major impact on the local and regional air quality. The pollutants can seriously impair human health and ecological environment and other materials. The emissions include sulphur dioxide, oxides of nitrogen, carbon monoxide, carbon dioxide, and particulates (which may contain trace metals). The emission levels depend on the type and size of facility, the type and quality of fuel and the manner in which it is burned.

- A significant impact will be interpreted if the concentration of pollutants in the ambient air exceeds the NEQS or recognized international guidelines for ambient air quality such as World Bank and World Health Organization (WHO) ambient air quality guidelines.
- The impact will also be considered significant if the pollutants emission level as well as the ground level concentration exceed the values as set out by GB- EPA.
- It is obvious that the transport will be shifted from nearby roads to proposed Project. Still there will be an increase in transportation. This distribution of traffic will share the air pollution load which will result in a slight change in existing air quality scenario in proposed project area.

### Mitigation Measures

The proposed mitigation measures to reduce the impacts on air quality during the proposed operation activities are:

- Use of cleaner fuels and if possible, to renewable fuels
- Motivation for proper maintenance of vehicles
- Monitoring of Ambient air parameters (CO, PM<sub>10</sub>, SO<sub>2</sub>, and NO<sub>x</sub> etc.) should be carried out on annual basis.

### Residual Impact

If the mitigation measures are effectively implemented, the residual impact of the proposed activities on the area's air quality is expected to be low in significance.

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## 7.7.15 WATER RESOURCES

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### Potential Impacts

Proposed activities could affect the area's water resources in two ways:

- The surface water bodies may get polluted due to uncontrolled release of contaminated storm water/road runoff from road surfaces
- The pollution risk from accidental spillage may increase moderately.

### Assessment of Potential Impacts

Surface water quality may deteriorate if pollutants are mixed with surface runoff during rain and carried to water resources in the vicinity. The pollutants associated with the road-runoff include:

- Hydrocarbons such as fuel and polycyclic aromatic hydrocarbons from wear and tear of the road surface, tires, lubricants leaking from vehicles and from unburnt fuels
- Suspended solids including insoluble heavy metals as colloidal materials

### Mitigation Measures

The mitigation measures described below will ensure that the project area's aquifer resources are not significantly affected by project activities.

- In order to discharge rapid removal of storm-water/road runoff, cross slopes and longitudinal drainage will be provided in the design. Well-designed cross drainage structures limit ponding across embankments
- Retention basins with reed beds provided in the design will improve the quality of polluted storm-water/road runoff;
- The surface water quality monitoring will also be carried out at defined intervals

### Residual Impact

Water resources may get polluted due to contaminated road runoff on earthen shoulders and embankments planted with grasses. However, the areas in the immediate vicinity of the proposed project will be avoided for vegetation due to the risk of contamination. Water quality monitoring will be carried out as per schedule suggested in the Environmental Monitoring Plan.

#### 7.7.15.1 GHG EMISSIONS

### Potential Impacts

Greenhouse gases are released as a result of combustion process. The increase in greenhouse gas emissions in the atmosphere due to human activities such as combustion and land use change contributes to the global warming.

### Assessment of Potential Impacts

The Kyoto Protocol is an amendment to the United Nations Framework Convention on Climate Change (UNFCCC) an international treaty on global warming. Ratifying developed countries commit to reduce their combined greenhouse gas levels. Islamic Republic of Pakistan ratified the United Nations Framework on climate change in January 1994 and is a party to other international agreements concerning climate change. Developing countries including Pakistan have no obligation beyond monitoring and reporting emissions.

### Mitigation Measures

There are no generally accepted methods for the mitigation of CO<sub>2</sub>, emissions. However, one possible mitigation strategies will be given consideration. This includes;





- Carbon sequestration by planting trees near the project vicinity.
- Smoke generating vehicles will not be allowed to travel on the road.

### **Residual Impacts**

CO<sub>2</sub> emissions contributes to the global warming however, CO<sub>2</sub> emissions from the proposed project will be considerably less as it is expected that there will be shifting of traffic from the nearby roads towards proposed Road so overall emissions will be with limited increase.

#### **7.7.15.2 HAZARDOUS MATERIALS**

##### **Potential Issues**

Although, there will be no use of hazardous material during the operational phase except for cleaning agent; still oil leakages from the vehicles are expected. Moreover, oil storage at rest areas might be expected for generators etc. These chemicals have a potential to harm human health and contaminate soil, surface and groundwater if not handled correctly.

##### **Assessment of Potential Impacts**

A significant impact will be interpreted if the hazardous materials are not handled properly. These chemicals and hazardous materials will be handled following the mitigation measures described below:

##### **Mitigation Measures**

A chemical and hazardous material handling procedure will be prepared that will contain:

- Storage areas for fuels and liquid chemicals will be designed with secondary containment to prevent spills and contamination of soil and groundwater.
- Labeling will be placed on all storage containers as appropriate to national and international standards. The labeling will clearly identify the stored materials.
- Supporting information such as Material Safety Data Sheets (MSDS) will be available for all hazardous materials.
- Disposal of any hazardous material will be according to the MSDS requirements.

##### **Residual Impacts**

Implementation of the proposed mitigation measures is not likely to leave any significant impact.

#### **7.7.15.3 OZONE DEPLETION**

The proposed project will not use any source of ozone depleting compounds such as Halon, Chlorofluorocarbons (CFC), Hydrochlorofluorocarbons (HCFC) or any other source which deplete the ozone layer, so the overall assessment of the impact is significantly low.

#### 7.7.15.4 NOISE

##### Potential Issues

The proposed ROW project may result in increase in noise. The increased noise may be a source of disturbance to nearby communities.

##### Assessment of Potential Impacts

Noise sources in the community are mostly intermittent in nature including road traffic specifically during day times. The NEQS for noise require that the sound level in residential areas should not exceed 65 dB (A) during the day and 55 dB (A) during the night.

##### Mitigation Measures

The following mitigation measure will be undertaken in order to further reduce the noise levels.

- The noise producing vehicles will not be allowed to enter in the areas.
- Tree plantation to reduce the effect of noise pollution.

##### Residual Impacts

Implementation of the mitigation measure proposed above will result in negligible / no residual impact due to noise on surrounding environment.

#### 7.7.15.5 SOLID WASTE MANAGEMENT

##### Potential Issues

The solid waste generated during the operational phase of proposed project can pose a health hazard, pollute soil, surface and ground water if not managed properly.

##### Assessment of Potential Impacts

- A significant impact will be interpreted if the waste management is not carried out properly;
- which may affect the health of nearby communities, pollution of soil, surface or groundwater:
- The operation of the proposed project will generate a relatively minor volume of solid wastes. This solid waste will be domestic in nature.
- Domestic waste from the Tunnel and Road activities which will include, waste from kitchen and general rubbish, recyclable waste such as empty containers, paper, plastics bottles etc.
- All wastes generated from the project will be properly managed by proposed controls discussed in the following section. The environmental impacts will be minimum after the implementation of the proposed mitigations.

##### Mitigation Measures

Key elements of the waste management system will be the following:

- Separate waste bins will be placed for different type of wastes - plastic, paper, metal, glass, wood, and cotton.
- Recyclable material will be separated at source. The recyclable waste will be sold to waste contractors for recycling.
- Non-hazardous, non-recyclable wastes such as kitchen wastes will be disposed-off on designated site.

- No waste will be dumped at any location outside the proposed project boundary.
- Records of all waste generated will be maintained. Quantities of waste disposed, recycled, or reused will be logged on a Waste Tracking Register.
- Training will be provided to personnel for identification, segregation, and management of waste.

### **Residual Impacts**

Proper implementation of the mitigation measures will ensure that the residual impact from waste is minimum.

#### **7.7.15.6 OCCUPATIONAL HEALTH AND SAFETY**

Health risks and workers safety problems may result at the workplace if the working conditions provide unsafe and/or unfavorable working environment specifically due to road traffic hazards, air emissions, unhealthy drinking water, storage handling and transport of hazardous material etc. Workers will be provided with safe and healthy working environment taking into account risks inherent to the particular sector and specific classes of hazards in Project area.

### **Mitigation Measures**

Obligatory insurance against accidents for laborers/workers;

- Providing basic medical training, road safety training to specified work staff and basic medical service during operations
- Firefighting equipment, safe storage of hazardous material, first aid, security, fencing, and contingency measures in case of accidents
- Provision of adequate sanitation, washing, cooking and dormitory facilities including light up to satisfaction;
- Elaboration of a contingency planning in case of major accidents;
- Instruct foremen to strictly enforce the keeping out of non-working persons;
- Particularly children, off work sites;
- Adequate signage, safety cones, lightning devices, barriers, yellow tape and persons with flags during operations to manage traffic;
- There should be proper spill control for Oil spillage / leakage of vehicle;
- Efforts will be made to create awareness about road safety among the drivers;
- Timely public notification on planned construction works;
- Seeking cooperation with local educational facilities (school teachers) for road safety campaigns;
- Provision of proper safety and diversion signage, particularly at urban areas and at sensitive/accident-prone spots;
- Setting up speed limits;
- Eliminate any unusable impounding of water.

## 7.7.16 ENVIRONMENTAL AND SOCIAL BENEFITS

### Changes in Land Value

The proposed project is expected to appreciate the current land values of associated villages, towns and cities. Land owners will have an opportunity to sell their land on increased prices and start new businesses. This impact will be major positive in nature.

### Employment

The project will generate directly hundreds of jobs during the construction phase of the project. The project operational phase will also generate new jobs. Most of these vacancies will be filled by Pakistani nationals as well as locals.

- Similarly, the construction and operation of the project will create far greater number of indirect income resources for example income resource for transporters for the transportation of the materials, procurement of goods from local market etc.
- Overall the proposed project will have a very positive impact on the employment opportunities in Pakistan.

### Plantation Plan

The two plantation plans have been recommended as “Minimum Requirement” with 1 row of plants on each side of the road, and, “Desirable Requirement” with 2 rows of plants on each side of the road. Details of both the plans are given below:

#### Minimum Requirement

Two rows of plants (one row on each side) will be raised of the proposed Tunnel and access road. Plant to plant distance will be kept as 2 meters, so there will be 500 plants in one row of one Km length. Total road stretch is approximately 41.5km in length; therefore, number of plants to be raised on both sides (one row on each side) will be 41,500.

#### Desirable requirement

Four rows of plants (two rows on each side) will be raised of the proposed Tunnel and access road. Therefore, the number of plants, which can be raised along the entire length of the Tunnel and access road are  $(41,500 \times 2)$  83,000.

- 1) These plants are to be planted along the access road and within the loops. Native species would be planted and no invasive/ exotic species would be introduced.
- 2) As per recommendation of District Forest officer (Astora), he wants to introduce native species related to the area on the row.
- 3) The cost of raising one-kilometer (1000 meter) length of plantation, with 500 plants in one row, has been estimated as Rs. 71,920/- including price of plants, earthwork, procurement of manures, continued supply of water to young plants throughout the year and its maintenance one (1) year.
- 4) Based on estimated costing for minimum requirement the total cost would be Rs. 5,969,360/- and for desirable requirement the total cost would be Rs. 11,938,720/- for 41.5km long access road (from shounter to Gorikot).



## **Landscape**

The proposed project of Shounter Tunnel and access road passes through two Districts, Astore of Gilgit Baltistan and Neelum of Azad Jammu & Kashmir (AJ&K). The project area consists mainly of hilly terrain with steep slopes having some patches and strips of flat land being used for settlements and agriculture. Some residents have converted the gentle slopes into terraces, where crops are grown and orchards are raised. The interventions of the shounter tunnel project are not likely to impact the topography of the area on a large scale except for those areas which will be submerged in the tunnel and where the physical activities of excavation, digging and movement of heavy machinery will take place. Similarly, areas where excavated material from tunnels will be disposed, dumped or stored will be negatively affected. The proposed shounter tunnel access road is existing road. However, after the construction of proposed project, the landscape of the project area will be changed in terms of better road infrastructure, construction of bridges and planned plantation of trees along the RoW. This will temporarily change the landscape of the project area due to loss of little agricultural land and some small shrubs but at the same time will have a positive impact in terms of socio-economic development of the project area.

## **Community Development**

Improved community infrastructure will promote new business opportunities. In addition, such an activity will also increase the land value that will benefit the local residents. This impact will be permanent and major positive in nature.



## CHAPTER-8 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

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The potential environmental impacts are identified from the planning stage of proposed project through the Environmental Impact Assessment (EIA) process. The EIA has identified potential impacts that are likely to arise during the project. The EIA has examined in detail both negative and positive impacts at each stage of the project covering both construction and operations phase. To minimize the effects of adverse impacts the EIA has recommended mitigation measures. These mitigation measures include the use of alternative technologies, management and physical controls, or compensation in monetary terms. The proposed mitigation measures have been based on the understanding of the sensitivity and behavior of environmental receptors in the project area, the legislative controls that apply to the project and a review of good industrial practices while operating in similar environments. For residual impacts (impacts remaining after applying the recommended mitigation measures) and for impacts in which there can be a level of uncertainty in prediction at the EIA stage, monitoring measures have been recommended to ascertain these impacts during the course of the project.

- For effective implementation and management of the mitigation measures an Environmental Management Plan (EMP) has been prepared. The EMP satisfies the requirement of the Gilgit Baltistan Environmental Protection Department Review of Initial Environmental Examination and Environmental Impact Assessment Regulations, 2000.
- The EMP is a tool that serves as to manage environmental impacts and specifically focuses on implementation of mitigation measures in its true sense against likely environmental impacts.

### 8.1 PURPOSE AND OBJECTIVES OF THE EMP

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The primary objectives of the EMP are to:

- Achieve NHA Corporate HSE goals;
- Facilitate the implementation of the mitigation measures identified in the EIA;
- Define legislative requirements, guidelines and best practices that apply to the project;
- Define the responsibilities of the project proponent;
- Define a monitoring mechanism and identify monitoring parameters in order to: Ensure the complete implementation of all mitigation measures.
- Ensure the effectiveness of the mitigation measures.
- Define requirements for environmental monitoring and auditing.
- Provide a mechanism for taking timely action in the face of unanticipated environmental situations;
- Identify training requirements at various levels.

### 8.2 COMPONENTS OF THE EMP

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The EMP consists of the following:

- Legislation and guidelines
- Organizational structure; roles and responsibilities

- Monitoring / Management plan
- Environmental monitoring
- Communication and documentation
- Change management Plan
- Training programme

### 8.3 LEGISLATION AND GUIDELINES

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The EIA has discussed national and international legislation and guidelines that are relevant to the project; proponent will ensure that the project is conducted in conformance to the project proponent corporate environmental policy, national legislation and relevant international conventions and that guidance is sought from national and international guidelines. Project proponent will also ensure that its key project management staff and all its assigned contractors are aware of these legislation and guidelines prior to the start of project activities. The details on national and international legislation and guidelines are given in Chapter 2 of the report.

### 8.4 ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES

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This section provides an organizational structure for environmental management during the proposed project operation and defines the roles and responsibilities of the various players for the duration of the project. The proposed project includes the following organizations: NHA as the project proponent and owners of the EMP;

- Project construction contractor(s) as executors of the EMP during construction phase of the project;
- Operation & Maintenance (O&M) team as executor of the EMP during the operational phase of the project.

These organizations will have the following roles and responsibilities during the project.

### 8.5 ROLES AND RESPONSIBILITIES OF NHA

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National Highway Authority (NHA) as project proponent will be responsible for ensuring the implementation of the EMP. NHA will be responsible for the overall environmental performance of the project. Project proponent will monitor the environmental performance of the project to ensure that the project is carried out in accordance with governing legislation, project proponent corporate policies and recommendations of this EIA. Details of specific NHA personnel involved in the project are given below:

**Project Director:** Project Director will be responsible for the successful implementation of the Project. He will be assisted by the Supervision Consultants. Project Director will have a Deputy Director for the said project.

**Director (Environment, Social and Land/Resettlement):** The Director (Environment) will be the overall Incharge for handling NHA's obligations with respect to the EMP. The Director (Environment) will depute one Deputy Director (Environment) for the Project, who will be responsible for ensuring that the provisions of the EMP and Site-Specific Environmental Management Plan (SSEMP) are implemented. Deputy Director (Environment) will be assisted by Assistant Director (Environment) for

the execution of Environmental Management Plan (EMP) for the Project. Deputy Director (Social and Land/Resettlement) will be responsible for the land acquisition and resettlement related issues.

The responsibilities of Director (Environment) may be briefly described as follows:

- To coordinate with regulatory agencies including EPA, EIA consultant, local NGOs, that could assist the NHA in independent reviews of environmental and social compliance;
- To supervise environmental and social assessment reports, and provide substantial inputs and guidance to the EIA consultant;
- Supervise Project design consultant to get the approval of EIA from the EPA Gilgit Baltistan;
- To ensure that the design consultant has incorporated all the mitigation measures proposed for the design phase in the design and included in the contract documents;

### **Roles and Responsibilities of Contractors**

NHA will appoint design consultants, supervision consultants, construction contractor(s) for the construction, testing and commissioning of the proposed project including the auxiliary facilities.

**Design Consultant:** Design consultant will ensure that all the mitigation measures designated for the design phase are incorporated in the design and included in the contract documents.

**Supervision Consultants:** Supervision consultants appointed by the Project Director (NHA) will be headed by a “Project Manager”. Supervision consultant along with his team will supervise the Project contractors to ensure quality of work and fulfilment of contractual obligations. The Supervision Consultant (SC) will provide one Environmental Specialist/ Monitoring Consultant (MC) who will:

- Ensure that all the environmental and social parameters/provisions comply with the applicable standards;
- Ensure that day-to-day construction activities are carried out in an environmentally sound and sustainable manner;
- Organize periodic environmental training programs and workshops for the Contractors’ staff and NHA site staff in consultation with the NHA; and
- Develop “good practices” construction guidelines to assist the Contractors and NHA staff in implementing the EMP;
- Assist NHA as required in developing the bi-annual environmental monitoring reports;
- Assist NHA in reviewing the SSEMP developed by the contractor.

**Construction Contractor:** EMP will be made a part of the contract agreement and the contractor will ensure that all Project activities are in compliance with the EMP and NEQS.

**Operations and Maintenance (O&M) Contractor:** Similarly, Operations and Maintenance (O&M) team will be appointed during operational phase of the project. These contractors will be responsible for implementation of, or adherence to, all provisions of the EMP and with any environmental and other codes of conduct required by project proponent. Overall responsibility for environmental performance of the operation will be the liability of the senior management of the contractors. Site managers of the contractors will be responsible for the effective implementation of the EMP.

**Contractual Provisions:** Adherence to the requirements of the EIA, EMP and GBEPA provided NOC in terms of environmental mitigation will be required from all project contractors and suppliers and thus EMP will form part of their contracts with project proponent.

## 8.6 PLANNING AND DESIGN OF THE OPERATION

### Design of the Operation

Design and operations of the proposed project have been described in Chapter 3 of the EIA report. Following approval of the EIA, if any aspect of the operations or requirements of the EIA need to be changed, project proponent will categorize that change in accordance with the Change Management Plan provided in following sections of this EMP and take appropriate measures thereon.

### Approvals

Obtaining No Objection Certificate (NOC) from Gilgit Baltistan Environment Protection Agency (GBEPA) will not relieve the proponent or its appointed contractors or suppliers of any other legal obligations and hence the proponent and its contractors and suppliers will obtain all other relevant clearances and necessary approvals required by the Government of Gilgit Baltistan prior to commencing the respective operations. The Deputy Director (Environment) will sustain a working partnership among the NHA, EPA Gilgit, Forest and Wildlife Dept. and other organizations.

## 8.7 IMPLEMENTATION OF THE EMP

### Co-ordination with Stakeholders

Project proponent will ensure that co-ordination required with the project stakeholders on environmental and social matters as required by the EMP is maintained throughout the operation.

### Environmental Management Systems

Project proponent and the contractors will ensure that the mitigation measures mentioned in the EIA are adhered to and organizational Environmental Management Systems are implemented during the proposed project. The contractors will abide by the relevant contractual provisions relating to the environment.

### Monitoring

The EPA will be overall monitoring of the project activities. Project proponent and its contractors will ensure that monitoring of the project activities is carried out according to the monitoring programme given in the EMP.

### Change Management

The EIA recognizes that changes in the operation or the EMP may be required during the construction & operation activities and therefore provides a Change Management Plan (incorporated in next sections) to manage such changes.

### Emergency Procedures

Project proponent and its contractor will prepare and maintain contingency plans to deal with any emergency situation that may arise during the construction or operation phase e.g. fire, major oil spills, and medical evacuation and communicate these to the regulatory agencies if and when required by these agencies. Emergency plans will be in accordance to project proponent internal procedures.

## Approvals

The project contractors will be responsible for obtaining all relevant approvals from project proponent such as approvals for waste contractors and others as specified in the environmental management and monitoring plan.

## Training

Project proponent and its contractors and suppliers will be responsible for the selection and training of their staff which shall be capable of completing the project activities in an environmentally safe manner. Project proponent and its contractors and suppliers will be responsible for providing induction to their staff members on the EIA, the EMP and their implementation provided in the EMP. The contractors will be responsible for providing awareness training on potential environmental issues of the project to all personnel at site. In addition, trainings on medical evaluation, emergency preparedness and implementation of EMP will also be covered during the training.

## Communication and Documentation

For effective monitoring, management and documentation of the environmental performance during the construction and operational phase of the project, environmental matters will be discussed during meetings held on-site. Environmental concerns raised during the meetings will be mitigated after discussions between project proponent and the contractors. Any issues that require attention of project proponent higher management will be communicated to them for action. Project proponent and its contractors will ensure that the communication and documentation requirements specified in the EMP are fulfilled during the project.

## Restoration

Project proponent will ensure that the restoration of the site after the end of construction activities and after the useful life of proposed project is carried out according to the requirements of the EIA and EMP.

## Audits

Project proponent and its contractors and sub-contractors will carry out periodic audits/inspections of all project activities regarding their effects on the surrounding environment. The contractors will take account of any recommendations relating to the activity/operation arising during the monitoring, with the prior consent of the proponent.

## 8.8 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMMP) will be used as a management and monitoring tool for implementation of the mitigation measure identified by the EIA. The purpose of monitoring is to ensure that the impact is within the predicted limits and to provide timely information if unacceptable impact is taking place. The scope and frequency of the monitoring depends on the residual impacts identified in **Chapter 7** of the report. To address the mitigation measure and monitoring requirement identified in EIA, a management plan is developed. It ensures that the project is designed, constructed, maintained and implemented in the manner described in the EIA. A detailed monitoring plan is discussed in following tables. These tables list all the impacts of project components and their associated mitigation measures identified in the EIA. For each component, the following information is presented in the plan:

- The required mitigation measures recommended in EIA.
- 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.
- The timings at which the mitigation or monitoring has to be carried out.

Project proponent will hold primary and overall responsibility for ensuring full implementation of the EMP. The Environmental Management Plan has been provided separately for pre-construction, construction and operations phase of the proposed project activities in Table-49, Table-50 and Table-51 respectively.



TABLE 49- MANAGEMENT AND MONITORING PLAN – DESIGN /PRE-CONSTRUCTION PHASE

Sr.	Project Activity	Impacts	Mitigation	Responsibility
1	<b>Alignment selection</b>	Accidents due to improper design some small shrubs cutting	<ul style="list-style-type: none"> <li>• Avoid sharp curves/turns in the design;</li> <li>• Ensure minimum tree cutting and vegetation clearance during alignment selection;</li> </ul>	DC, NHA, EPA
		Wild life habitat may be disturbed		
		Road roughness producing sounds	<ul style="list-style-type: none"> <li>• Selection of the route with minimum dislocation/</li> </ul>	
		perturbing the fauna in the natural habitat of areas	<ul style="list-style-type: none"> <li>• Proper signage while passing through animal, aviary areas.</li> </ul>	
			<ul style="list-style-type: none"> <li>• No horn signage.</li> </ul>	
2	<b>Public and Cultural Properties</b>	Disturbance to people visiting public	<ul style="list-style-type: none"> <li>• Incorporate technical design features to minimize</li> <li>• Incorporate technical design features to minimize</li> </ul>	DC, NHA, EPA
			The Project construction activities to avoid any interference to cultural & heritage sites,	
			<ul style="list-style-type: none"> <li>• In case of unavoidable interference prior</li> <li>• notification and</li> </ul>	
3	<b>Shifting of Public Utilities</b>	Disturbance and interruption to the public may occur	<ul style="list-style-type: none"> <li>• Incorporate technical design features to minimize</li> </ul>	DC, NHA, EPA
			There is no any structures exist within ROW.	
4	<b>Identification of sites for Construction camps, asphalt &amp; batching plants and crushers.</b>	Disturbance to the public may occur	<ul style="list-style-type: none"> <li>• Construction camps will be located away from</li> </ul>	DC, NHA, EPA
		Some small shrubs cutting may be involved for the	The local communities & cultural sites. Asphalt,	
		Construction of camp site, asphalt and batching plant sites.	Batching and crushing plants (if required) must be installed in the downwind direction from residential areas and agricultural land.	DC, NHA, EPA
5	<b>Excavation of Earth</b>	Soil erosion and contamination, Loss of top layer of soil and Air quality may also deteriorate during excavation	Agricultural areas will be avoided for borrowing of materials, unless requested by the landowner for lowering the land;	DC, NHA
			Contractor needs to obtain approval for excavation and for plan of rehabilitating the site after excavation;	
			Identify locations where excavated material would be utilized.	
DC- Design Consultant, NHA - National Highway Authority, EPA – Environmental Protection Agency				



TABLE 50- MANAGEMENT AND MONITORING PLAN – CONSTRUCTION PHASE

Sr.	Project Activity	Impacts	Mitigation	Responsibility
1	<b>Tunnel construction</b>	Proper spoil disposal	To the extent possible reuse spoils as embankment /sub grade or other suitable facilities according to area Consultation with local government and community as to reuse spoils for urban or community infrastructure construction	CC, SC, NHA, EPA
		Potential impact on drinking water, safety for villagers, Blast impact on community safety concern and impact on wildlife	Proper disposal of remain spoils in the identified spoils sites. Geological advanced probe boring and prediction will be adopted. Grouting will be used to seal the leakage, and water discharge will limit. Tunnel liner will be timely and properly installed. Sedimentation and filtration ponds will be adopted at tunnel construction sites to treat wastewater before discharged to nearby irrigation ditches Strictly follow blast operation and safety codes. Prior notice will be announcement to local community Prior safety inspection of nearby buildings for determination of blasting method and dosage. Strengthening and relocation of buildings if necessary. Presplitting blasting, perimeter blasting and millisecond blasting technique will be used for tunnels in sensitive areas to minimize blasting impact on wildlife Blast time arranged in day time to minimize disturbance on wildlife.	CC, SC, NHA, EPA
2	<b>Tunnel excavations: Blasting operations Extraction of materials</b>	Fossil finds may be disturbed Disturbance of rock formation, rock movements and fragmentation	Finding of mineralized zones & fossil finds along the tunnel alignment will be brought to the notice of the Department of Geology and Mining of the State Government for directions from their end Procurement of boulders from authorized suppliers	CC, SC, NHA, EPA



Sr.	Project Activity	Impacts	Mitigation	Responsibility
3	<b>Earth-stone excavation, borrowing</b>	Loss of vegetation Soil erosion issues	Woodland take will be conducted in compliance with relevant laws. Top soil to be reserved for future reclamation. Temporary drainage system will be built during dumping operation. Cutting/filling slopes will be timely protected with engineering or green education on environmental protection and identification of key Slopes, borrow / disposal sites, stations and green belt along the alignment. Protected plants will be provided to construction personnel. Education on environmental protection and identification of key	CC, SC, NHA, EPA
4	<b>Crushers, asphalt and Batching Plants Location</b>	Impact on air Noise disturbance including vibrations	Crushers, asphalt and Batching Plants should be sited sufficiently away from settlements and agricultural operations or any commercial establishments. Such plants will be located at maximum distance away from the nearest village/settlement preferably in the downwind direction. The Contractor shall submit a detailed lay-out plan for all such sites and approval of Environmental Expert of CSE shall be necessary prior to their establishment. Arrangements to control dust pollution through provision of windscreens, sprinklers, and dust encapsulation will have to be provided at all such sites. Specifications of crushers and batching plants will comply with the requirements of the relevant current emission control legislations for all such plants shall be submitted to the CSE and Environmental Expert. The Contractor shall not initiate plant/s operation till the required legal clearances are obtained and submitted.	CC, SC, NHA, EPA
5	<b>Site clearing /leveling</b>	Loss of vegetation may occur Soil erosion &	<ul style="list-style-type: none"><li>Unnecessary clearing of outside the working areas will be avoided and shall be strictly prohibited</li></ul>	CC, SC, NHA, EPA



Sr.	Project Activity	Impacts	Mitigation	Responsibility
		<ul style="list-style-type: none"><li>▪ Soil and surface water pollution/contamination.</li></ul>	<ul style="list-style-type: none"><li>• Assure minimum disturbance to native flora during construction especially where the asphalt, batching and crushing plants will be installed;</li><li>• Use erosion control measures such as hay bales, berms, straw, or fabric barriers;</li><li>• Re-vegetate with recovered plants and other appropriate local flora immediately after equipment is removed from a section of the site.</li></ul>	CC, SC, NHA, EPA
6	<b>Construction crews and camps</b>	Construction and operation of crew camps may pollute the surface & groundwater Workers may rise conflicts with the locals	<ul style="list-style-type: none"><li>• Explore off-site accommodation for crew. Keep camp size to a minimum.</li><li>• Avoid as much clearing of vegetation as possible, define footpath for crew;</li><li>• The contractor will provide plan for removal and rehabilitation of site upon completion;</li><li>• Photographs will be taken before any activity to record the conditions of site at locations that are likely to undergo soil erosion. Similar photographs will be taken after restoration, where applicable.</li><li>• Provide proper solid waste disposal facilities at camp.</li><li>• Provide proper sanitation facilities.</li><li>• Maintain emergency response system;</li><li>• Strictly prohibit poaching, and cutting of trees</li><li>• Drinking water should meet the NEQS and WHO Guidelines;</li><li>• Movement of all project personnel will be restricted to work areas</li><li>• Wildlife protection rules will be included in the Camp Rules.</li><li>• Ensure that a 'no-hunting, no-trapping, no-harassing' wildlife policy will be strictly observed, unless threatening to human life.</li></ul>	CC, SC, NHA, EPA





Sr.	Project Activity	Impacts	Mitigation	Responsibility
7	<b>Excavation,</b>	Soil erosion.	<ul style="list-style-type: none"><li>Identified quarry sites and borrow pit sites to be exhausted, reinstated and rehabilitated before opening other sections.</li></ul>	CC, SC, NHA, EPA
8	<b>acquisition work, transportation and storage of raw materials</b>	Air pollution: aerial emission of dust Noise, Land degradation Loss of land value at raw material sites and stockpile. Loss of vegetation.	Exhausted quarries to be backfilled. Limit earth movements to dry season. Borrow pits should be rehabilitated. Balance cut and fills to avoid deposition. Material from borrow site should be directly transported and deposited to the site where it has to be used. Stockpiles should be positioned and sloped to create least visual impact. No foreign material generated or deposited should remain on the site after completion of the activity and the areas affected by stockpiling should be reinstated. Dust emission Sensitize workforce. Maintain work equipment. Destinations during transportation. Loads shall have appropriate cover to prevent spillage and contractor should be responsible for any clean up resulting from any failure. Contaminated water should be collected, stored and disposed off at the designated site of liquid fuel and oil at storage area.	CC, SC, NHA, EPA
9	<b>Handling/transportation of hazardous materials</b>	Toxicity, soil contamination and air pollution are the major impacts which may occur by mishandling of hazardous waste.	Prevent dumping of hazardous materials especially near seasonal nullahs. Proper labelling of containers, including the identification and quantity of the contents, hazard contact information etc. Emergency Response Plan is prepared to address the accidental spillage of fuels and hazardous materials Immediate collection of spilled oils/fuels/lubricants through collection of contaminated soils and skimming oils from surface water through appropriate technologies.	CC, SC, NHA, EPA



Sr.	Project Activity	Impacts	Mitigation	Responsibility
10	<b>Waste Management</b>	Solid waste may be generated from the active construction sites and also from the camp sites	Fenced storage area with paved floor. Separate bins will be placed for different type of wastes - plastic, paper metal, glass, wood, and cotton. Recyclable material will be separated at source. The recyclable waste will be sold to waste contractors An emergency response plan will be developed for the hazardous waste and substances. On-site audits of the waste management will be undertaken on a regular basis during the period of project activity logged on a waste tracking register. Records of all waste generated during the project activity period will be maintained. Quantities of waste disposed, recycled, or reused will be Training will be provided to personnel for identification, segregation, and management of waste. No waste will be dumped at any location	CC, SC, NHA, EPA
11	<b>Hydrology and drainage</b>	Soil erosion Accidents Water pollution	Tunnel and Roads design and related activities not to encroach on environmentally sensitive areas such as wetlands. Replant road reserve with grass or stabilizing shrubs to prevent soil erosion. Design adequate culverts for all crossings to accommodate peak runoff from effective catchments.	DC, CC, SC, NHA, EPA



Sr.	Project Activity	Impacts	Mitigation	Responsibility
12	<b>Traffic control</b>	Traffic jams and congestion may take place and cause inconvenience to the people where the construction will take place especially at the sites for bridges, and culverts etc.	Efforts should be made to accommodate the traffic along the road as far as practically possible. Provision of signboards directing the drivers about the diversion. Providing and maintaining traffic management comprising diversion warning, guiding and regulatory signage, channelizes and delineators, lightening etc. Contractor staff should be trained and put on the duty to manage the traffic during the construction activities taking place along the road; Movement of vehicles carrying construction material should be restricted; Availability of continuous services of police for traffic control especially at diversions in urban areas. Max. allowable speed for heavy machinery on the site should not exceed than 20 km/ hr.	CC, SC, NHA, EPA



Sr.	Project Activity	Impacts	Mitigation	Responsibility
13	<b>Worker's Health &amp; Safety</b>	Health problems or immediate risk may take place. Occupational health of workers and community may be affected.	Providing basic medical training to specified work staff and basic medical service and supplies to workers; Layout plan for camp site, indicating safety measures taken by the contractor, e.g. firefighting equipment, safe storage of hazardous material, first aid, security, fencing, and contingency measures in case of accidents; Work safety measures and good work man ship practices are to be followed by the contractor to ensure no health risks for laborers. Protection devices (ear muffs) will be provided to the workers operating in the vicinity of high noise generating machines. Proper maintenance of facilities for workers will be monitored. Provision of protective clothing for laborers handling hazardous materials, e.g. helmet, adequate footwear for bituminous pavement works, protective goggles, gloves etc.; Ensure strict use of wearing PPE during work activities. Timely public notification on planned construction works. Close consultation with local communities to identify optimal solutions for diversions to maintain community integrity & social links. Provision of proper safety signage at sensitive/accident prone spots.	CC, SC, NHA, EPA
14	<b>Running of asphalt mixing plants, crushers</b>	Air Pollution, Dust generation from construction machineries	All equipment, generators, and vehicles used during the project will be properly tuned and maintained in good working condition in order to minimize exhaust emissions. Imposing speed limits and encouraging more efficient traffic management will reduce the dust emissions. All project vehicles will be checked regularly to ensure that engines are in sound working condition and are not emitting smoke.	CC, SC, EPA



Sr.	Project Activity	Impacts	Mitigation	Responsibility
15	<b>Implementation of Plantation Plan</b>	Clearing of vegetation and trees from the area	Afforestation activities will be conducted on both sides of the road. The vegetation will only be cleared from the road site if required.	CC, SC, NHA, EPA
16	<b>Slope Failure/Landslide</b>	Clearing and levelling for tunnel and road construction, Physical scarring of the landscape, Accelerated soil erosion, Disturbance caused by the earthquake and aftershocks, Reconstruction and rehabilitation activities and Aggravated the landslides etc.	The Hard Engineering (Protection wall, Check drawing, Diversion channels, Breast walls, Surface drains and Retaining walls Bio-Engineering (Contour watling, Hedges laying and Bruch hedge laying), Soil Cover (Vegetative cover by synthetic materials, Reforestation and Green grid with plantation, Preventive Measure (Fencing/Hedging, By-passing of road, ceasing the construction, cutting to reduce load and Slope creeping approaches are apply for slope stabilization in the area,	CC, SC, NHA, EPA
17	<b>Socioeconomic /Local community</b>	Community disturbance Community awareness Skilled and un-skilled jobs for local community.	All community grievances will be recorded and maintained in a Community Complaint's Register. In addition to this close liaison will be maintained between the community and the site representatives of project proponent throughout the project activities. Maximum number of unskilled and semi-skilled jobs will be reserved for the local communities. Awareness and cultural inductions to educate the contractor workforce on the requirement of minimizing social interaction with local communities; Unnecessary interaction of local population with the non-local project staff will be avoided. Discharging firearms will be explicitly prohibited. Communities will be informed about the project activities and possible disturbance in advance.	CC, SC, NHA, EPA





Sr.	Project Activity	Impacts	Mitigation	Responsibility
18	<b>Landscaping, Decommissioning and rehabilitation of raw material sites.</b>	Land degradation. Abandoned borrow pits. Proper disposal of stockpile and spoil areas.	All materials from stockpile areas to be removed and the area to be landscaped. All waste and surplus materials at spoil areas to be collected and disposed at designated places and not dumped within the road reserve. Replant vegetation on reserve, diversion route upon completion Quarry pits to be covered with soil and thus creating farming land.	CC, SC, EPA
CC - Construction Contractor, SC - Supervision Consultant, NHA - National Highway Authority, EPA – Environmental Protection Agency				



TABLE 51- MANAGEMENT AND MONITORING PLAN – OPERATIONAL PHASE

Sr.	Project Activity	Impacts	Mitigation	Responsibility
1	<b>Tunnel Operation</b>	Proper spoil disposal	Monitoring the effectiveness of the pollution attenuation barriers, if there is any, will be taken up thrice in the operation period. Tunnel ventilation systems shall have suitable noise control measures incorporated into their design to reduce mechanical noise to acceptable levels in the surrounding community. Depending on the results of noise monitoring, installation of acoustical treatment to the first few meters (i.e., < 15 m) of the tunnel portal shall be implemented as necessary.	NHA
2	<b>Road</b>	Deterioration of roads and associated structures and accidents of hazardous material.	Monitor and maintain drainage structures and ditches including culverts. Clean out culverts and side channels when they begin to fill with sediment and lose their effectiveness. Fill mud holes and potholes with good quality gravel; remove fallen trees and limbs obscuring roadways. Monitoring and cleaning of concrete pads, drains, and oil/water pits in areas where vehicle and equipment maintenance and fueling occur.	NHA
3	<b>Damaged drainage</b>	Harmful environmental impacts resulting from damaged drainage or uncontrolled erosion	Routine monitoring of drainage system and erosion control at least twice a year.	NHA
4	<b>Pollution Monitoring</b>		The periodic monitoring of the ambient air quality, noise level, water (both ground and surface water) quality, soil pollution/contamination in the selected locations as suggested in pollution monitoring plan will be responsibility of project proponent.	NHA
5	<b>Noise emission</b>		Noise pollution will be monitored as per monitoring plan at sensitive locations. Noise control programs are to be enforced strictly.	NHA
6	<b>Waste Management</b>	Generated waste resulting from various operations. Oil pollution.	Provide appropriate options for waste management. Assess opportunities for reducing solid waste generation in particular of hazardous and undesirable materials (oils and grease). Dumping of oil residuals and any other waste to be done in designated areas only. Encourage	NHA



Sr.	Project Activity	Impacts	Mitigation	Responsibility
			segregation of waste from the source and use the 3R waste management approach: Reduce, Reuse and Recycle. Design provisional waste material storage for the sorted-out waste at the site (e.g. spoil area).	
7	Road Safety	Increase of road and related accidents. Occupational injuries.	Maintain provisions for road safety e.g. through installing signage and awareness information on road condition such as black spots etc. Encroachments upon road reserve to be avoided. Provide facilities for accidental spillages to combat risk. Enforcement of speed limits, installation of speed guns and enforcement of penalties for the violators.	NHA
NHA - National Highway Authority				

## 8.9 COMMUNICATION AND DOCUMENTATION

An effective mechanism for storing and communicating environmental information during the project is an essential requirement of an EMP. The key features of such mechanism are:

- Precise recording and maintenance of all information generated during the monitoring
- Communicating the information to a central location
- Processing the information to produce periodic reports
- Providing information and answering queries on monitoring originating from various researchers and stakeholders.

### 8.9.1 MEETINGS AND REPORTING

- The purpose of the meetings will be to present the environmental management plan to the senior staff of the project team, contractors and stakeholders and discuss its implementation.
- Meetings will be held to discuss the environmental conditions of the operation, non-compliances noted by the field supervision consultant (Environmental Engineer), and their remedial measures. Minutes of the meeting will be recorded in the form of action tracking register.
- The purpose of the meeting will be to review the weekly or monthly performance of the project activities by reviewing the number of non-conformances and the environmental incidents that occurred during the week/month.
- Weekly and monthly reports will be communicated to the project proponent management and senior members of the contractors.
- The report will include:
  - Summary of weekly/monthly project activities.
  - Non-compliances observed and mitigation measures taken or required.

### 8.9.2 GENERAL GUIDELINES FOR REPORTING

A report to be submitted should generally contain details incorporating the following salient:

- The general progress of the report.
- It includes the environmental incidents (if any) e.g. spills, accidents etc.
- Progress of any environmental initiative taken e.g. energy savings, recycling etc.
- Records of any environmental monitoring. Both – observational and instrumental.
- Conclusions and recommendations (if any required).

### 8.9.3 SOCIAL COMPLAINTS REGISTER

The project proponent Field Environmental Representative will maintain a register of complaints regarding environmental issues received from local communities and measures taken to mitigate these concerns.

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## 8.9.4 CHANGE RECORD REGISTER

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All changes to the EMP or the project will be handled through the Change Management Plan provided in Section 8.13 of the EMP. These changes will be registered in a Change Record Register.

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## 8.9.5 PHOTOGRAPHIC RECORD

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Project proponent will maintain a photographic record of all areas to be used during the project. As a minimum the photographic record will include the photographs of project areas prior to and after activities (restoration). Project proponent will ensure that a photographic record including the following is maintained.

- All areas used by the project activities; before use, during use and after restoration
- Key non-compliances
- Key project activities

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## 8.9.6 AUDIT REPORTS

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Project proponent will hire independent firm for auditing. Funding Agency and EPA Gilgit Baltistan can also conduct audit as independent party from proponent.

### Environmental Monitoring and Reporting

Environmental monitoring can be categorized into two types; 1) - compliance monitoring and 2) - effects monitoring. The environmental monitoring programme is summarized in table-51 which identifies the roles and responsibilities of project monitoring, further described in detail in following section.

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## 8.9.7 COMPLIANCE MONITORING

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Compliance monitoring will be carried out to ensure compliance with the requirements of the EIA. The objectives of the EIA compliance monitoring will be to:

- Systematically observe the activities undertaken by the contractors or any other person associated with the project.
- Verify that the activities are undertaken in compliance with the EIA and other conditions identified by project proponent.
- Document and communicate the observations to the concerned person(s) at project proponent so that any corrective measures, if required, can be taken timely.
- Maintain a record of all incidents of environmental significance and related actions and corrective measures.

Compliance monitoring will be the responsibility of all teams involved in the project activities i.e. Project proponent and the contractors. Project proponent staff and contractors will carry out the inspections on a set frequency.

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## 8.10 EFFECTS MONITORING

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To monitor actual impacts of the project on selected sensitive receptors so that impacts not anticipated in the EIA or impacts which exceed the levels anticipated in the EIA can be identified and appropriate mitigation measures can be adopted in time. This objective will be achieved through effects monitoring.

- Considering the environmental conditions of the project area and the assessment of potential impacts of the project made in the EIA, the following environmental parameters will be monitored at locations identified during the construction phase (e.g. location of asphalt plants, construction camps etc.).
- Considering the receptors with less environmental impact, the proposed location is tentative and based on current field survey finding, situation may vary at the time of construction.
- Air Quality Monitoring – Air quality monitoring will be done during the construction and operation phase of the project at the representative locations. Ambient air quality parameters will include: NOX, SOX, CO, PM10, and Smoke.
- Water Quality Monitoring – Ground and surface water quality monitoring will be done during the construction and operation phase of the project at the representative locations.
- Groundwater Quality Parameters: Total Coliforms, Total Colonial Count, Fiscal Enterococci, pH, TDS, Total Hardness, Nitrate, Chloride, Sodium.
- Wastewater Quality Parameters: pH, DO, TSS, Alkalinity, BOD5, COD, Turbidity.
- Noise Monitoring - The monitoring will be carried out at key locations covering all receptors.

### 8.10.1 MONITORING ROLES AND RESPONSIBILITIES

Funding Agency and EPA Gilgit Baltistan will be overall monitoring as per EMP. The project staff engaged in social and environmental monitoring is listed below, followed by descriptions of the monitoring responsibilities specific to each post:

- Deputy Director Environment
- Supervision Consultants

Monitoring Plan has been provided separately for pre-construction, construction and operations phase of the proposed project activities in Table-50 and Table-51 respectively.

#### **Deputy Director (Environment)**

The Deputy Director (Environment) will be responsible for Environmental Monitoring and Evaluation (M&E). This includes the following:

- Contracting out external monitoring to independent firms and ensuring that periodic environmental audits are carried out;
- Supervise and ensure preparation of periodic monitoring reports and disseminating these among the management and appropriate staff members;
- Ensuring the availability of human and material resources required for environmental monitoring;
- Carrying out visits to the construction sites to review the environmental performance of the contractors





### **Supervision Consultant**

Supervision Consultant will involve the Environmental Specialist/ Monitoring Consultant and Resident Engineer for compliance and effect monitoring described above. The Resident Engineer will overlook the performance of contractor to make sure that the contractor is carrying out the work in accordance with EMP. The Environmental Specialist will prepare bi-annual environmental monitoring reports The Monitoring Consultant (MC) on the other hand will carry out the environmental monitoring and report to DD (Environment) for adequacy of the monitoring program as specified in EMP. The MC will also induct a Technical Training Consultant to educate the Contractor's and NHA's staff.



TABLE 52- ENVIRONMENT MONITORING PLAN AND BUDGETING

<b>Component Operation Phase</b>	<b>Parameters</b>	<b>No. of samples × frequency × year</b>	<b>Frequency</b>	<b>Responsibility</b>	<b>Duration</b>	<b>Cost (PKR)</b>
<b>Air Quality(Stationary Source Emissions)</b>	CO, NO <sub>2</sub> , SO <sub>2</sub> , PM	14×36×1 = 504	Quarterly (36 quarter in 108 months period of construction)	EE of CC	-	4536,000/-
<b>Ambient Air Quality</b>	CO, NO <sub>2</sub> , SO <sub>2</sub> , Ozone, PM <sub>10</sub> , PM <sub>2.5</sub> , Lead, SPM	36×1×1 = 36	Annually	EE of CC	24 hours	1350,000/-
<b>Ground Water Quality</b>	Total Coliforms, Fecal E.Coli, Total Colonial Count, Fecal Enterococci, pH, TDS, Total Hardness, Nitrate, Chloride, Sodium, Arsenic pH, Dissolved Oxygen,	72×2×1 =144	Bi-annually	EE of CC	-	1440,000/-
<b>Surface &amp; Waste Water Quality</b>	TSS, TDS, Alkalinity, BOD <sub>5</sub> , COD, Turbidity, Oil & Grease	72×2×1 = 144	Bi-annually	EE of CC	-	2592,000/-
<b>Noise Level</b>		10×36×1 = 360	Quarterly (36 quarter in 108 months period of construction)	EE of CC	24 hours	5400,000/-
<b>Site Specific Plans for different Construction Phases of the Project</b>						2,000,000/-
<b>Total</b>						<b>17,318,000/-</b>

## 8.11 ENVIRONMENTAL MITIGATION (PLANTATION) COST

To minimize the negative impacts arising due to increased vehicular activity on the proposed ROW and to enhance the landscape of the project area, the mitigation measures would include; plantation along the whole stretch of the proposed project as a noise barrier. Following plantation plan would be followed:

### Minimum Requirement

Two rows of plants (two rows on each side) will be raised of the proposed Tunnel and access road. Plant to plant distance will be kept as 2 meters, so there will be 500 plants in one row of one Km length. Total road stretch is approximately 41.5km in length; therefore, number of plants to be raised on both sides (one row on each side) will be  $(41,500 \times 2)$  83,000.

### Desirable requirement

Four rows of plants (two rows on each side) will be raised of the proposed project. Therefore, the number of plants, which can be raised along the entire length of the proposed tunnel and access road project are  $(41,500 \times 2)$  83,000

These plants are to be planted along the side roads and within the loops. Native species would be planted and no invasive/ exotic species would be introduced. The number of trees affected during The cost of raising one kilometer (1000 meter) length of plantation, with 500 plants in one row, has been estimated as Rs. 71,920/- including price of plants, earthwork, procurement of manures, continued supply of water to young plants throughout the year and its maintenance one (1) year. Based on estimated costing for minimum requirement the total cost would be Rs. 5,969,360/- and for desirable requirement the total cost would be Rs. 11,938,720/- for 41.5km long access road (from shounter to Gorikot).

## 8.12 ENVIRONMENTAL TRAINING

Environmental training will help to ensure that the requirements of the EIA and EMP are clearly understood and followed by all project personnel throughout the project period. Environmental training will form part of the environmental management system. The training will be directed towards all personnel for general environmental awareness.

### 8.12.1 OBJECTIVES OF THE TRAINING PROGRAMME

The key objective of training programme is to ensure that the requirements of the EMP are clearly understood and followed throughout the project. The trainings to the staff will help in communicating environmental related controls specified in the EIA and EMP.

### 8.12.2 ROLES AND RESPONSIBILITIES

Project proponent Field Environmental Representative and the contractor's Environmental Engineer will primarily be responsible for providing training to all project personnel on potential environmental issues of the project. Contractor will prepare a project specific training manual for this purpose. Contractors on their part will be required to provide induction training/ briefing to all their staff before the start of any activity in the project area.

### 8.12.3 TRAINING TOPIC

The training modules will include air, noise and water pollution monitoring, social awareness, Environmental Laws, Environmental Quality Standards usage of personal protection equipment's, and health and safety related issues on the construction site.

The contractor will train all construction workers in basic sanitation and health care issues (e.g., how to avoid malaria etc.) and in general health and safety matters, and on the specific hazards of their work. Training should also consist of basic hazard awareness, site specific hazards, safe work practices, and emergency procedures for fire, evacuation.

### 8.13 GRIEVANCE REDRESS MECHANISM (GRM)

In order to receive and facilitate the resolution of project affected people's (PAP's) concerns, complaints and grievances about the Project's environmental performance, a Grievance Redress Mechanism (GRM) will be established by NHA for this Project. The GRM will address the PAPs' concerns and complaints proactively and promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the PAPs at no costs and without retribution. The GRM will be coordinated by the designated NHA, the DD – Environment as focal person of GRM Committee the Project Director to Chairmen is also focal person of GRM Committee with portfolio for environmental matters in liaison with the public representative at the district level. The mechanism will not impede access to the country's judicial or administrative remedies. The PAPs will be fully informed of their rights and of the procedures for addressing complaints verbally and in writing during consultations. A mechanism will be established to address / resolve the PAPs concerns or grievances due to project related social and environmental issues. Under this GRM, a Grievance Redressal Committee (GRC) / Environmental Committee (EC) will be constituted and established at each areas GB and AJK, which will review all the grievance cases. The GRC will be composed of the DD-Environment of NHA, supervision consultants and PAP representatives.

#### 8.13.1 REGULATORY REQUIREMENT FOR GRIEVANCE REDRESS MECHANISM

The Pakistan EPA, under Regulation 6 of the IEE-EIA Regulations 2000, has issued a set of guidelines of general applicability and sectoral guidelines indicating specific assessment requirements. Under the regulations and guidelines, no specific requirements are laid out for developing a grievance redress mechanism for projects. However, under its Guidelines for Public Consultation, 1997, the proponent is required to consult stakeholders during the implementation phase of the project. In this regard, it is stated that the representatives of local community partake in the monitoring process to promote a stable relationship between the project management and the community.

#### Framework for Grievance Redress Mechanism

NHA will assist the project affected communities/villages to identify local representatives to act as Grievance Focal Persons (GFPs). The GFPs will be responsible for i) acting as community representatives in formal meetings between the project team and the local community he/she represents; ii) communicating the community members' grievances and concerns to the contractor during project implementation.

A pre-mobilization public consultation meeting will be convened by NHA's EALS Unit and attended by the GFPs, Supervision Consultant, contractor, Project representative and other interested parties (e.g. area level representatives, NGOs). The grievance redress committee (GRC) will be headed by the DD (environment) – depending upon the nature of the complaint - as focal person. Besides, the GRC will

include the environment staff of the Project Management Unit/Supervision Consultants, environment staff of the contractor and representative of the local community (preferably the relevant GFP). Under the Project the following will be established or appointed to ensure timely and effective handling of grievances about project environmental performance:

- NHA Director will nominate one assistant director as NHA representative of the GRC and shall act as Project Environmental Grievance Officer (PEGO)
- PEGO will be approached by the community members (PAP Representatives) for their grievances against the Project.
- PEGO will review the case on merit basis and address the grievances in accordance with the prevailing rules as per EMP
- PEGO will then refer the case to GRC for final decision, whether to update and make necessary amendments in the EMP
- GRC will review and update with its decision within 30 days of registration of the case.
- If the PAP's are not satisfied with the decision of Director (Environment), then it can be referred to higher authorities/ relevant Government departments for its resolution. He/she may also submit the complaint to Pak EPA. GB EPA should start a system to receive online complain relevant to project.

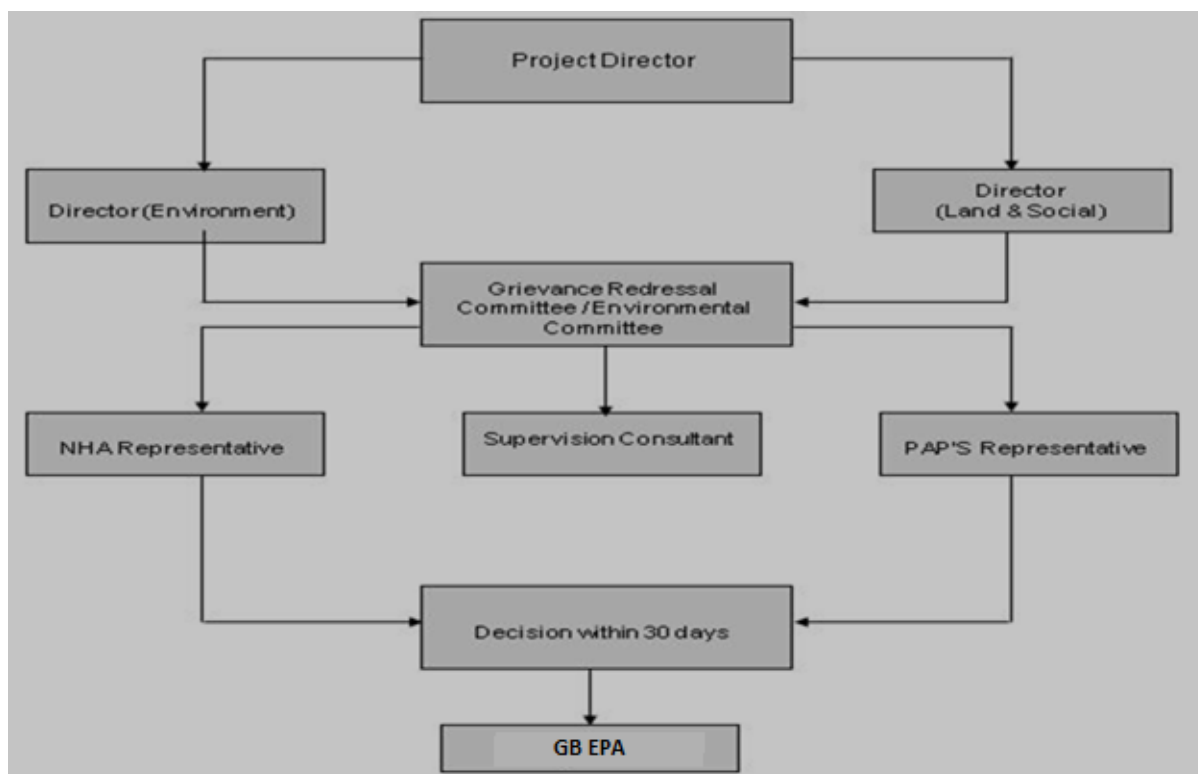
### **Operating Principles for GRC**

The GRC will operate on the principles of transparency, approachability and accountability. To achieve these, the GRC will be required to:

- Be equipped to handle grievances in the local languages;
- Be equipped to work through all possible modes of communication, such as, emails, by-post and face-to-face meetings at site or requiring visits; and issues of the female community members.
- Maintain a log of all grievances, with record of the date and time of the complaint logged and stakeholder information, such as, name, designation and contact details;
- Provide opportunity to the stakeholder to revert with their comments on the proposed plan of action;
- Keep the stakeholder informed of the progress in grievance resolution;
- Obtain stakeholder consent on the mechanism proposed to redress the grievance and document consent; and,
- Maintain confidentiality of the stakeholder, if requested so.

### **Complaints and Grievances**

A grievance mechanism will be available to allow a PAP appealing any disagreeable decision, practice or activity arising from noncompliance of EMP during project implementation. Care will always be taken to prevent grievances rather than going through a redressal process. This can be obtained through implementing an updated EMP or corrective action plan to address unpredicted environmental impacts, by ensuring full participation and consultation with the PAPs and by establishing extensive communication and coordination between the community and project office. The flow chart of the proposed redressal mechanism is shown below in Graph-3.



Graph 3- Organogram of Proposed Grievance Redressal Mechanism

## 8.14 CHANGE MANAGEMENT PLAN

The EIA recognizes that changes in the operations or the EMP may be required during the project activities and therefore a Change Management Plan has been provided to manage such changes. The management of changes is discussed under two separate headings, changes to the EMP and changes to the Operation.

### Changes to the EMP

The EIA and the EMP have been developed based on the best possible information available at the time of the EIA study. However, it is possible that during the construction and operation phase some aspects of the EMP may need to be changed owing to their non-applicability in a certain area of operation or the need for additional mitigation measures based on the findings of environmental monitoring during the construction and operation phase. In such cases following actions shall be taken.

- A meeting will be held between project proponent and the concerned contractor. During the meeting the proposed deviation from the EMP, planning and designing will be discussed and agreed upon by all parties.
- Based on the discussion during the meeting, a change report will be produced collectively, which will include the original EMP clause/plan or design, the change that has been agreed upon, and the reasons for the change.
- The report will be signed by all the parties and will be filed at the site office. A copy of the report will be sent to project proponent and contractor head offices.
- All relevant project personnel will be informed of the change.



## Changes to the Operation

The change management system recognizes three orders of changes.

### First-Order Change

A first order change is one that leads to a significant departure from the project described or the impacts assessed in the EIA and consequently require a reassessment of the environmental impacts associated with the change. Examples of such change include change in location of the proposed plant. In such an instance, the environmental impacts of the proposed change will be reassessed, and the results sent to the GB-EPA for approval.

#### A. Second- Order Change

A second-order change is one that entails project activities not significantly different from those described in the EIA, and which may result in project impacts whose overall magnitude would be similar to the assessment made in this report. In case of such changes, the environmental impact of the activity will be reassessed, additional mitigation measures specified if necessary, and the changes reported to the GB-EPA.

#### B. Third –Order Change

A third-order change is one that is of little consequence to the EIA findings. This type of change does not result in impact levels exceeding those already assessed in the EIA; rather these may be made on site to minimize the impact of an activity. The only action required in this case will be to record the change in the change record register.

## 8.15 ENVIRONMENTAL BUDGET ESTIMATE

For an effective implementation of environmental mitigation measures, it is very important to provide sufficient funds for the implementation of environmental mitigation measures (tree plantation cost), monitoring and training. National Highways Authority (NHA) is committed to implement all mitigation measures given in this report and will provide required funds in this regard. The summary of total environmental costs is given in table-53. The table gives two options specifically considering the tree plantation estimation.

TABLE 53- ENVIRONMENTAL BUDGETING AND PLANTATION COST

Description	Cost (PKR)
Environmental Monitoring Cost	20,847,000
Environmental Training Cost	3,000,000
Environmental Mitigation (Tree Plantation) Cost (Minimum requirement with one row of plants on each side)	5,969,360
<b>Total Cost with Minimum requirement</b>	<b>29,816,360</b>
Environmental Mitigation (Tree Plantation) Cost (Desirable requirement with two rows of plants on each side)	11,938,720
<b>Total Cost with Desired requirement</b>	<b>35,785,720</b>



## CHAPTER-9 CONCLUSIONS

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The proposed project starts from Shounter and ends at Gorikot. The planned proposed project will largely contribute to the economic and social development of the both districts Astore (GB) and Neelum (AJK) and adjoining areas as well surrounding regions on a larger scale. It will bring more population into the stream of benefits, which in turn will change the economic framework of people around this project. This link will bring about further revolution in the road transport and time saving journey for passengers. It will also ensure smooth and efficient movement of trade, goods and traffic in relatively shorter time.

Any residual environmental and social impacts are assessed for their significance in this report. These requirements have been addressed in this EIA, which has covered in detail the following:

- The proposed project activities;
- Alternatives considered in finalizing the project;
- Environmental conditions of the project area; Legislative requirements related to the project;
- Potential environmental effects of the proposed project activities on the physical, natural and socio-economic receptors;
- Mitigation and monitoring measures that will help in avoiding or minimizing these impacts.

After assessing the significance of potential impacts, it has been concluded that if the project activities are carried out as described in this report, and the suggested mitigation measures are implemented, the proposed project will not have a significant impact on the area's natural and socio-economic environments. Careful implementation of the provided EMP will ensure that environmental impacts are managed and minimized and all statutory requirements are met by the project proponent.

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## *Annexures*



## ANNEXURE-1 LIST OF RESPONDENTS, PARTICIPANTS OF SOCIO-ECONOMIC SURVEY AND PUBLIC CONSULTATION

### LIST OF GOVERNMENT OFFICES, LINE AGENCIES AND NGOS VISITED AND PERSONS CONTACTED

Name of Agency	Name of Person(s) Contacted
Environmental Protection Agency, Gilgit Baltistan	Mr. Shehzad Hessian, Director Mr. Manawer Hussain, Assistant Director
W.W.F Regional Office Gilgit Baltistan	Mr. Rehmat Hussain, WWF Mr. Tajdar Hussain, WWF
Aga Khan Rural Support Programme, Gilgit Baltistan	Mr. Javeed Ahmed, Area Manager Mr. Nisar Ahmed, Social Officer
Department of Agriculture Gilgit Baltistan	Mr. Maqsood Hussain , Agri statistic division Mr. Dr. Azhar Hussain , Dy. Director
District Astore of Live Stock Gilgit Baltistan	Dr. Mudsar Hussain, Deputy Director Dr. Shamshad Alam, Vetnery Officer
District Astore of Fisheries, Gilgit Baltistan	Mr. Yousaf Jan, Deputy Director
Forest Department of District Astore, Gilgit Baltistan	Mr. Jabran Headir, Divisional Forest Officer
Wildlife Department of District Astore, Gilgit Baltistan	Mr. Muhammad Zahid, Divisional Forest Officer
Planning & Development Department, Gilgit Baltistan	Mr. Ali Jabar, Assistant Chief Mr. Muhammad Alam, Director
Pakistan Metrological Department, Gilgit Baltistan	Mr. Bashriat Hussain, Representative





## LIST OF RESPONDENTS INTERVIEWED FOR VILLAGE PROFILE SURVEY

Village	Name of Respondent
<b>Gorikot</b>	Zafar Ullaha S/oAbdulaha Khan
	Noor Ullaha S/o Sheer Khan
	Muhammad Saleem S/oRoozi Khan
	Ghulam Murtaza S/oSamudar Khan
	Shoail Ahmed S/O Sheair Ahmed
<b>Rehmanpur</b>	Ijaz Wali S/oAmir Khan
	Muhammad Wali S/oMuhammad Ayub
	Khursheed Alam S/oAzhar Khan
	Shah Reihas S/oGhulam Muhammad
	Noor Khan S/oUmer Khan
<b>Chugam</b>	SatheerAhmed S/oFaqueer Muhammad
	Munir Ahmed S/oMukhabat Khan
	Muhammad Masroof S/oMuhammad Khan
	Shahreefud Deen S/oKareem Khan
	Sirbuland S/oSardar
<b>Nasirabad</b>	Doola Khan S/oJumah Khan
	Ghulam Deen S/o Zaroof Khan
	Muhammad Ashraf S/o Abdul Jabar
	Niamat Khan S/o Jan
	Jan Muhammad S/o Muhammad Meer
<b>Rattu</b>	Khalid Kursheed S/o Kursheed Ahmed
	Muhammad Saleem S/o Muhammad Akram
	Manzoor Ahmed S/o Karmat Ullaha
	Muhammad Arif S/o Muhammad Riaz
	Adem Sufah S/o Muhammad Ibrheem
<b>Mirmalik</b>	Abdul Queem S/o Abdul Kalig
	Shah Janha S/o Yahseen Malik
	Abdul Manan S/o Raj Muhammad
	Shahnar Malik S/o Mirza Malik
<b>Astore</b>	Abul Wad Loon S/o Abdul Wahab Khan
	Abdul Haleem KhanS/o Abdul Hakeem
	Fidh Muhammad S/o Yar Muhammad
	Abur Ruaf S/o Muhammad Shah
	Kafiat Ullaha S/o Sher Zaman

## ANNEXURE-2 TREES, SHRUBS, HERBS, GRASSES, AND FRUIT TREES IN THE REGION

### TREES

Scientific Name	Common Name/Local Name
<i>Pinus wallichiana</i>	blue pine/cheer
<i>Pinus macropoda</i>	chalghoza pine/tholesht
<i>Juniper marcopoda</i>	juniper/chilli
<i>Abies pindrow</i>	fir/rai
<i>Betula utilis</i>	birch/jongji
<i>Picea smithiana</i>	spruce katchal
<i>Salix tetrasperma</i>	willow/beyo
<i>Morus alba</i>	mulberry/toot/marooch
<i>Eleagnus angustifolia</i>	russian olive/ber, guner
<i>Juglans regia</i>	walnut/khakai
<i>Ailanthus altissima</i>	ailanthus/kikar
<i>Robinia pseudo Acacia</i>	robinia/kikar
<i>Plantanus orientalis</i>	chinar/bicchu
<i>Eucalyptus spp</i>	yukalipas/saffada
<i>Cupressus sempervirens</i>	sarru
<i>Populus alba</i>	safeda
<i>Populus ciliate</i>	poplar/thiruns
<i>Olea cuspidata</i>	kahu/zetoon
<i>Phoenix sylvestris</i>	Khajoor

### SHRUBS

Scientific Name	Common Name/Local Name
<i>Ribes alpestris</i>	goose berry/shumloo
<i>Tamarix gallica</i>	farash/hookaro
<i>Ribes grientale</i>	mehershot
<i>Rosa webbiana</i>	wild rose/shingie
<i>Lonocea spp.</i>	loni/barai
<i>Berberis igant</i>	berberry/ishkeen/kashmal
<i>Juniperus communis</i>	pencil cedar/matharee
<i>Traxacum</i>	ishkanachi
<i>Daphne oleoides</i>	nirko
<i>Rosa moschata</i>	jangli Gulab
<i>Salix Spp.</i>	bed
<i>Ficus igante</i>	phagwara/anjeer
N/A	dara
<i>Punica granatum</i>	anar/danu
<i>Agropyron caninum</i>	khharri
<i>Agrostis igantean</i>	joodar
<i>Dactylis glomerata</i>	karkan

## HERBS

Scientific Name	Common Name/Local Name
Artemisia aritime	Worm Seed/Zoon
Traxacum officinale	Dan delion/Ishkamachi
Aurtica dioica	Stinging nettle/Jomi
Capparis spinosa	Capper/Kabir
Ephedra intermediary	Armani butti/Soom
Coriandrum sativum	Coriander/Naski
Carthamus tinctorious	Safflower/Pung
Peganum harmala	Wild rue/Ispundur
Hippophae rhamnoides	Sea buck thorn/Buro
Rumex hastatus	Curled sock/Churki
Tribulus terrestris	Puncture vine/Khurkazal
Datura stramonium	Thorn apple/Datura
Chenopodium	Bathu/Kuna
Mentha sylvestris	Horse mint/Falee
Berberis lyceum	Barberry/Ishkeen
Cichorium intybus	Chicory/Ishkenagee
Trifolium repens	Trifolium/Shaftal
Ephedra spp.	Ephedra/Soom
Hippophae rhamnoides	Sea buckthorn/Buro
Lycopersicon esculentum	Tamatar
Luffa cylindrica	Tori

## GRASSES

Scientific Name	Common Name/Local Name
Cymbopogon martinii	Rosha
Cynodon dactylon	Khabbal
Stipa brevifolia	N/A
Dicanthium annulatum	N/A
Setaria italica	Ghass
Setaria pumila	N/A
Sorghum halepense	Baru
Arundo donax	Narri
Saccharum spontaneum	Kai



## FRUIT TREES

Scientific Name	Common Name/Local Name
Prunus armeniaca	Apricot/ Joiee
Pyrus malus	Apple / Phlaa
Pyrus communis	Pear / Nashpatee
Prunus persica	Aru
P. amygdalus	Badam
P. avians	Cherry
P. detasus	Cherry
Pyrus pashia	Batangi
Diospyrus lotus	Japani Phal / Amlok
Punica granatum	Anar / Dannu
Juglans regia	Walnut /Khakai
Elgeanus angustifolea	Russian Olive / Gonaer
Morus alba	Mulberry / marooch
Vitis vinifera	Anghoor



## ANNEXURE-3 SOCIO-ECONOMIC SURVEY QUESTIONNAIRES

### Social Survey Questionnaires SHOUNTRER ROAD AND TUNNEL PROJECT Socio-Economic Study

#### Village Profile

Year: \_\_\_\_\_    Questionnaire No. \_\_\_\_\_

Name of the Respondent: 1. \_\_\_\_\_ Father Name: \_\_\_\_\_

2. \_\_\_\_\_ Father Name: \_\_\_\_\_

3. \_\_\_\_\_ Father Name: \_\_\_\_\_

Q. 1: Village: \_\_\_\_\_ Q. 2: Union Counsel: \_\_\_\_\_

Q. 3: Valley: \_\_\_\_\_ Q. 4: Tehsil: \_\_\_\_\_

Q. 4: District: \_\_\_\_\_

Q. 5: Tribes in the Village: 1. \_\_\_\_\_ 2. \_\_\_\_\_  
3. \_\_\_\_\_ 4. \_\_\_\_\_

Q. 6: Languages Spoken: 1. \_\_\_\_\_ 2. \_\_\_\_\_  
3. \_\_\_\_\_ 4. \_\_\_\_\_

Q. 7: Distance from Gilgit to Village: \_\_\_\_\_ (Km)

Q. 8: Accessibility: 1. Metalled Road \_\_\_\_\_ 2. Un-metalled Road \_\_\_\_\_   
3. Track \_\_\_\_\_ 4. Others \_\_\_\_\_

Q. 9: Transport available in the village: 1. Public Transport \_\_\_\_\_ 2. Private Transport \_\_\_\_\_   
3. Pedestrian \_\_\_\_\_ 4. Other \_\_\_\_\_

Q. 10: Approximate area of the Village \_\_\_\_\_ (Km<sup>2</sup>)

Q. 11: Approximate population of the Village: \_\_\_\_\_ (Km<sup>2</sup>)

Q. 12: Total Houses in the Village: \_\_\_\_\_



Q. 13: Educational facilities Available in the Village.

Sr. No.	Facilities	Yes	No	Govt.	Private	Boys	Girls
(i)	Primary School						
(ii)	Middle School						
(iii)	High School						
(iv)	Deeni Madrassa						

Q. 14: Institutional Facilities Available in the Village.

Sr. No.	Facilities	Yes	No	Govt.	Private	Remarks
(i)	Hospital					
(ii)	Dispensary					
(iii)	Basic Health Unit					
(iv)	Post Office					
(v)	Mosque					
(vi)	Banks					
(vii)	Others					

Q. 15: Civic Facilities Available in the Village

Sr. No.	Facilities	Yes	No	Remarks
(i)	Lined Drainage System			
(ii)	Street Lights			
(iii)	Grocery Shops			
(iv)	Recreation/ Games Facilities (Clubs, grounds) Tourjen			
(v)	Medical Stores			
(vi)	Graveyards			
(vii)	Electricity			
(viii)	Telephone			
(ix)	Public Water Supply			
(x)	Others			

Q. 16: Source of water in the village

1. Water Supply	2. Nullah	3. Spring	4. Channel	5. Storage Tank
Q. 17: If	1. Lined		2. Partly	
				3. Kacha





Channel	<input type="text"/>	Lined	<input type="text"/>
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Q. 18: Nature of water supply in village

(1) Self Carried	<input type="text"/>	(2) Tapped	<input type="text"/>
(3) Partially Tapped	<input type="text"/>	(4) Other	<input type="text"/>

Q. 19: Common Disease in the village:

1. Common cold	<input type="text"/>	2. Diahorrea	<input type="text"/>	3. Typhoid	<input type="text"/>
4. Stomach Worms	<input type="text"/>	5. TB	<input type="text"/>	6. Malaria	<input type="text"/>
7. Goitoir	<input type="text"/>	8. Dysentery	<input type="text"/>	9. Hepatitis	<input type="text"/>

10. Other (Specify)

\_\_\_\_\_

Q. 20: Does any NGO exists in the village?

1. Yes ☐ 2. No ☐

Q. 21: If Yes, give detail

Sr. No.	Name	Objectives
1.		
2.		
3.		

Q. 22: Who has the ownership rights of the mountains, pastures, jungles and natural resources of the area?

1. Individual  2. Owner Tribes  3. Non-Owner Tribes

4. Other (Specify) \_\_\_\_\_

Q. 23: Who has the rights of selling and purchasing the agriculture land, residential and commercial property in village?

1. Individual  2. Owner Tribes  3. Anyone

4. Non-Owner Tribes

Q. 24: What are the preferences to sell the personal immoveable property like houses, agriculture land, shops etc. to:

1. Immediate Neighbor	<input type="text"/>	2. Owner Tribes	<input type="text"/>
3. Non-Owner Tribes	<input type="text"/>	4. Anyone	<input type="text"/>

Q. 25: Who are the influential in your village?

1. Head of the Tribes  2. School Teacher



3. Religious Scholars

4. Heads of Families

5. MNA/ MDC

6. Numberdar

7. Other (Specify)

Q. 26: How the matters related to property, dispute about the control and consumption of the natural resources of the area are settled?

1. Jirgah

2. Head of the Tribes

3. Council of Ulamahs

4. Heads of Families

5. Government Officials

6. Other (Specify)

Q. 27: Do rock carving/ historical places exit in the village or valley village?

1. Yes

2. No

Q. 28: If Yes, Give detail

Sr. No.	Name	Number	Location	
			In Village	Near Village
1.	Rock Carvings			
2.	Historical Ruins			
3.	Old Graveyard			
4.	Other			

Q. 29: Are there markets for grains and livestock in the village?

a. Grains

1. Yes

2. No

b. Livestock

1. Yes

2. No

Q. 30: If No, where do people sell their agricultural produce and livestock?

a. Near by  
village

b. Juglot

c. Gilgit

d. Rawalpindi/ Islamabad

e. Other Cities

Q. 31: What type of cottage industry exists in your village?

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_



Q. 32: What types of trees are in your village:

Sr. No	Fruit Trees			Sr. No	Non-Fruit Trees(Timber/ Firewood)		
	Name	Yes	No		Name	Yes	No
1.	Apple						
2.	Walnut						
3.	Mulberry						
4.	Apricot						
5.	Pomegranate						
6.	Peaches						
7.	Grapes						
8.	Almonds						
9.	Fig						
10.	Pear						
11.	Alucha						
12.	Locat						
13.	Oranges						
14.	Amblook						
15.	Others						

Q. 33: Disaster Management

Is there any system of disaster management at the village and nearby Government centre? 1. Yes 2. No

1. Yes

☐

2. No

☐

Q. 34: If Yes

Yes

No

a. Early warning system

☐

b. Quick evacuation of population and animals

☐

c. Shifting of human live stock, live stock and the other economic assets at safe places

☐

d. Temporary accommodation arrangement for affectees

☐

Q. 35: What are the prevailing of rates of the following in your area

1. Average fire wood price per 40 kg

2. Average Timber wood price per foot (sq)

3. Bullock or tractor per kanal/ per hour

4. Average harvest of timber per tree

5. Average labour rate per day in skilled worker

Skilled worker

Masson

Carpenter



6. Average green fodder gross price per 40 kg \_\_\_\_\_
7. Average dry fodder price per 40 kg \_\_\_\_\_
8. Average price of residential land per kanal \_\_\_\_\_
9. Average price of agricultural land per kanal \_\_\_\_\_
- Grazing land \_\_\_\_\_
- Uncultivated land \_\_\_\_\_
10. Average price of house in village \_\_\_\_\_
1. Katcha area \_\_\_\_\_ Price \_\_\_\_\_
2. Pacca area \_\_\_\_\_ Price \_\_\_\_\_

Q. 36: What are the major problems of your village

Sr. No	Types of Problems	Proposed Solution
1.		
2.		
3.		
4.		

Interviewer's Name: \_\_\_\_\_ Date: \_\_\_\_\_



## ANNEXURE-4 PROJECT TEAM OF ROAD AND SHOUNTER TUNNEL PROJECT

Sr.No.	Name	Proposed Postion	Role and Responsibility
1	Dr. Malik Yasir Sarfraz	Director Operations Mineral/ Environmental Expert	Teram Leader/ Technical Review
2	Raja Shahzad Akhtar	Environmental/Social Expert	Field Surveys, Collection of Environmental and Socio-economic Baseline, Stakeholder Consultation and Report writing
3	Abid Ali	Environmental Engineer	Socio-economic Study
4	Noman Ahmed Mir	Sociologist/Environmental	Socio-economic Study
5	Zulfiquar Ali	soil and noise Expert	Field study and Environmental Baseline.
6	Quratul ain	Gender Expert	Socio-economic/ Gender Study
7	Irfan Ali	Project Coordinator/Geologist	Coordination with client/Geological Study
8	M. Shafiq	Hydrologist	Hydrology Study
9	Zahid Ahmed	Water Pollution Expert	Geology and Hydrogeology
10	Muhammad Akram	Assistant Manager (Env.)	Field Surveys
11	Zahid Malik	Lab In charge	Technician
12	Mirza Ubaid	Irrigation Expert	Water and soil baseline
13	Nasir Ahmed	GIS Expert	Study maps development

## ANNEXURE-5 PHOTOGRAPHS OF CONSULTATIONS OF THE PROJECT AREA



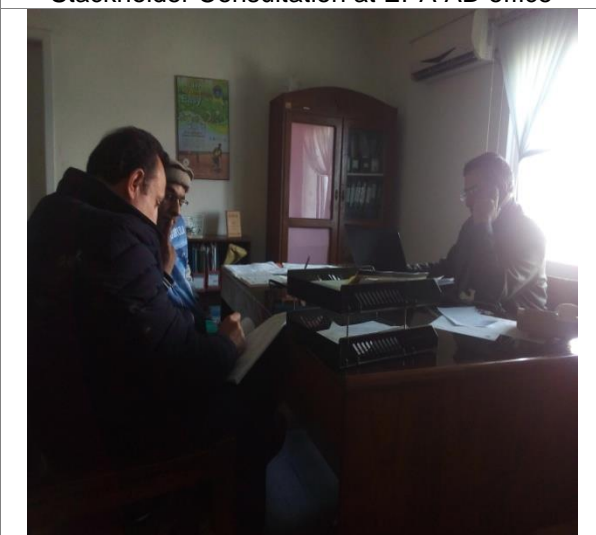
Environmental team During  
Stackholder Consultation at EPA Director office



Environmental team During  
Stackholder Consultation at EPA AD office



Environmental team During  
Stackholder Consultation at WWF office



Environmental team during  
Stackholder Consultation at WWF office



Consultant team at Forest office Astore  
during Stackholder consultation



Consultant team at Wildlife office Gilgit  
during Stackholder consultation

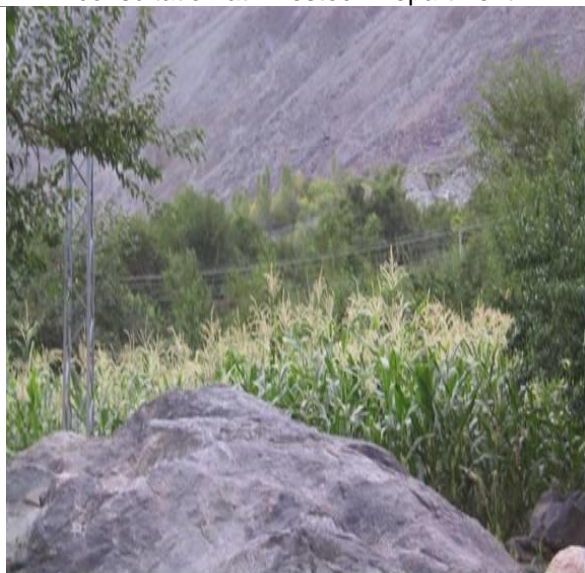




Consultant team during Stackholder  
consultation at Livestock Department



Consultant team during Stackholder  
consultation at Livestock Department



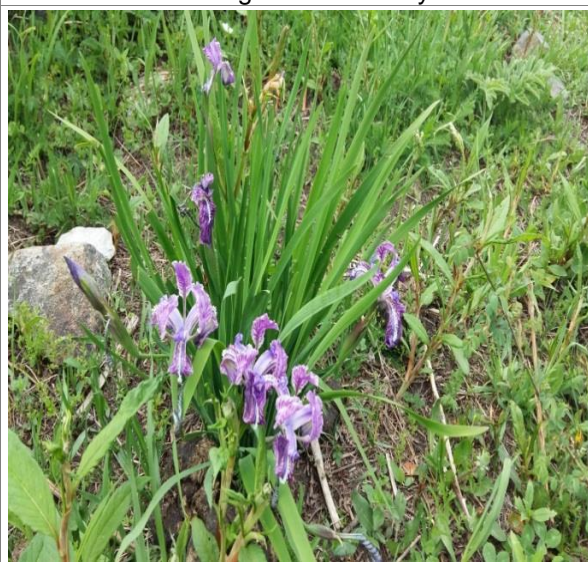
Agriculture crop observed at project area  
during baseline study



Agriculture crop observed at project area  
during baseline study



Flora species observed at project area  
during baseline study



Flora species observed at project area  
during baseline study

## ANNEXURE-6 DISASTER MANAGEMENT PLAN FOR THE PROJECT AREA

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### DISASTER MANAGEMENT PLAN

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#### GENERAL

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Disaster is an unexpected event due to sudden failure of the system, external threats, internal disturbances, earthquakes, fire and accidents. As per the disaster management act, 2005 "disaster" means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area".

#### OBJECTIVES

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The main objectives of the Disaster Management Measures for Shounter Tunnel and access road project are as follows:

- Save life and alleviate suffering
- Provide help to stranded passengers and arrange their prompt evacuation
- Instill a sense of security amongst all concerned by providing accurate information
- Protect property within the project area
- Expedite restoration of operation
- Lay down the actions required to be taken by staff in the event of a disaster in order to ensure handling of crisis situation in coordinated manner.

To ensure that all the officials who are responsible to deal with the situation are thoroughly conversant with their duties and responsibilities in advance. It is important that these officials and workers are adequately trained in anticipation to avoid any kind of confusion and chaos at the time of the actual situation and to enable them to discharge their responsibilities with alertness and promptness.

#### NEED FOR DISASTER MANAGEMENT MEASURES

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The effect of any disaster spread over in operational area of shounter tunnel is likely to be substantial as MEGA deals with many passengers daily in underground tunnels and other areas. Disaster brings about sudden and immense misery to humanity and disrupts normal human life in its established social and economic patterns. It has the potential to cause large scale human suffering due to loss of life, loss of livelihood, damage to property, injury and hardship. It may also cause destruction or damage to proposed project infrastructure, buildings and communication channels of the project area. The contractor should be provided an efficient disaster management plan for the start of the project activity in the collaboration of District Disaster Management Authority Astore GB.

- The first step is to identify the causes which develop/ pose unexpected danger to the structural integrity due to construction.
- The most critical component of the project is the tunnel, hence a detailed tunnel design including tunnel safety measures have been attached as Annexure-9;
- The potential causes are excessive load, cracks, failure and malfunctioning of sensing instruments, accident, etc. These need to be looked into with care.





## ANNEXURE-7 GLACIER MANAGEMENT PLAN OF THE PROJECT AREA

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### GLACIER MANAGEMENT PLAN

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#### INTRODUCTION

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This plan is describes the method and management disposition of the glaciers sectors that must be removed during the construction of the shounter tunnel and access road within ROW. During the field visit the local community informs about glaciers. From Shounter to Gorikot reach many glaciers exist on different locations in winter season. These all glaciers must be removed and adequately managed to avoid the instability of slopes and environmental impacts. The thickness of the glacier sectors that must be removed from the site areas before construction of proposed project activities.

#### METHODOLOGY

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The methodology previously described has the following advantages:

- The controlled method permits minimizing the removal of glacier to the least necessary, according to the advancement of the area.
- The chunks of glacier removed shall be positioned similarly to their original position and basically within the same basin, minimizing the hydrological effects.
- No acid water problems are generated (or accentuated) due to the meeting of the chunks of ice removed.

#### DISPOSAL CHARACTERISTICS OF THE SITES

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The sites for disposal of the chunks of glaciers shall comply with the following conditions:

- They shall be located at a similar or slightly lower altitude than their original position.
- They shall not be destined to other works, infrastructure, or project development, nor shall they compromise the safety of these if they are located downstream of the pit.
- Preference shall be made for sites of low inclination, to minimize the possibility of down slope shifting. In the pit vicinity there is ample relative level terrain to dispose of the glacier chunks.
- Notwithstanding the above, retention walls (breams) shall be introduced and/or machinery shall level the terrain at the extremes, “downstream”, to retain eventual ice collapse and avoid down slope slippage.
- No gorge floors shall be used or sectors that might present significant surface water flow during the periods of ice melt.
- The characteristics of the terrain or rock surface shall be similar to original sites (prioritizing the same geological formations and geomorphologic configuration).

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## MANAGEMENT PLAN

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- The glacier area that must be removed will be determined with the necessary anticipation according to the updated mining plan.
- The mining equipment shall be employed as needed for each glacier area to be managed (basically bulldozers and/or front loaders).
- The chunks of glacier shall be removed with the mentioned machinery until the surface is clear (principally rock).
- If necessary, controlled explosives shall be used, of small size, to remove the ice.
- The chunks of ice that come apart and that are removed, until the level of the terrain is reached, shall be “pushed” or transported by the same mining machinery to an adjacent area, nearby but outside of the boundaries of the development of the pit.

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## RESPONSIBILITIES

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- The definition of the glacier area removal program shall be incorporated to the mine development plan.
- The specific Departments in addition to the Department of Health, Safety and Environment of National Highway Authority, shall participate in the definition of the sites for glacier disposition, which shall approve the determined sites.
- The Department of Health, Safety and Environment of National Highway Authority, shall supervise the loading, transport and final disposal of the glacier.
- The monitoring of the safety conditions of the glacier shall be informed frequently to the Management of the project and to the competent authorities.

## ANNEXURE-8 DUMPING SITES

### GENERAL

The identification of muck disposal areas is done in line with the topographic and site specific conditions. Muck is to be dumped in 04 pre-identified sites (**Figure1, 2, 3 and 4**). The quantity is muck to be accommodated at each site. The Shounter-Rattu Road Tunnel will generate substantial quantities of rock spoil while tunnel excavating. Large quantity of material would be excavated from the road and tunnel. Muck generated from excavation of any project component is required to be disposed in a planned manner so that it takes a least possible space and is not hazardous to the environment. An account of the same has been given in the following paragraphs.

### DUMPING SITES SELECTION CRITERIA

Based on the geological nature of the rocks and engineering properties of the soil, a part of the muck can be used as construction material. However, the balance requires being suitably disposed. In the proposed project, the large quantity is to be reused as backfilling material, soling, aggregate /protection works, leveling of material storage area, workshop & stores, office, Temporary colony and contractor colony etc. and also is to be used is to be disposed at muck disposal sites, with a total area.

The following points were considered and followed as guidelines for finalization of the areas to be used as dumping sites:

- The dumping sites have been selected as close as possible to the project area to avoid long distance transport of muck.
- The sites are free from active landslides or creep and care has been taken that the sites do not have a possibility of toe erosion and slope instability.
- The dumping sites are either at higher level than the flood level or are away from the stream/Nullah so that the possibility of muck falling into the stream/Nullah is avoided.
- There is no active channel or stream flowing through the dumping sites.
- The sites are far away from human settlement areas.
- The dumping sites have been selected away from the any Glaciers.

The selection of muck disposal sites was done based upon site inspections and available best conditions of the land availability, land stability, accessibility from the portals, sloping pattern, minimum vegetative and tree cover, away from any ecological sensitive area, river/stream/Nullah bed conditions and away from high flood levels and also any glaciers. After surveys four suitable sites were identified located at up and down area of the tunnel and road which satisfy above criterion (images - 3, 4, 5 and 6). Total capacity of muck disposal areas is more than total quantity of unused muck to be disposed. The unused excavated material would be piled at the proposed dumping sites. This will be done to provide stability to the slopes and also to provide ample space for planting of trees which would further help in holding and consolidation of the material stacked at the proposed dumping sites.

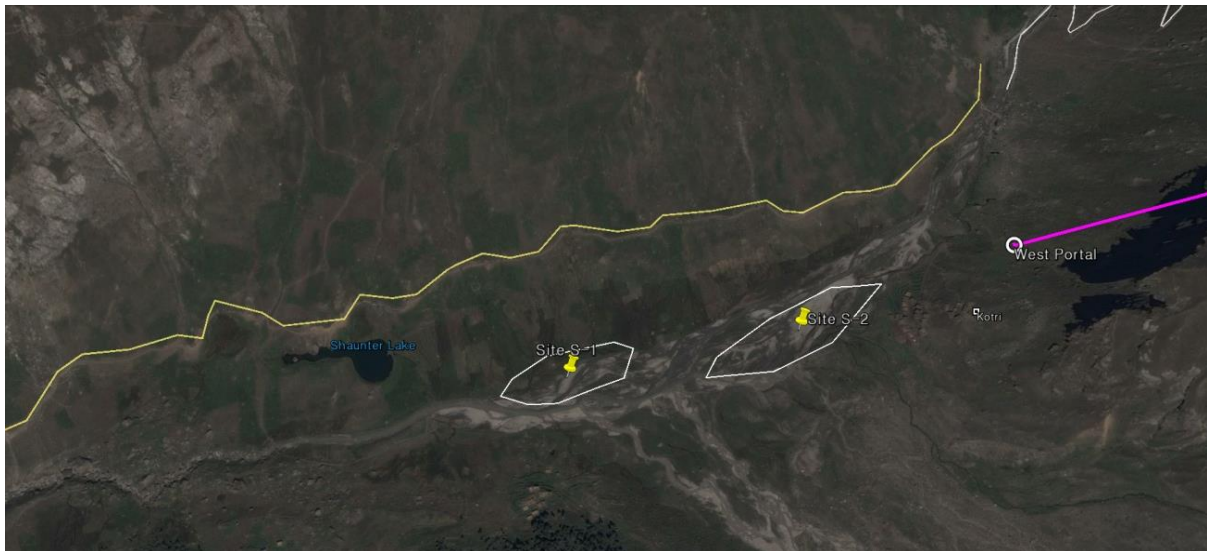
The muck that needs disposal would be piled at the proposed dumping sites. For this, the slopes would be broken up by creating benches across the slope. This will be done to provide stability to the slopes and also to provide ample space for planting trees, which would further help in holding and

consolidating the material stacked at different sites. The description regarding the stabilization of the stacked material along the proposed road has been discussed in the following paragraphs.

The muck is expected to be comprised of fragmented rock mixed with soil. The options like dumping muck in stages and allowing it to consolidate/settle through the monsoon, compacting the dumped muck with Dozer movement, zoning the dump judiciously to ensure the stability of slope under all superimposed conditions will be utilized.

## SHOENTER SIDE

Image 3- Location and Description of Site S-1



Location: E455947.27 m, N3870188.33 m; Elevation: 3,084m; Area: 19,900 m<sup>2</sup>

Image 4- Location and Description of Site S-2



Location: E 456398.84 m, N 3870323.75 m; Elevation: 3,088m; Area: 29,500 m<sup>2</sup>



## RATTU SIDE

Image 5- Location and Description of Site R-1



Location: E 471263.69 m, N3874304.63 m; Elevation: 3,252m; Area: 218,400 m<sup>2</sup>

Image 6- Location and Description of Site R-2



Location: E472790.58 m, N3875255.57 m; Elevation: 3,142m; Area: 168,700 m<sup>2</sup>

## METHODOLOGY OF DUMPING

The main objectives of process of muck dumping and restoration of these muck disposal sites are:

- To protect and control soil erosion;
- To create greenery in the muck disposal areas;
- To improve and develop the sites into recreational sites;

- To ensure maximum utilization of muck for the construction purpose;
- To develop the muck disposal sites/ dumping yards to blend with the surrounding landscape; and
- To minimize damages due to the spoilage of muck in the project area.

A scientific approach and methodology was followed for identification of the dumping sites. All possible alternate sites were inspected and examined before rejecting or selecting any site. All the dumping sites are:

- With minimum possible forest cover.
- The populated /settlement areas are away from the identified dump zones and therefore will be least impact on human life.
- Sites are either at higher level than the flood level from the river course to provide protection from high flood.
- Muck sites are close to the project area to avoid hazards related to transport of muck to long distances.
- Dumping sites are away from the any glaciers.

---

## DUMPING PROCESS

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The generated muck will be carried in dumper trucks covered with heavy duty tarpaulin properly tied to the vehicle in tune with international practice. All precautionary measures will be followed during the dumping of muck. All dumpers will be well maintained to avoid any chances of loose soil from being falling during the transportation. All routes will be periodically wetted with the help of sprinklers prior to the movement of dump trucks. Dumping would be avoided during the high speed wind, so that suspended particulate matters (SPM) level could be maintained. Further, the dumping will be avoided during heavy traffic. After the dumping the surface of dumps will be sprayed with water with the help of sprinklers and then compacted.

A retaining wall shall be constructed prior to dumping of muck. Loose muck would be compacted layer-wise. The height of usage/ Gabion Wall is proposed to be 4.5 m on an average. The muck brought by dumpers will be spread in layers behind the wire crate walls and then compacted by rollers till the top level is achieved. The retaining/sausage wall shall be laid with proper berm and the muck dumped behind it in layers and compacted by rollers. The process shall be repeated up to 50 cm level below the desired height which shall be laid with good soil for providing grass cover. At a regular vertical interval of 1.5 m and 3.0 m c/c masonry drains (catch water drains) shall be provided to drain off the rain water. Proper fencing of the entire area will be done.

The muck disposal area will ultimately be covered with fertile soil and suitable plants will be planted adopting suitable bio-technological measures. The project authorities would ensure that the dumping yards blend with the natural landscape by developing the site with gentle slope, patches of greenery in and around them. These sites can also be developed later as recreational parks and tourist spots with sufficient greenery by planting trees.

The Rehabilitation plan of muck dumping sites includes engineering and biological measures. Most of the total unused excavated muck would be placed at an angle of repose to avoid any slippage of the muck at the proposed dumping sites. Besides, required quantity would be stacked along the roads, which would be utilized either in widening of the road or in newly constructed roads. In the former case slopes would be broken up by creating benches across the slope. This will be done to provide stability to the slopes and also to provide ample space for planting of trees which would further help in

holding and consolidating the material stacked at different sites. As stated earlier, efforts will be made to dispose the muck within short distances from sites of its generation.

The capacity/volume of the muck dumping sites is more than the volume of the muck to be disposed. All measures would be adopted to ensure that the dumping of muck does not cause injury or inconvenience to the people or the property around the area. The spillage of muck into the stream/Nullah at any site would be prevented by making concrete retaining walls to retain the muck pile. It shall be ensured that dumping is carried out at a minimum distance of 30 m away from the active stream/Nullah bank. The top surface would be leveled and graded after the capacity of any dumping site is exhausted. The top surface will be covered with soil and grass seeding will be ensured to promote vegetation cover.

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## REHABILITATION OF SPOIL DUMPS

---

The project authorities would ensure that the dumping yards blend with the natural landscape to develop the sites with gentle slopes, bunds, terraces, water ponds, and patches of greenery in and around them. These sites can also be developed later as recreational parks and tourist spots with sufficient greenery by planting ornamental plants. The re-vegetation of dumping yards through 'Integrated Biotechnological Approach' would be undertaken. It may be necessary to inoculate the spoil dumps for development of landscape as the soils would be poor in nutrients. This can be developed through culture of microorganism or vermiculture practices at the nurseries developed for this purpose. This task can be undertaken by Forest Departments, Government of AJ&K and GB. All the spoiled areas will be developed as per the latest technology of dumping, impact of rain, time and angle of soil setting. In addition sprinkling of water may also be resorted to, if required to avoid or minimize dust pollution. Proper drainage system also has to be provided to ensure unobstructed flow of runoff. Planting with suitable species of trees, shrubs and other biomass will also be initiated. The following engineering and biological measures have been proposed for the development of spoiled areas.

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## ENGINEERING MEASURES

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For stacking of dumped material retaining wall is proposed to be built before dumping of any material on to the sites. The retaining walls would be required to be built wall (Muck Dumping Areas. In addition, leveling would also be done after dumping the material on every cycle and simultaneously improving the drainage of the disposal site. The approach roads to various project structures will be constructed by ESMPloying the methodology recommended by Border Roads with minimal environmental damage. The methodology consists in developing the formation width is half cutting and half filling, so that the materials obtained from cutting are utilized in filling. The excavation on hill side will be done to get a stable slope for the materials encountered. At places breast wall, gabion walls shall be done in natural slope to retain filled material, particularly where there is problem of retaining the hill slope.

In case of steep gorge, retaining wall and gabion structure shall be constructed to retain filled material. To minimize the environmental damage, construction material like stones, sand, etc., required for the construction of road will be obtained mostly from the excavated material. In the streams, box culverts will be provided to prevent the erosion of Nullah bed. In addition, stone/concrete work on the down area and the area will also be provided at vulnerable places to minimize erosion.

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## RETAINING WALLS

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Total area is the dumping of muck which can accommodate whereas the estimated muck to be disposed is less than. The total length of retaining wall proposed to be constructed along the stream/Nullah. The height of these retaining walls including MSE wall panels will be approximately 4.5m.

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## COMPACTION & LEVELING

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Compaction is an engineering measure, which would reduce bulk density of the muck thereby optimizing the use of muck disposal area and would make it suitable for the plantation and other biological measures. Top surface would be levelled and graded to make the alternative use. The muck will be spread in 50 cm thick layers. Top surface would be levelled and graded to make the alternative use. On top a layer of soil would be spread to make the land suitable for plantation.

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## FENCING

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Fencing is a bio-engineering measure. After rehabilitation of muck the dumping areas need protection for some time from disturbing by human and domestic animals. For this reason fencing over the muck deposits is required. Barbed wire strands with two diagonal strands, clamped to wooden/ concrete posts placed at 3 m distance are proposed around the dumping piles. PESMU will establish temporary wind barriers around 3 sides of dumps in close of settlement area.

The disposable muck is proposed to be dumped at 3 pre-identified sites up and down area of the project area. The muck is proposed to be filled in layers properly compacted. A PCC base would be provided for the toe wall. In addition catch water drains are also proposed to be built and leveling of soil would also be done after dumping the material on every cycle and simultaneously improving the drainage of the disposal site.

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## BIOLOGICAL MEASURES

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Top surfaces and slopes of all dumping areas would be left with a total area. These areas will be treated for the purpose of plantation. Vegetation cover controls the hydrological and mechanical effects on soils and slopes. Therefore, biological measures to stabilize the loose slope are essential. In order to implement the biological measures in dumping areas the following activities would be taken into account. The biological measures include the following:

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## SOIL TREATMENT

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Muck dumped at various sites is not considered to be nutrient rich as it is excavated from tunnels, road and other structures. In order to make it suitable for the plantation it will be provided bio treatment. The work plan will be formulated for re-vegetation of the dumping sites through Integrated Biotechnological Approach.

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## PLANTATION

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The selected species will be planted after their nurseries have been developed. The dumping areas are very small therefore; separate nursery would not be required. The nurseries developed for the implementation of plan can be used for the rehabilitation of dumping areas. Nearly 1-2 years old saplings would be used for the plantation. The plantation can be carried out in lines across the slopes. Grass and native species would be used in the inter space of tree species. They will help in providing



the continuous chain of support in retaining debris, reinforcing soil and increasing the infiltration capacity of the area. After the process of compaction total area will be available for the plantation. About 10,000 saplings will be planted at these dumping sites. In order to stabilize the stacked dumped material, vegetation cover would be provided to hold dumped material over a period of time. Following steps are envisaged:

- The Plantation of suitable tree species and soil binding were using bio-fertilizer technology.
- The Turfing was the exposed area and improvement of environment with ornamental species.
- The Protection was with mechanical support.
- The Social fencing was through mass public awareness.

The work plan formulated for re-vegetation of the dumping sites through 'Integrated Biotechnological Approach' is based on following parameters:

- Evaluation of dumped material for their physical and chemical properties to assess the nutrient status to support vegetation.
- Formulation of appropriate blends of organic waste and soil to enhance the nutrient status of rhizosphere.
- Isolation and screening of specialized strains of mycorrhizal fungi, rhizobium, azotobacter and phosphate solubilizes (bio fertilizers inoculum) suitable for the dumped material.
- Mass culture of plant specific bio fertilizer and mycorrhizal fungi.
- Plantation of dumping sites using identified blend and bio fertilizer inoculum.

The afforestation with suitable plant species of high ecological and economic value which can adapt to local habitat will be undertaken and depending upon the canopy cover required.

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## MONITORING & COMPLIANCES

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Muck shall be dumped from bottom in layers of 50-70 cm depending on size of boulders.

- Each layer shall be rolled compacted.
- A layer of soil shall be spread on top of it to make it suitable for plantation.
- Water testing facilities shall be set up for checking quality parameter of water.
- Soil samples shall be regularly collected and tested for checking the level of contamination.
- Prescribed norms and approvals will be sought, wherever necessary.
- All norms of Forest department, and their acts related to muck disposal shall be complied with.
- Design consultant shall be engaged for designing of retaining structures.

Plantation shall be done on the reclaimed land and native variety of plants and trees shall be planted.

## ANNEXURE-9 PHOGRAPHS OF ENVIRONMENTAL MONITORING



**Ambient Air Quality Monitoring**



**Water Sampling**



**Noise Level Monitoring**





## ANNEXURE-10 AMBIENT AIR QAUALITY, WATER AND NOISE MONITORING RESULTS

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## ANNEXURE-11 REPORT MAPS & IMAGES

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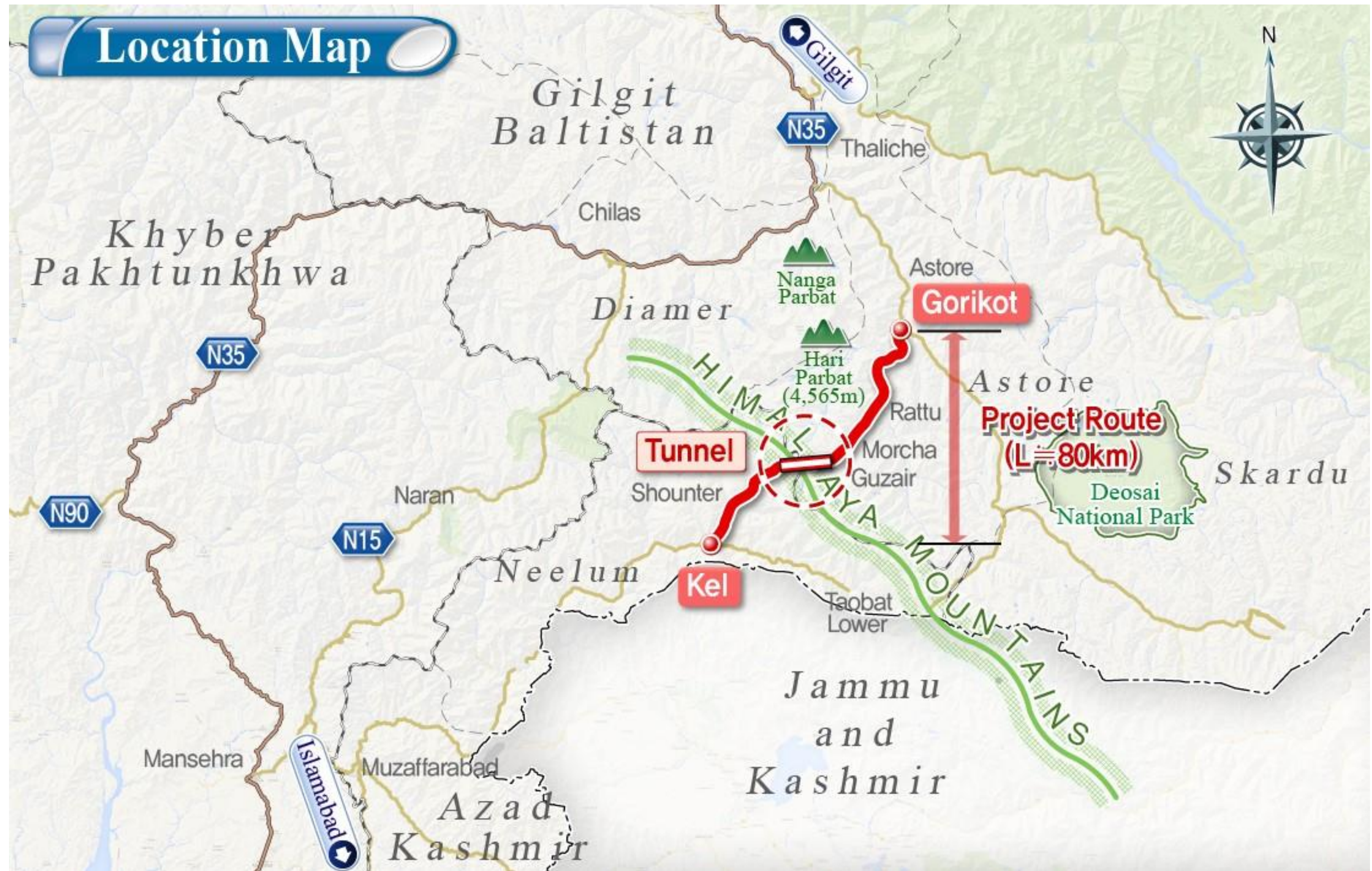


Figure 1.1: Project Location Map



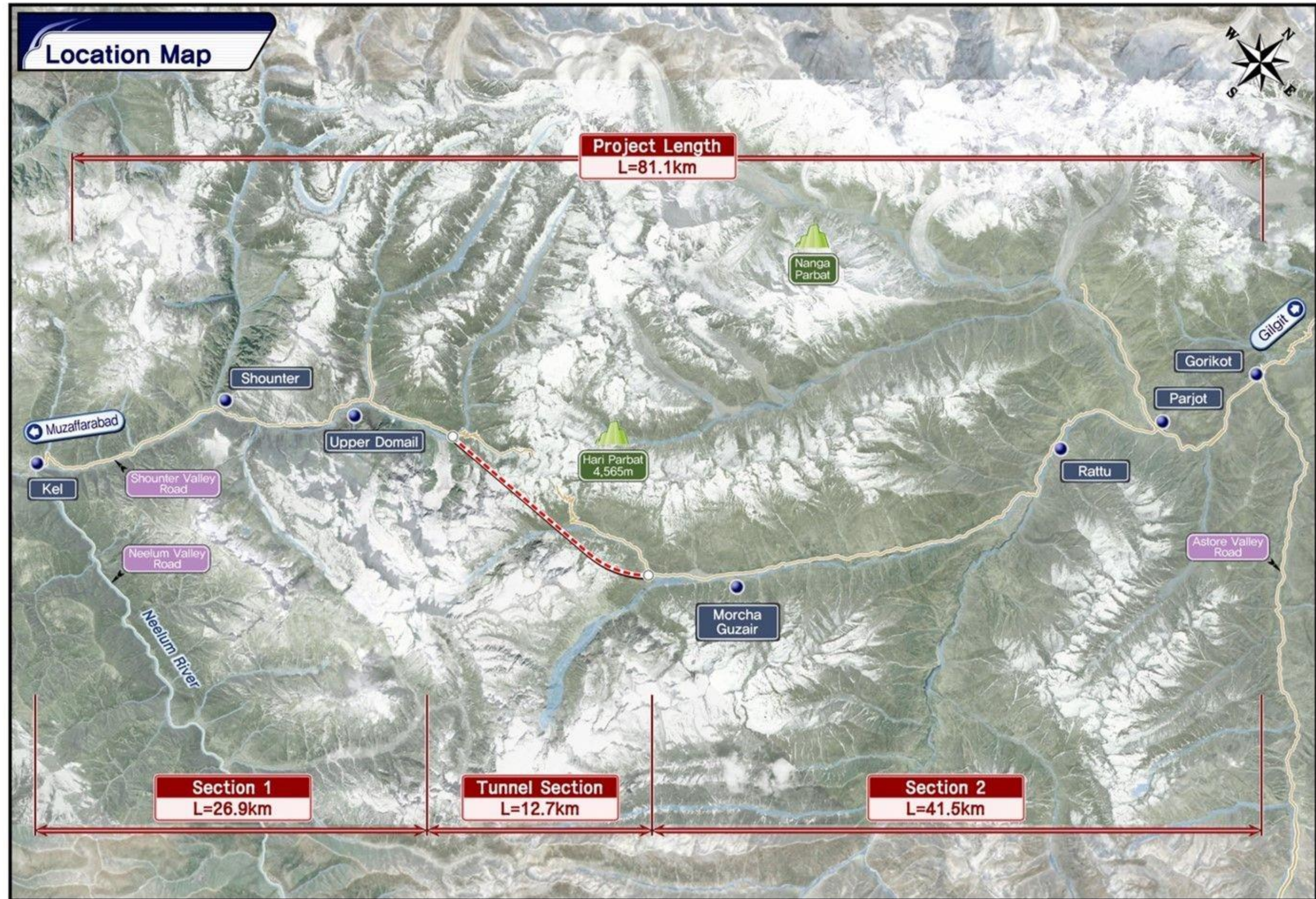
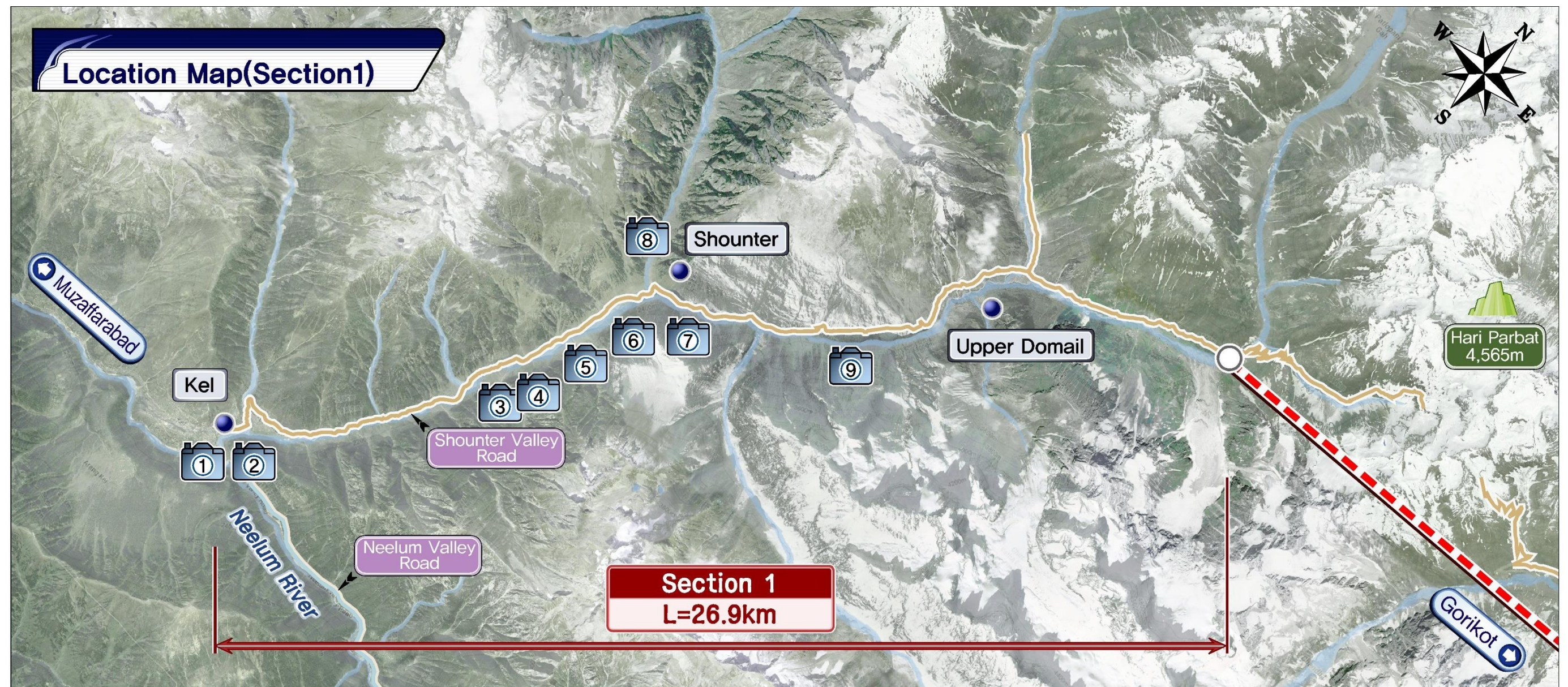


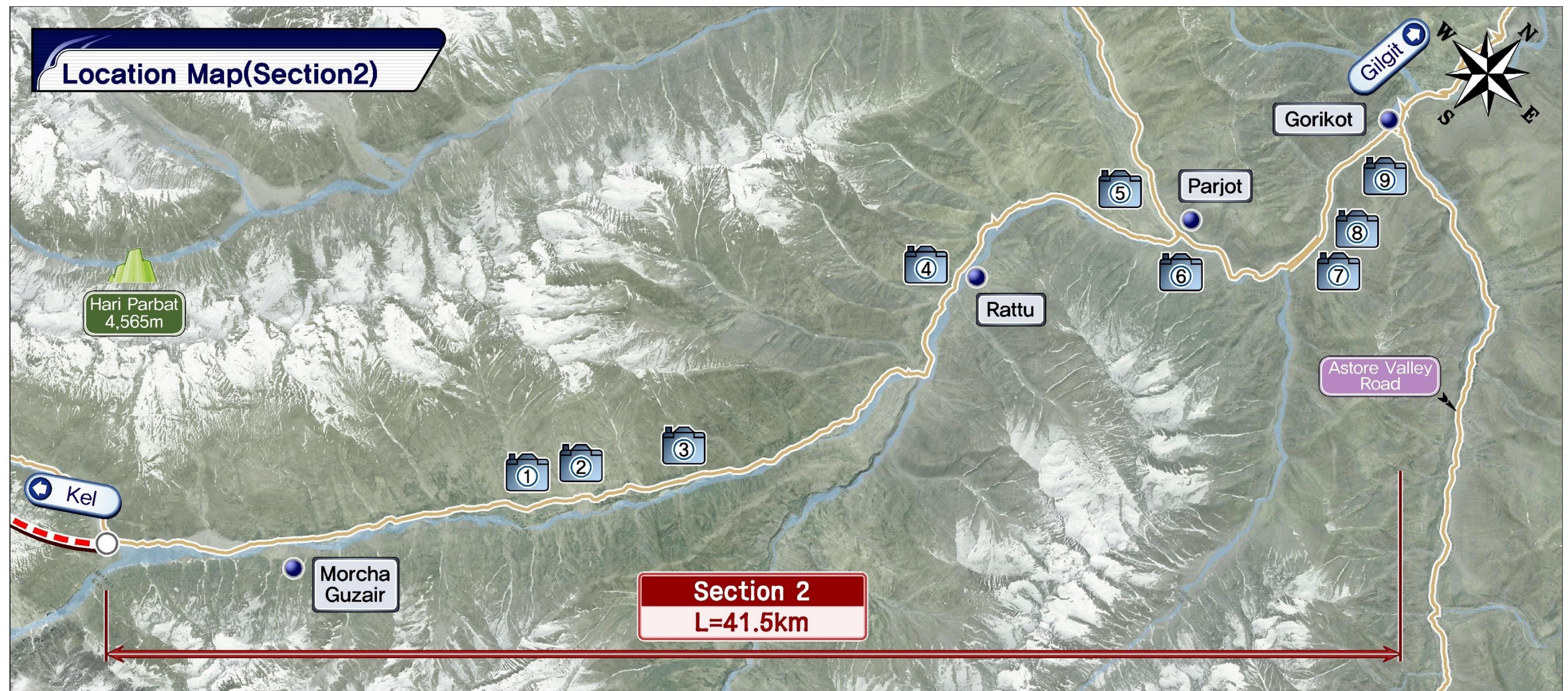
Figure 1.1: Proposed Project Location Map





SECTION 1 (KEL ~ SHOUNTER ~ UPPER DOMAIL ~ WEST PORTAL OF THE TUNNEL)





SECTION 2 (EAST PORTAL OF THE TUNNEL ~ MORCHA GUZAIR ~ RATTU ~ GORIKOT)



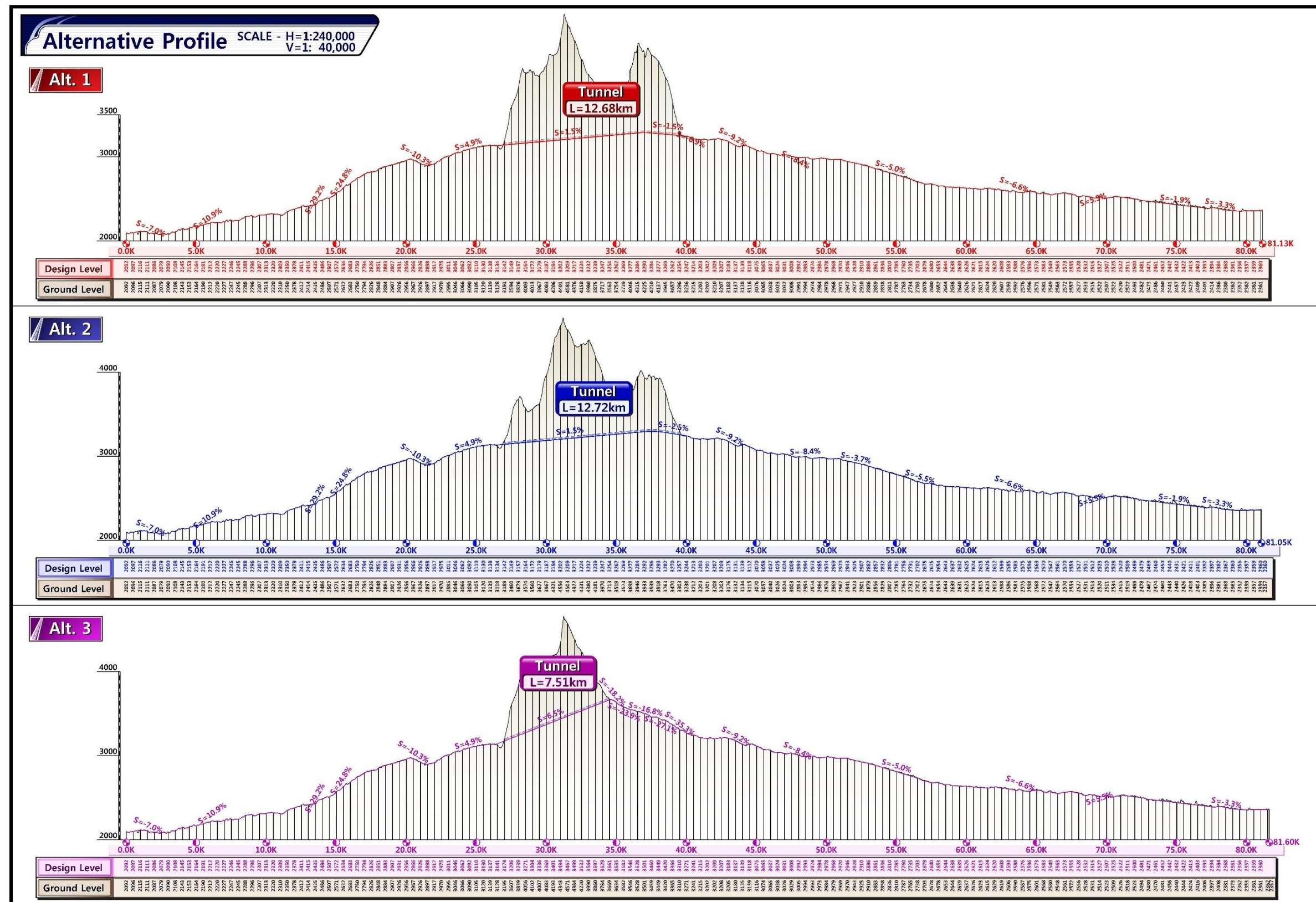


Figure 3- Alignment Drawings Options of Proposed Tunnel Project and Access Road



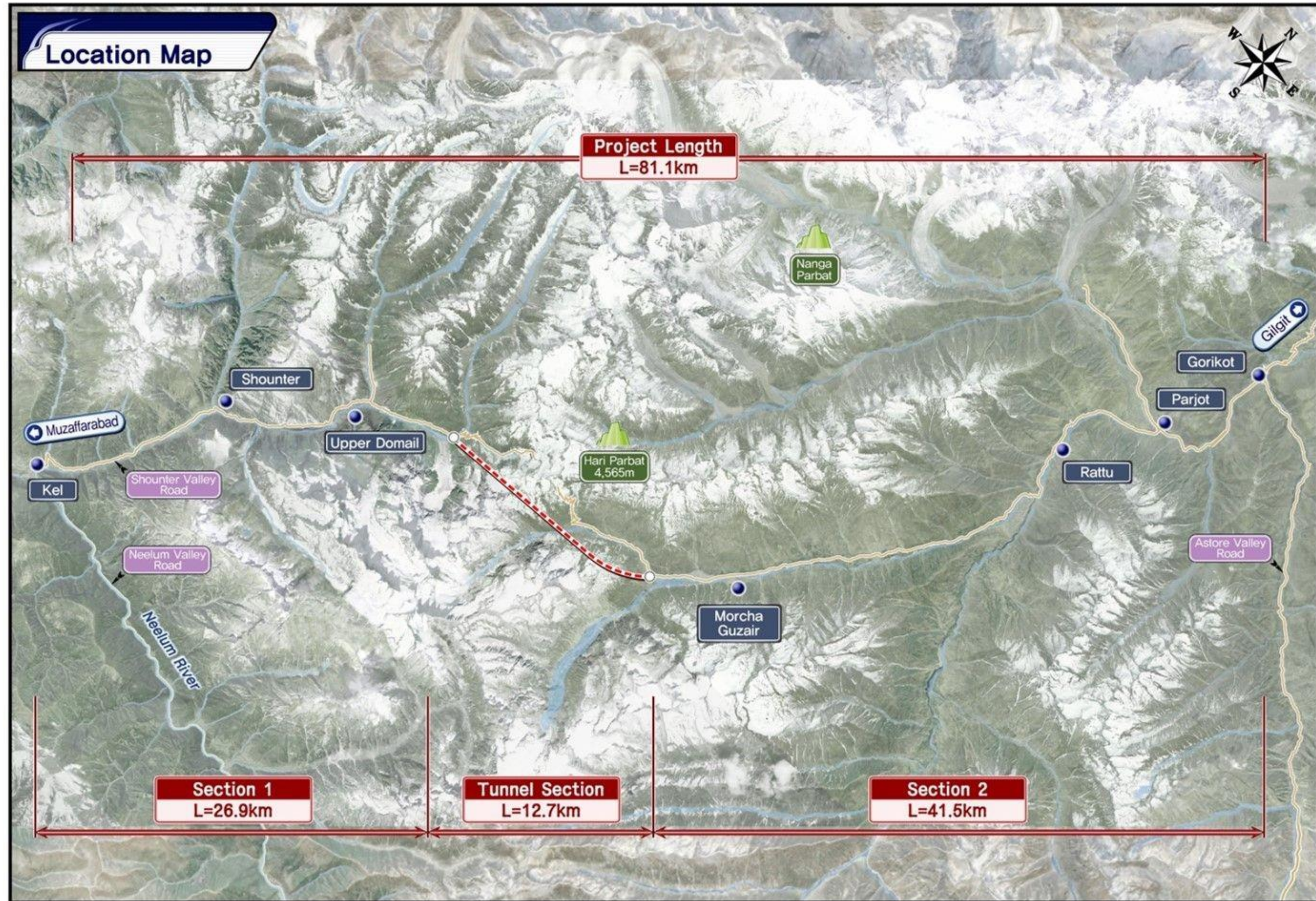
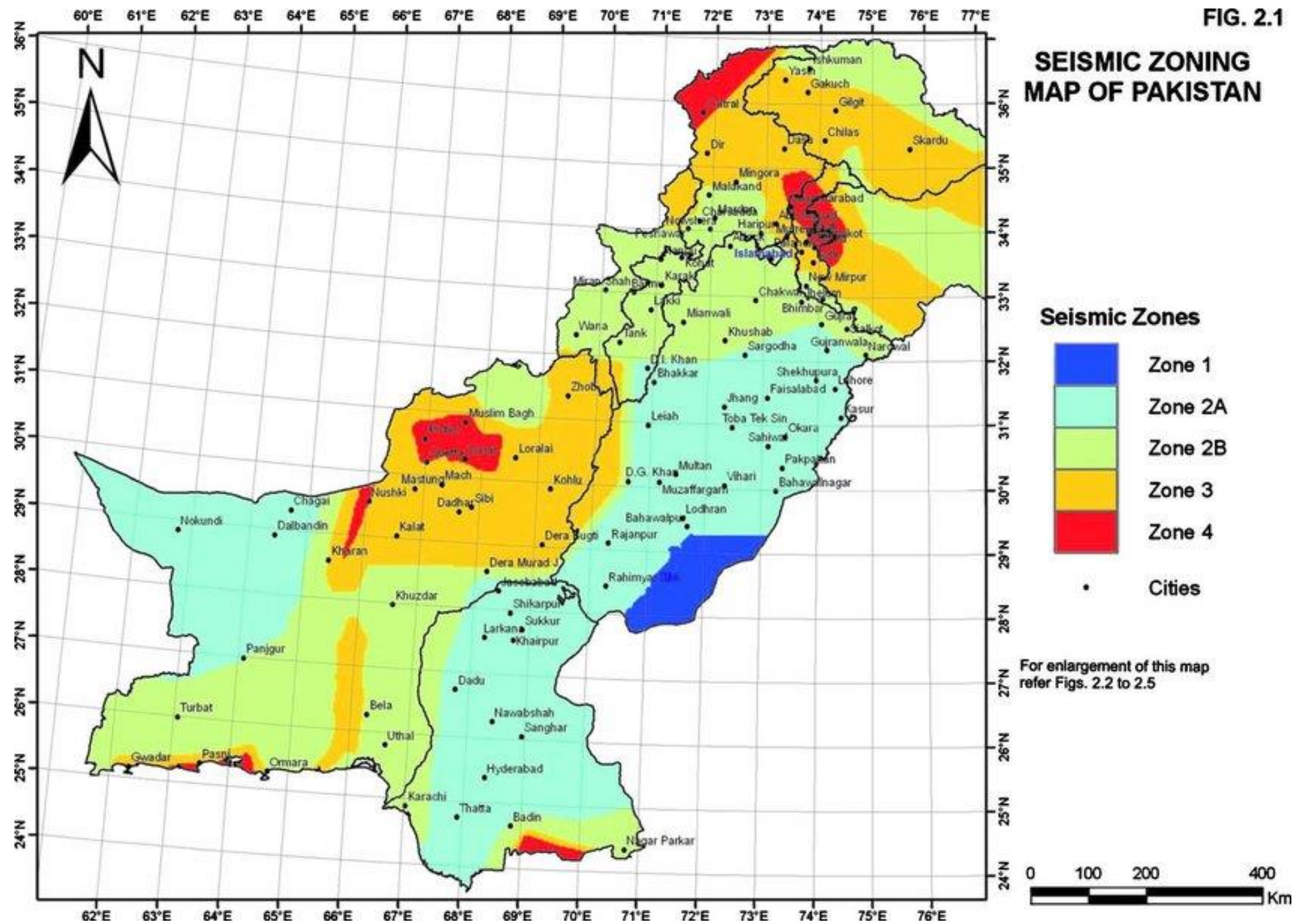


FIGURE-4 PROPOSED PROJECT LOCATION MAP





MAP 2- SEISMIC ZONING MAP OF PAKISTAN



**Dohwa Engineering Co., Ltd. Republic of Korea**

in association with

**Prime Engineering & Testing Consultants (Pvt) Ltd, Pakistan**

