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**The Administration of the Union Territory of Ladakh
PWD (R&B)**



Project:

Detailed Project Report (DPR) for preparation of various Road/Tunnel projects of Public Works (R&B) Department, UT of Ladakh - Highway tunnel across Fotu La Pass (1.7 Km approx.) along with its approaches on Zojila - Leh –Kargil Road

Subject:

**FOTULA TUNNEL
ENVIRONMENTAL ASSESSMENT
REPORT
VOLUME -3**

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Table of Contents

1	<u>THE PROJECT</u>	8
1.1	<u>Introduction</u>	8
1.2	<u>Scope of Consultancy Services</u>	9
1.3	<u>Project Background</u>	9
1.4	<u>Objective of the Assignment</u>	10
1.5	<u>Approach and Methodology</u>	10
2	<u>POLICY, LEGAL AND INSTITUTIONAL REQUIREMENTS</u>	11
2.1	<u>Environmental Policy Framework</u>	11
2.2	<u>Legal Policy</u>	11
2.2.1	<u>Environment Protection Act</u>	12
2.2.2	<u>Environmental Clearance Process</u>	13
2.2.3	<u>The Forest (Conservation) Act</u>	15
2.2.4	<u>Wildlife Protection Act</u>	15
2.2.5	<u>Water and Water Pollution</u>	16
2.2.6	<u>Air Quality</u>	16
2.2.7	<u>Noise Quality</u>	17
2.2.8	<u>Solid Waste Management</u>	17
2.2.9	<u>The Ancient Monuments and Archaeological Sites and Remains Act, 2010</u>	17
2.2.10	<u>The Building and Other Construction Workers Act, 1996</u>	18
2.2.11	<u>Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RTFCT-LARR) Act, 2013</u>	18
2.2.12	<u>National Environment Policy, 2006</u>	20
2.3	<u>Institutional Framework</u>	21
2.3.1	<u>Central and State Pollution Control Boards</u>	21
3	<u>PROJECT DESCRIPTION</u>	22
3.1	<u>Introduction</u>	22
3.2	<u>Salient Features of Existing Road</u>	23
3.3	<u>Tunnel System Recommendation</u>	23
4	<u>ENVIRONMENTAL AND SOCIAL BASELINE DATA</u>	25
4.1	<u>General</u>	25
4.2	<u>Land Environment</u>	25
4.2.1	<u>Physiography</u>	26
4.2.2	<u>Geology</u>	26
4.2.3	<u>Soils and Minerals</u>	26
4.2.4	<u>Seismicity</u>	27
4.3	<u>Water Environment</u>	27
4.3.1	<u>Water Resources of the Districts</u>	27
4.3.2	<u>Water Quality of the Project Area</u>	28
4.4	<u>Ambient Environment</u>	29
4.4.1	<u>Climate</u>	29
4.4.2	<u>Air Quality</u>	29
4.4.3	<u>Noise Environment</u>	30
4.5	<u>Ecological Environment</u>	30

4.5.1	Forest	30
4.5.2	Natural vegetation	31
4.5.3	Natural fauna	31
4.5.4	Agro-Ecosystem in study area	32
4.6	Socio-Economic Profile	32
4.6.1	Demography	32
4.6.2	Literacy and Education	34
4.6.3	Work Participation	34
4.6.4	Other Demographic Indicators	35
4.7	Households Profile of Project Influence Area	35
4.7.1	Gender Ratio	36
4.7.2	Age Group	36
4.7.3	Marital Status	37
4.7.4	Educational Attainment	37
4.8	Economic Conditions	39
4.8.1	Main occupation of Household Members	39
4.8.2	Marginal Occupation of Household Members	40
4.9	Household Monthly Income	40
4.9.1	Household Monthly Expenditure and Distribution	40
4.10	Social Characteristics	41
4.10.1	Religious and Social Groups	41
4.10.2	Family Pattern and Family Size	41
4.11	Economic Indicators	42
4.11.1	Possession of Household Assets	44
4.11.2	Gender Issues	44
4.11.3	Indebtedness of Households	44
4.11.4	Health Seeking Behavior	44
4.11.5	Awareness about HIV/AIDS	45
4.12	Perceived Benefits about the Project	45
5	ENVIRONMENTAL IMPACTS	46
5.1	Impact Identification	46
5.2	Impact on Natural Environment	47
5.3	Impact on Land Environment	47
5.3.1	Change of Land Use Pattern	47
5.3.2	Impact on Soil	47
5.3.3	Soil Erosion	48
5.3.4	Borrow/Quarry Areas	48
5.3.5	Muck Disposal	48
5.3.6	Impact due to Snow Avalanche	48
5.3.7	Risk due to Seismicity	49
5.4	Air Environment - Impacts	49
5.4.1	Impact during Construction	49
5.4.2	Impact during Operation	49
5.5	Impacts on Water Environment	49
5.5.1	Change in Natural Drainage Pattern	50
5.5.2	Pollution at Construction Site	50
5.5.3	Health Risks due to Waste Disposal	50
5.5.4	Water requirement for project	50
5.5.5	Water Quality	50

5.6	Impact on Noise Environment	51
5.6.1	Impact during Construction	51
5.6.2	Impact during Operation	52
5.7	Impact on Ecological Environment	53
5.7.1	Loss of Biomass	53
5.7.2	Forest & Wildlife	53
5.8	Other Impacts	53
5.8.1	Impact due to Hazardous Waste	53
5.8.2	Impacts due to Labour Camps	53
5.8.3	Welfare of Labour on construction site	54
5.8.4	Safety of Labour	54
5.8.5	Vibration Impacts	54
5.9	Socio-Economic Impacts	54
5.9.1	Potential Social Impacts	54
5.9.2	Health Impacts	54
5.9.3	Pressure on Existing Infrastructure	54
5.9.4	Cultural Conflicts	55
5.9.5	Woman and Gender Issues	55
5.9.6	Anticipated Change	55
6	ENVIRONMENTAL MONITORING PLAN	56
6.1	Construction Phase	56
6.2	Operation Phase	57
7	PROJECT BENEFITS	58
7.1	All Weather Connectivity	58
7.2	Employment Opportunities	58
7.3	Enhancement of Rural Economy	58
7.4	Reduction in Length and Travel Time	58
7.5	Enhanced Social Interaction	58
7.6	Increased Tourism Potential	59
7.7	Revenue Generation	59
8	ENVIRONMENTAL MANAGEMENT PLAN	60
8.1	EMP during Pre-Construction Phase	61
8.1.1	Wildlife Conservation plan	61
8.1.2	Snow Avalanche Mitigation	62
8.2	EMP during Construction	63
8.2.1	Construction Material Management and Housekeeping	63
8.2.2	Hazardous Waste Management	64
8.2.3	Muck Disposal	64
8.2.4	Labour Camp	65
8.2.5	Welfare of Labour on Construction Site	65
8.2.6	Safety of Labour	66
8.2.7	Safety Precautions in Tunnel Construction	67
8.2.8	Air Pollution Control Measures	67
8.2.9	Noise Control Measures	68
8.2.10	Water pollution Control	68
8.2.11	Soil Erosion	68
8.2.12	Measures for Road Construction	69

<u>8.3</u>	<u>EMP during Operation</u>	69
<u>8.3.1</u>	<u>Air Pollution</u>	69
<u>8.3.2</u>	<u>Noise Pollution</u>	69
<u>8.4</u>	<u>Human Health and Safety</u>	69
<u>8.5</u>	<u>Implementation Arrangements</u>	69
<u>8.5.1</u>	<u>Organization and Staffing</u>	70
<u>8.5.2</u>	<u>Environmental Training</u>	70
<u>8.5.3</u>	<u>Monitoring and Reporting Procedures</u>	70
<u>8.6</u>	<u>Corporate Environmental Responsibility</u>	71
<u>9</u>	<u>ENVIRONMENTAL COSTS</u>	72
<u>9.1</u>	<u>TABLE OF ANNEXURES</u>	74

1 THE PROJECT

1.1 Introduction

Major Parts of the highways in Leh-Ladakh crossing high elevation mountain passes gets blocked every year by heavy snowfall and avalanches resulting in disruption of connectivity across various places. This makes them non-motorable for some duration of the year. It is envisaged that to serve the national interest, there should be an all-weather motorable road which in turn will enable round the clock connectivity to the most important strategic locations of the country.

In order to serve the above purpose, RITES Limited, a Sch. 'A' Government of India Enterprise, has been entrusted with the assignment of preparation of Detailed Project Report (DPR) of various Road/Tunnel projects by Public Works (R&B) Department, Union territory of Ladakh vide letter No. CE/PW/R&B//Leh/97-99 dated 13.04.2022 in terms of Rule-133(3) (i) of GFR - 2017

The total project work is bifurcated in the following packages.

- i. Package-I: Tunnel Across Fotu La Pass (5.50 km) on road Leh – Khalsar
- ii. Package-2: Tunnel across Namik La (2.5km) on road Zojila - Leh Kargil
- iii. Package-3: Tunnel across Fotu La (1.8km) on road Zojila - Leh - Kargil
- iv. Package-4: Construction of Basgo - Nia La - Hunder Road to NH double lane specifications, inter valley connectivity between Indus (Sham) and Nubra/ Shyok Valleys

This report pertains to the preparation of DPR for Package -2 “Tunnel across Fotu La (1.8km) on road Zojila - Leh - Kargil”.

The Fotu La pass having an altitude of 4108m (circa) above sea level is located between the districts of leh and Kargil on NH-1 (Leh-Srinagar Highway). The top of Fotu La pass has the famous Lamayuru Monastery approx. 15km to its east.



Figure 1.1: Project Location

The main objective of the consultancy service is to prepare detailed project report for Construction of Tunnel along with the approach roads, with the aim to construct/provide all weather road across Fotu La Pass. The approach roads would be of 4/2-lane plus paved shoulders configuration based on the approved tunnel alignment & configuration.

1.2 Scope of Consultancy Services

The scope of principal objectives of the consultancy services as described in the contract agreement, covers the following main activities:

- i) Information Study and Conceptual Planning.
- ii) Site Reconnaissance and Surveys
- iii) Alignment Finalisation, Geometric Requirements and Constructability
- iv) Environmental and Social Studies
- v) Geotechnical Studies comprising of geological mapping, geophysical survey (ERT/SRT) and confirmatory vertical drilling including field and lab test.
- vi) Feasibility Study
- vii) Preparation of Detailed Project Report (DPR)
- viii) Preparation of technical schedule
- ix) Land acquisition and Forest clearance

1.3 Project Background

Fotu La pass is the highest point on NH-1 (Leh-Srinagar Highway). It is one of the two high altitude obstructions between Len and Kargil district of UT of Ladakh, the other being Namik La pass. Present at an altitude of 4108m (Circa) from mean sea level, it connects the only two districts of UT of Ladakh, one being Leh at the distance of 129km on its east and the other being the district of Kargil at a distance of 75km towards its west. This road (NH-1) also connects Srinagar on its extreme west via Kargil and NH-1 on its east via Leh which further connects Ladakh to Himachal Pradesh.



Figure 1.2: Fotu La Pass

The maintenance of road at such a high altitude is very difficult yet Border Roads Organisation (BRO) is doing it relentlessly. The road has steep switchbacks/hairpin pin bends on both side of the pass where the gradient is rising sharply, and travellers have to travel through a high-

altitude road section. Also, the accumulation of Snow near the top provide hindrance in the mobility of the passengers traveling on it.

Also, the snow accumulation in this stretch is considerable during winter season which results in the frequent closing of the road and arduous snow clearance subsequently.

It is envisaged that to serve the national interest the Leh-Kargil road should be improved to an all-weather motorable road. In this regard RITES is entrusted by PWD (R&B), UT of Ladakh to carry out detailed project report for construction of tunnel across Fotu La pass, to provide all weather connectivity across this axis alongwith providing better mobility between the two districts.

1.4 Objective of the Assignment

The objective of the study is to facilitate the UT Ladhak administration in preparation of EIA report as per the requirement of regulatory agencies. The scope of EIA includes the impacts resulting from pre-construction, construction, and operation phases of Tunnel. In addition, the objective is also to establish environmental baseline and safeguard measures for protection of environment for sustainable development during project cycles.

1.5 Approach and Methodology

Environmental Impact Assessment (EIA) methodology adopted in this project is based on the basic principle of conceptualization, identification, analysis and preparation of action plan to mitigate negative or adverse impacts.

- Collection and analysis of Baseline Environmental data
- Identification of Potential Impacts
- Evaluation of Environmental Components based on the possible negative impacts
- Suggestion/Recommendation of possible/feasible mitigation measures

The methodology of the study is to assess the impacts likely to result due to construction and operation of tunnel and its approach roads. The changes likely to occur in different components viz. physical, biological, socio-economic etc are studied and analysed. Potential impacts have been identified and quantified wherever possible based on the available data. Based on identified potential environmental impacts, Environmental Management Plan is prepared with mitigation measures for negative impacts.

2 POLICY, LEGAL AND INSTITUTIONAL REQUIREMENTS

2.1 Environmental Policy Framework

The environmental policy framework includes existing institutions and legislations relevant to the project at the International, National and State levels. The various statutory clearances/permissions from state and central government authorities and institutional framework are discussed in the subsequent section.

2.2 Legal Policy

The proposed project would be governed by various Acts, Rules and regulations set by the Ministry of Environment, Forests and Climate Change (MoEFCC) at the Central level and other regulatory agencies at the State and local level. Various environmental standards, specifications, and guidelines of Central Pollution Control Board (CPCB) and state level agencies will also be applicable.

It is important to mention over here that the Central government framed an 'umbrella law', called the Environment (Protection) Act, 1986 to broadly encompass and regulate an array of environmental issues. The overall purpose of EPA was to establish an overall coherent policy and provide a basis for the coordinated work of various government agencies with operational responsibility for the environment and natural resources. The legislation also invests authorities with regulatory powers to address specific issues affecting the environment. The Act also does not allow any person to carry on an industry, operation, or process that discharge or emit any environmental pollutants more than standards prescribed under specific rules and notifications.

The Acts, Rules and Notifications applicable to environmental aspects of the constructional and operational phases of the proposed project are summarized and briefly described in Table 2-1.

Table 2-1: Key Applicable Environmental Legislations

LEGISLATION	ACTIVITY / FEATURE
Environment (Protection) Act, 1986 amended 1991. Environment (Protection) Rules, 1986	<ul style="list-style-type: none"> • Overall Environmental Protection • Compliance to Environmental (Air, Water, Noise) Standards
Air (Prevention and Control of Pollution) Act, 1981 amended in 1987. Air (Prevention and Control of Pollution) Rules, 1981	<ul style="list-style-type: none"> • Protection of Air Quality • Consent to Establish (CTE) for establishing and • Consent to Operate for activities causing air pollution • Compliance to National Ambient Air Quality Standards
Water (Prevention and Control of Pollution) Act, 1974 amended in 1988. Water (Prevention and Control of Pollution) Rules, 1975	<ul style="list-style-type: none"> • Protection of Water Quality • Discharge of sewage from project • Obtaining No Objection Certificate (NOC) for establishing and • Consent to Operate for activities causing water pollution from SPCB
EIA Notification 2006 and its amendments	<ul style="list-style-type: none"> • For getting Environmental Clearance • Integration of environmental Conditions in local build-

LEGISLATION	ACTIVITY / FEATURE
	ing byelaws
Forest (Conservation) Act 1980 amended in 1988 Forest (Conservation) Rules 2003	<ul style="list-style-type: none"> • Clearances from forest department • Conservation of forest • Regulating Access to Natural Resources
Indian Wildlife Protection Act, 1972, amended in 2002	<ul style="list-style-type: none"> • Protection of animals and specified plants
The Ancient Monuments and Archaeological sites and Remains Act, 1958 amended in 2010.	<ul style="list-style-type: none"> • Preservation of ancient and historical monuments and archaeological sites and remains of national importance. To regulate the archaeological excavations and protection of sculptures, carvings etc.
Noise Pollution (Regulation and Control) Rules, 2000 amendment in 2010	<ul style="list-style-type: none"> • Compliance with Ambient Noise Standards in accordance with land use of the area
Hazardous and Other Wastes (Management, and Trans boundary Movement) Rules, 2016	<ul style="list-style-type: none"> • Handling, storage, treatment, and disposal of hazardous material (fuel)/ waste like waste oil and lubricants etc.
Solid Waste Management Rules, 2016	<ul style="list-style-type: none"> • Management (Collection, Handling, Storage, and disposal) of solid waste
Construction and Demolition Waste Management Rules, 2016	<ul style="list-style-type: none"> • Management of waste resulting from construction, remodeling, repair, and demolition of any civil structure
The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, No. 30 of 2013	<ul style="list-style-type: none"> • Land acquisition and compensation for Resettlement and Rehabilitation of PAFs/PAPs

2.2.1 Environment Protection Act

The Act is for the purpose of protecting and improving the quality of the environment and preventing, controlling, and abating environmental pollution. Protect and improve environment under this Act by

- a) Planning and execution of a nation-wide programme for the prevention, control, and abatement of environmental pollution,
- b) Laying down standards for the quality of various environmental aspects,
- c) Laying down standards for emission or discharge of environmental pollutants from various sources,
- d) Restriction of areas in which any industries, operations or processes or class of industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards,
- e) Laying down procedures and safeguards for the prevention of accidents which may cause environmental pollution and remedial measures for such accidents,
- f) Laying down procedures and safeguards for handling of hazardous substances.

No person can discharge or emit or permit to be discharged or emitted any environmental pollutant more than such standards as may be prescribed.

2.2.2 Environmental Clearance Process

The permitting requirement involved in the setting up of development projects (projects with potential to cause significant environmental impacts) in India is through the Environmental Clearance (EC) Process based on EIA study. The EC process is mandated by the EIA notification (as amended) of 4th May 1994 and 14th September 2006. The EC process is administered by the State Pollution Control Board/State Environmental Impact Assessment Authority (SEIAA) at the state level and the MoEFCC at the Central Government level.

The schedule in the new EIA notification 2006 provides the list of projects or activities requiring prior environmental clearance. All the projects listed in the notification are categorized into “Category A” and “Category B” categories, based on the extent of potential impacts and sensitivity of the candidate sites.

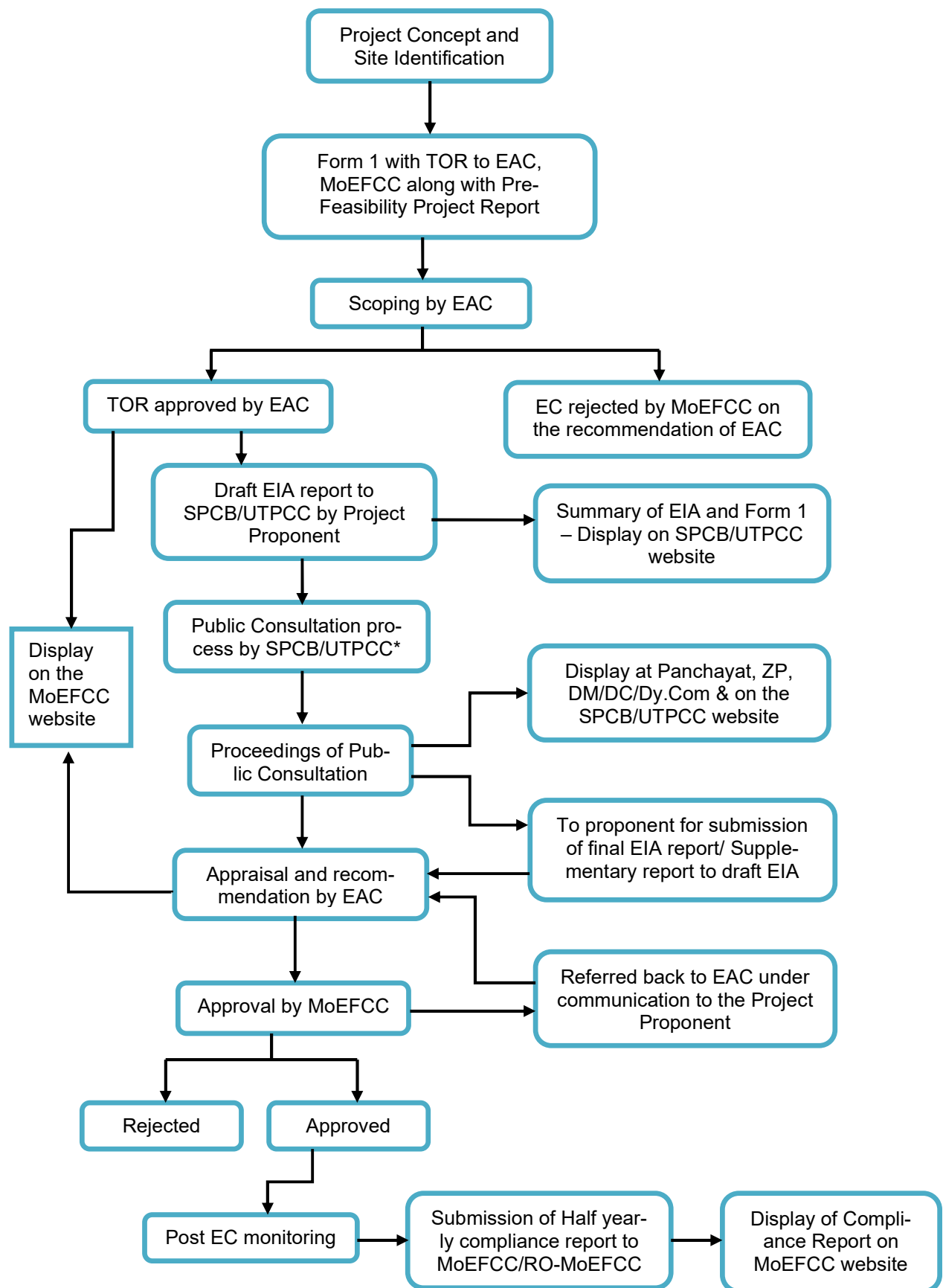
Category A: Appraisal will be done by the Central Level Expert Appraisal Committee (EAC) and clearance will be given by MoEFCC.

Category B: Appraisal will be done by the State Level Expert Appraisal Committee (SEAC) and clearance will be given by State Environmental Impact Assessment Authority (SEIAA), except in cases of special conditions and general conditions. Sub-grouped as category B1 (EIA necessary) and category B2 (EIA not necessary).

The environmental clearance (EC) process consists of the following stages:

- a) Application for EC: to be made by the project proponent (PP) to the concerned authority with form 1, pre-feasibility report (PFR) and terms of reference for conducting EIA study.
- b) Scoping: determination of terms of reference (ToR) for EIA study for category A and category B1 projects. To be done by EAC (for category A) or SEAC (for category B1).
- c) EIA Report: The project proponent (PP) will prepare draft EIA & EMP based on ToR.
- d) Public Hearing/Consultation: will be organized based on Draft EIA and EMP report. Issues raised will be addressed in final EIA & EMP report.
- e) Appraisal: EIA & EMP will be appraised by EAC (for category A) and SEAC (for category B1). For category B2, EIA is not required; appraisal will be done by SEAC based on form 1 and PFR only.
- f) Decision: Based on recommendations by EAC / SEAC, clearance will be finally granted or rejected by the MoEFCC (for category A) / SEIAA (for category B).

Flow chart depicting these stages in obtaining the prior Environmental Clearance for Highway projects is given in **Figure 2.1**.

Figure 2.1: Environmental Clearance Process

* All linear projects such as Highways, Pipeline etc in boarder states does not require Public Consultations

As per S. No 7 F under “List of Projects requiring Prior Environmental Clearance” of EIA Notification 2006 and its amendments; “i) all New National Highway Projects and ii) Expansion of National Highways greater than 100 km involving additional right of way or land acquisition greater than 40m on existing alignment and 60 m on re-alignment or bypasses” need to get Environmental Clearance (EC) from MoEFCC. The proposed Tunnel and its approach roads is realignment of existing National Highway, with a total length of > 2.0 km (which is less than 100 km); hence, EC from MoEFCC is not applicable to this project.

2.2.3 The Forest (Conservation) Act

The Forest (Conservation) Act, 1980 and its amendments are for the conservation of forests and for matters connected therewith or ancillary or incidental thereto. It aims at putting a restriction on the de-reservation of forests or the use of forest land for non-forest purposes.

Forest clearance is required if forest area is to be diverted for the project (including notified roadside plantations). The application shall be submitted to the State Govt. and after scrutiny proposal is recommended to the MoEFCC. Up to 5 ha clearance issued by RO of MoEFCC. Proposal involving forest land from 5 to 40 ha will be processed by RO and approved by MOEFCC, New Delhi. Proposal involving forest land > 40 ha will be processed and approved by MOEFCC, New Delhi.

The proposed Tunnel and its approach roads are not passing through any type of Forest land, hence Forest Clearance is not required for the proposed project.

2.2.4 Wildlife Protection Act

Wildlife Protection Act, 1972 provides for the protection of the country's wild animals, birds, and plant species, to ensure environmental and ecological security. Among other things, the Act lays down restrictions on hunting many animal species. Salient features of this act are

- a) The Act prohibited the hunting of endangered species.
- b) Scheduled animals are prohibited from being traded as per the Act's provisions.
- c) The Act provides for licenses for the sale, transfer, and possession of some wildlife species.
- d) It provides for the establishment of wildlife sanctuaries, national parks, etc.

There are 5 types of protected areas under this act as given below:

1. Sanctuaries: Sanctuary is a place of refuge where injured, abandoned, and abused wildlife can live in peace in their natural environment without any human intervention.
2. National Parks: National Parks are the areas that are set by the government to conserve the natural environment.

3. Conservation Reserves: The State government may declare an area (particularly those adjacent to sanctuaries or parks) as conservation reserves after consulting with local communities.
4. Community Reserves: The State Government may declare any private or community land as a community reserve after consultation with the local community or an individual who has volunteered to conserve the wildlife.
5. Tiger Reserves: These areas are reserved for the protection and conservation of tigers in India. They are declared on the recommendations of the National Tiger Conservation Authority.

The site does not form a part of any National Park, Wildlife Sanctuary, Reserve, Tiger Reserve, Elephant corridor etc.

2.2.5 Water and Water Pollution

The use of water resources and also the discharge of polluted water (sewerage) are primarily regulated by the Water (Prevention and Control of Pollution) Act, 1974 amended in 1988. The Water Cess Act, 1977 amended in 1992 and 2003, including Rules 1978 and 1991 provides for levy and collection of Cess on water consumed with a view to generate resources for prevention and control of water pollution. The Act assigns functions and powers to the Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB) for prevention and control of water pollution.

The Environment (Protection) Act 1986 amended in 1991 and Rules also lays down specific standards for quality of water effluents to be discharged into different type of water bodies (sewers, surface water bodies like lakes and rivers, marine discharge). Additionally, the water supplied to users for drinking shall also conform to the National Drinking Water Standard; IS-10500 (Annexure 2.1). The general standards for discharge effluent in Inland Surface Water Bodies are given at Annexure 2.2. Tolerance limits for Inland Surface Water Quality are given at Annexure 2.3.

The Central Ground Water Board (CGWB) the statutory authority set up by the Central Government has also restricted the drilling of tube wells and bore wells in certain water scarce areas in the country. CGWB not estimated the water resources of the Kargil and Leh districts as the project area is hilly terrain having very high slopes.

2.2.6 Air Quality

The Air (Prevention and Control of Pollution) Act, 1981 and amended in 1987 including Rules 1982 and 1983 was enacted to prevent, control and reduce air pollution. According to Section 21 of the Act, no person shall establish or operate any activity, which can cause air pollution without obtaining Consent to Establish (CTE) as per the Air Act. The Act also lays down national ambient air quality standards for pollutants like PM10, PM2.5 Sulphur dioxide, Nitrogen dioxide, Carbon monoxide, Lead, Ozone, Ammonia, Benzene and Benzo pyrene, Arsenic and Nickel with the intent of managing air quality for different category of areas (Industrial, Residential, Rural and Ecological sensitive areas). Ambient Air Quality Standards have been noti-

fied by the CPCB vide Gazette Notification dated 16th November 2009, are given at Annexure 2.4.

2.2.7 Noise Quality

With the objective of regulating ambient noise quality in the environment, the Central Government has notified the Noise Pollution (Regulation and Control) Rules, 2000 amended in 2010 under the EPA. The noise standards for different category of areas are based on the weighted equivalent noise level (Leq). The notified ambient noise standards are presented in Annexure 2.5.

2.2.8 Solid Waste Management

Construction and Demolition Waste Management Rules, 2016, and its amendments identify roles of waste generator, service provider, local authorities, SPCB, State Government, CPCB, BIS and Central Government. The Rules specify procedure for reporting accidents during waste processing or treatment or disposal, roles, and criteria for site selection for storage and processing or recycling facilities, applications of waste made from waste materials.

Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and its amendments specify the following:

- a) Occupier's responsibility for safe and environmentally sound management of hazardous and other wastes in terms of sending or selling to an authorised actual user or disposal in an authorised disposal facility.
- b) Responsibilities of State Government,
- c) Rules for grant of authorization to manage wastes and for utilization of wastes.
- d) Roles of waste processor and State Government in treatment, storage, and disposal facility for hazardous and other wastes.
- e) Procedures for packaging, labelling, and transport of hazardous and other wastes.

Solid Waste Management Rules, 2016 and its amendments are applicable to every domestic, institutional, commercial and any other non-residential solid waste generator except industrial waste, hazardous waste, hazardous chemicals, bio medical wastes, e-waste, lead acid batteries and radio-active waste. Duties of waste generators, manufacturers, local authorities, various Officers and ministries of Government, Pollution Control agencies are stipulated in these Rules.

2.2.9 The Ancient Monuments and Archaeological Sites and Remains Act, 2010

This act has been enacted to amend the Ancient Monuments and Archaeological Sites and Remains Act, 1958 and to make provision for validation of certain actions taken by the Central Government under the said Act.

The Act states that the limits of prohibited area and regulated area around the monuments, archaeological sites and remains declared by the Central Government as protected have been specified in the principle Act as 100 m and 200 m, respectively. The limits so fixed may be further extended on the basis of gradation and classification of the monuments, archaeological sites and remains to be done by the National Monuments Authority, which is to be constituted

by the Central Government by virtue of the Amendment in the principle Act. The regulated area has extent not only horizontally but also vertically and covers even below the surface.

2.2.10 The Building and Other Construction Workers Act, 1996

The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 aims to provide for regulation of employment and conditions of service of the building and other construction workers as also their safety, health and welfare measures in every establishment which employs or employed ten or more workers. The provisions in the Act for health and safety measures for the construction workers are in conformity with International Labour Organization Convention.

2.2.11 Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RTFCT-LARR) Act, 2013

The new land acquisition law came into force on 1st January 2014. The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, (RTFCTLARR Act) replaces the Land Acquisition Act, 1894, which existed from colonial times. The new RTFCTLARR Act is an attempt to revamp and make the land acquisition process more effective by addressing the major lacunae in the old Land Acquisition Act.

The Act seeks to harmonize the interests of landowners, industrialization/ growth of real estate and infrastructure industries and bring in transparency in the process of land acquisition. The objective of the Act is thus in line with the requirements of modern times. The Act, inter alia, contains provisions pertaining to mandatory rehabilitation and resettlement of those whose lands are acquired and payment of fair compensation to them. Significantly, the Act provides for enhanced compensation to landowners in cases of land acquisition by the government for public purposes or for Public Private Partnership (PPP) projects that may aggregate to up to four times the market value in rural areas and up to twice the market value in urban areas. The Act has been hailed as beneficial and necessary to protect the interest of land holders and other affected persons.

Key Features of RTFCTLARR Act: The Act specifies provisions for land acquisition as well as R&R. Some of the major changes from the current provisions are related to (a) the process of land acquisition; (b) rights of the people displaced by the acquisition; (c) method of calculating compensation; and (d) requirement of R&R for all acquisitions.

i. Public Purpose

- Land may be acquired only for public purpose. The Act defines public purpose to include defence and national security; roads, railways, highways, and ports built by government and public sector enterprises; land for the project affected people; planned development; and improvement of village or urban sites and residential purposes for the poor and landless, government administered schemes or institutions, etc. This is broadly like the provisions of the LA 1894 Act.
- In certain cases, consent of 80 per cent of the project affected people is required to be obtained. These include acquisition of land for (i) use by the government for purposes

other than those mentioned above, and (ii) use by public-private partnerships, and (iii) use by private companies.

ii. Process of Land Acquisition

The government shall conduct a Social Impact Assessment (SIA) study, in consultation with the Gram Sabha in rural areas (and with equivalent bodies in case of urban areas). After this, the SIA report shall be evaluated by an expert group. The expert group shall comprise two non-official social scientists, two experts on rehabilitation, and a technical expert on the subject relating to the project. The SIA report will be examined further by a committee to ensure that the proposal for land acquisition meets certain specified conditions.

A preliminary notification indicating the intent to acquire land must be issued within 12 months from the date of evaluation of the SIA Report. Subsequently, the government shall conduct a survey to determine the extent of land to be acquired. Any objections to this process shall be heard by the Collector. Following this, if the government is satisfied that a particular piece of land must be acquired for public purpose, a declaration to acquire the land is made. Once this declaration is published, the government shall acquire the land. No transactions shall be permitted for the specified land from the date of the preliminary notification until the process of acquisition is completed.

iii. Compensation to Landowners

The compensation for land acquisition is determined by the District Collector and awarded by him to the landowner within two years from the date of publication of the declaration of acquisition. The process of determination of compensation is given below.

- First, the market value of the acquired land is computed as the higher of (i) the land value specified in the Indian Stamp Act, 1899 for the registration of sale deeds; or (ii) the average of the top 50 per cent of all sale deeds in the previous three years for similar type of land situated in the vicinity.
- Once the market value is calculated, it is doubled for land in urban areas. Then, the value of all assets attached to the land (trees, buildings, etc) is added to this amount. On this amount, a 100 per cent solatium, (i.e., extra compensation for the forcible nature of acquisition), shall be given to arrive at the final compensation figure.
- Landowners whose property is acquired using the urgency provisions shall be given an additional 75 per cent of the market value of the land.

iv. Process of Rehabilitation and Resettlement

The RTFCTLARR Act requires R&R to be undertaken in case of every acquisition. Once the preliminary notification for acquisition is published, an Administrator shall be appointed. The Administrator shall conduct a survey and prepare the R&R scheme. This scheme shall then be discussed in the local bodies in case of urban areas. Any objections to the R&R scheme shall be heard by the Administrator. Subsequently, the Administrator shall prepare a report and submit it to the Collector. The Collector shall review the scheme and submit it to the Commissioner appointed for R&R. Once the Commissioner approves the R&R scheme, the

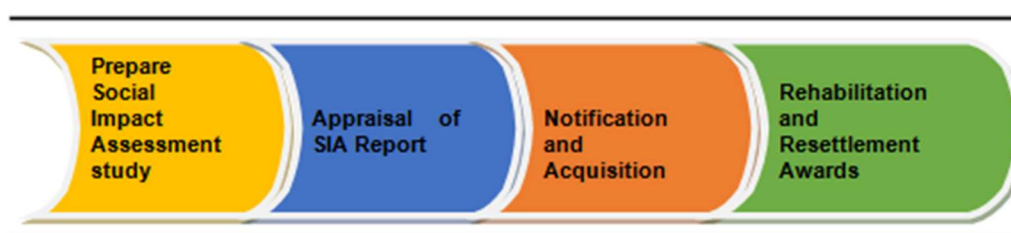
government shall issue a declaration identifying the areas required for the purpose of R&R. The Administrator shall then be responsible for the execution of the scheme. The Commissioner shall supervise the implementation of the scheme.

v. Rehabilitation and Resettlement Entitlement

The Act also provides the displaced families with certain R&R entitlements. These include, among other things, (i) land for a house as per the Indira Awas Yojana in rural areas or a constructed house of at least 50 square meters plinth area in urban areas; (ii) a one-time allowance of Rs 50,000 for affected families; and (iii) the option of choosing either mandatory employment in projects where jobs are being created or a one-time payment of Rs 5 lakh or an inflation adjusted annuity of Rs 2,000 per month per family for 20 years, (iv) subsistence grant of Rs.3000/- for one year, (v) Transportation cost of Rs.50,000/- for shifting, (vi) one –time assistance of Rs.25,000/-for cattle shed/petty shop, (vii) One –time grant of Rs.25,000/- to artisan, small traders & others, (viii) one-time resettlement allowance of Rs. 50,000/- to PAF.

Every resettled area is to be provided with certain infrastructural facilities. These facilities include roads, drainage, provision for drinking water, grazing land, banks, post offices, public distribution outlets, etc.

Standard land acquisition, compensation and resettlement process according to the RTFCT-LARR Act, 2013 is presented below.



2.2.12 National Environment Policy, 2006

National Environment Policy 2006 is a response to India's national commitment to a clean environment, mandated in the Constitution in Articles 48 A and 51 A (g), strengthened by judicial interpretation of Article 21.

The existing policies have recognized the need for sustainable development in their specific contexts and formulated necessary strategies to give effect to such recognition. It does not displace but builds on the earlier policies. The objectives of the National Environmental Policy are:

- a) Conservation of Critical Environmental Resources
- b) Intra-generational Equity: Livelihood Security for the Poor
- c) Inter-generational Equity
- d) Integration of Environmental Concerns in Economic and Social Development
- e) Efficiency in Environmental Resource Use
- f) Environmental Governance
- g) Enhancement of Resources for Environmental Conservation

The policy focuses on encouraging the regulatory authorities, Central and State, to institutionalize regional and cumulative environmental impact assessments to ensure that environmental concerns are identified and addressed at the planning stage itself. The policy adopts the civil liability for environmental damage that would deter environmentally harmful actions and compensate the victims of environmental damage.

2.3 Institutional Framework

The Ministry of Environment Forest and Climate Change (MoEFCC) is the nodal agency in the administrative structure of the central government for planning, promotions, co-ordination and overseeing the implementation of India's environmental and forestry policies and programs. The major responsibilities of MoEFCC include:

- a) Environmental resource conservation and protection, including environmental impact assessment, clearance of developmental projects.
- b) Co-ordination with the other ministries and agencies, voluntary organizations, and professional bodies for environmental action plans.
- c) Promotion of research and development, manpower planning and training and creation of environmental awareness.
- d) Liaison and coordination with international agencies involved in environmental matters.

2.3.1 Central and State Pollution Control Boards

The Central Pollution Control Board is responsible for pollution control throughout the country. In addition to the control of air, noise, and water pollution it is also responsible to ensure effective control of disposal of hazardous wastes and storage and handling of hazardous chemicals and substances. With the enactment of air and water pollution laws, states have set-up their own State Pollution Control Boards (SPCBs) to monitor industrial emissions and effluents and to approve the operation of new industries after scrutiny. The functions of the SPCBs include:

- a) The planning of comprehensive state programs for the prevention and control of air and water pollution and to ensure the implementation thereof.
- b) Inspection of pollution control equipment/ plants for monitoring of their efficiency.

The SPCB in consultation with the Central Pollution Control Board may establish norms for air quality, gaseous emission, and noise level etc.

3 PROJECT DESCRIPTION

3.1 Introduction

Fotu La or Fatu La is a mountain pass on the Srinagar-Leh highway in the Zaskar Range of hills of the Himalayas at an elevation of 4108 m and the one of the highest point on the highway, sur-passing the famed Zoji La pass. With the proposal of tunnel, the road along the Fotu La can be shorter by more than 5km reducing approx. half an hour of the travelling time. Constructing a tunnel along Fotu La can mitigate issues of high altitude. Also, considering the high traffic volume between the two districts of Leh and Kargil, it will provide much better connectivity and mobility across them throughout the year.

The whole area is covered by debris material caused because of freezing and thawing effect on rocks experiencing extremely freezing temperatures especially in winters. The area supports no vegetation, as observed during the recci visit and can be seen in the attached pictures below.



Figure 3.1: Terrain near Fotu La Pass



Figure 3.2: Wide valley formed by Mass movement of slope wash material

3.2 Salient Features of Existing Road

Lamayuru (Fotu La) is very well connected by main highway from Srinagar- Leh Highway with high altitude road bends and switches. The highest elevation along the road is at Fotu la pass which stood at 4108m located close to Lamayuru village. Although, the road is two lane and paved with bituminous concrete layer on top, some section of the road have very steep gradient ($>10\%$) and sharp curves. All such factors combined make the maintenance of this highway difficult. The road also frequently remains closed during the winter season due to heavy snow fall.

The new alignment a possibility of tunnel across Fotu La can suddenly remove the high elevation road part and rest of the road can also be planned without any major problem of steep gradient and sharp curves. It will also, provide better connectivity and mobility to the travelers, especially in winter season.

3.3 Tunnel System Recommendation

For this project twin tunnel solution with unidirectional traffic are envisaged owing to various benefits. Ventilation and safety requirement are more critical due to long tunnel length. Following the RFP/ IRC SP-91 2010 and other relevant guidelines following aspects are considered for tunnel cross section.

Vertical Clearance: Minimum vertical clearance of 5.5m as per IRC SP 91: 2010 has been provided.

Walkways: Normally, pedestrians are not permitted in freeway tunnels. However, space should be provided for emergency walking and for access by maintenance personnel. Raised

sidewalks 0.7m wide are desirable beyond the traffic lane to serve the dual purpose of safety walk and a buffer to prevent the overhand of vehicles from damaging the wall finish or the tunnel lighting fixtures. Walkways are necessary for safe movement of service personnel and for free access in case of emergency. Walkway of 1.0 m width has been provided for this project, with a walkway height of 15cm above pavement (this is a deviation to IRC:SP:91-2010).

Clear height above walkway is given as 1.8m as per IRC:SP:91-2010. It is recommended to use clear height of 2.3m above walkway following other international guidelines.

Tunnel Drainage: Drainage arrangement separated for surface water (pavement spill) and groundwater shall be provided.

Cable Pits: Cables pits are generally laid to accommodate power supply, telephone lines, lighting wires, water supply lines and other cables.

Tunnel Ventilation and Firefighting System: A vertical clearance for installation of tunnel ventilation shall be provided above the minimum clearance requirement. A space of minimum 2m height is proposed to house jet fans or any similar ventilation arrangement inside the tunnel.

Fire-fighting line with hydrants at proper spacing should be connected to water tanks located (preferably 60m spacing outside the tunnel) for use in emergencies.

4 ENVIRONMENTAL AND SOCIAL BASELINE DATA

4.1 General

Environmental baseline data describes the existing environmental settings in the study area. The objective of the Environmental Impact Assessment (EIA) is to ascertain the baseline environmental conditions and then assess the impacts because of the proposed project during various phases of the project cycle. The environmental baseline data has been compiled for:

- a) Land Environment (Physiography, Soils, Geology and Minerals)
- b) Water Environment (Water resources, water use and quality)
- c) Ambient Environment (Meteorology, Ambient Air Quality and Noise Quality)
- d) Ecological Environment (Flora and Fauna)
- e) Socio-Economic environment (Demography and Socioeconomics, etc.)

Environmental baseline data includes the physical, biological, and socio-economic data. The data collection was carried out in the months from September 2023 to October 2023. A scoping matrix along with the frequency adopted for data collection for environmental attributes is summarized in **Table 4-1**. Based on environmental scoping matrix and project settings the attributes likely to be affected were identified for baseline data generation.

Table 4-1: Environmental Attributes and Frequency of Monitoring

S. No	Attribute	Parameter	Frequency	Source
LAND ENVIRONMENT				
1.	Soil	Soil Characteristics	One Season	Field studies
2.	Geology	Geological Status	---	Secondary Data & Feasibility Report
3.	Seismology	Seismic Hazard	---	Secondary Data
WATER ENVIRONMENT				
4.	Water Quality	Physical, Chemical and Biological parameters	One Season	Field studies
AIR, NOISE AND METEOROLOGY				
5.	Ambient Air Quality	PM2.5, PM10, SO ₂ , NO ₂ , and CO	One Season	Field Studies
6.	Meteorology	Temperature, RH, Rainfall, wind direction and speed	Data	India Meteorological Department
7.	Noise	Noise levels in dB (A)	One Season	Field Studies
ECOLOGY				
8.	Flora and Fauna	Type of species	Once	Filed Studies & Secondary Data
SCIO-ECONOMIC				
9.	Socio-economic aspects	Socio-economic characteristic	Once	Field Studies, Literature review.

4.2 Land Environment

Field studies were carried out towards collection of baseline data with respect to physical environment viz. physiography, geology, soils, minerals, and seismicity. The data on physical environment was collected from existing literature and from field observations.

4.2.1 Physiography

The terrain of the project area is high altitude hilly mountainous terrain with limited access during the year.

4.2.2 Geology

According to Geological Survey of India, the area falls near Indus Suture Belt comprises rocks of the Cretaceous-Tertiary age, sandwiched between the Himalayan belt of rocks to the south and Ladakh Granite to the north.

4.2.3 Soils and Minerals

The soil of the district is sandy to loamy in nature and deficient in organic matter and availability of phosphorus and potashes low and mixed with stones and gravels. It is shallow in formation, weak friable and vulnerable to all types of erosion. Fertility of the soil varies from place to place, and growing season is very short.

In the project area, Soil samples from two locations were collected and analyzed to understand the soil characteristics of the area with respect to its productivity potential. The description of Soil quality monitoring locations is given in **Table 4-2**.

Table 4-2: Description of Soil Quality Monitoring Locations

Sample ID	Location	Environmental Setting
SS1.	Near East Portal of Fotu La Tunnel	Barren
SS2.	Near South Portal of Namik La Tunnel	Barren

These samples were tested in the laboratory to determine the nature and physical characteristics like soil classification, nutrient contents, electrical conductivity, etc. The results of the soil sample analysis are given in **Table 4-3**. The soils in the project area are acidic soils; and the soils are falls under loam soils as per the soil classifications.

Table 4-3: Soil Quality Data

S. No	Parameter	Unit	SS1	SS2	Test Method
1.	pH (1.5 Aq. Extraction)	-	8.54	7.89	IS: 2720
2.	Electrical Conductivity (1.5 Aq. Extraction)	µS/cm	158.60	130.7	IS: 2720
3.	Moisture Content	% by mass	7.60	6.68	IS: 2720
4.	Available Potassium (as K ₂ O)	mg/kg	38.50	43.0	Manual of Soil Testing by Govt. of India.
5.	Available Nitrogen (As N)	mg/kg	56.0	63.0	
6.	Available Phosphorous (as	mg/kg	12.0	29.0	

S. No	Parameter	Unit	SS1	SS2	Test Method
	P ₂ O ₅)				
7.	Organic Matter	%	2.51	1.64	
8.	Calcium (as Ca)	mg/kg	240.0	120.0	
9.	Magnesium (as Mg)	mg/kg	97.20	86.0	
10.	Zinc (as Zn)	mg/kg	6.80	5.60	
11.	Iron (as Fe)	mg/kg	15.80	17.30	
12.	Boron (as B)	mg/kg	3.50	10.80	
13.	Texture				
i.	Sand	% by Mass	65.45	51.09	
ii.	Silt	% by Mass	20.15	39.20	
iii.	Clay	% by Mass	14.40	9.71	

4.2.4 Seismicity

As per revised seismic zoning map of India, UT of Ladakh falls in region of High Damage Risk Zone (Zone IV). The proposed project Tunnel and its approach roads falls in Zone IV.

4.3 Water Environment

Water Resources of the Districts: Springs are the major source of water supply for drinking and irrigational requirements in the project area. People are mainly dependent on surface water sources and springs for meeting water supply requirements.

4.3.1 Water Resources of the Districts

Springs are the major source of water supply for drinking and irrigational requirements in the project area. People are mainly dependent on surface water sources and springs for meeting water supply requirements. The district is underlain by consolidated formation in maximum part; and Ground water in consolidated formations occur in fissures and fractures developed due to repeated tectonic activity. Large scale ground water development is not possible in consolidated formations; hence the stage of ground water development is very minimal.

The proposed project area witnesses a lot of precipitation of snow. The occurrence of prominent persistent and steep joints in the area can therefore be expected to hold and conduct water. Local drainages/ nallas could be witnessing significant fluctuations in surface water levels.

There are lot of other water resources namely tanks and streams available throughout the district among which some are still unutilized. Many streams even in summer flow for only a few hours a day when the ice melts.

4.3.2 Water Quality of the Project Area

To assess the baseline water quality status of the study area, two (2) surface water samples were collected in the project area. The description of water quality monitoring locations are given in **Table 4-4**. The results of Surface water parameters are compared with Tolerance Limits for Inland Surface Waters subject to Pollution (IS: 3025 & APHA 23rd Edition). The results of sample testing are presented in **Table 4-5**.

Table 4-4: Description of Water Quality Monitoring Locations

Sample ID	Location	Environmental Setting
SW1	Near East Portal of Fotu La Tunnel	Stream Water
SW2	Near South Portal of Namik La Tunnel	Stream Water

Table 4-5: Water Quality Monitoring Results

S. No	Parameter	Unit	SW1	SW2	Test Method
1.	pH at 25 ^o C	-	7.65	7.95	IS: 2720
2.	Electrical Conductivity at 25°C	µS/cm	438.0	396.0	IS: 2720
3.	Turbidity	NTU	<1	<1	APHA 23 rd Edition
4.	Total Dissolved Solids	mg/l	286.0	308.0	IS: 2720
5.	Total Alkalinity (as CaCO ₃)	mg/l	105.0	108.0	IS: 2720
6.	Total Hardness (as CaCO ₃)	mg/l	134.0	127.0	IS: 2720
7.	Calcium as Ca	mg/l	34.4	27.2	IS: 2720
8.	Chloride as Cl ⁻	mg/l	19.98	15.48	IS: 2720
9.	Fluoride as F	mg/l	ND [DL- 0.1]	0.24	IS: 2720
10.	Iron (as Fe)	mg/l	0.21	0.29	APHA 23 rd Edition
11.	Lead (as Pb)	mg/l	ND [DL- 0.005]	ND [DL- 0.005]	
12.	Magnesium as Mg	mg/l	11.67	21.67	
13.	Sodium as Na	mg/l	30.0	40.76	
14.	Potassium as K	mg/l	2.98	1.97	
15.	Sulphates (as SO ₄)	mg/l	35.75	33.85	IS: 2720
16.	Nitrate (as NO ₃)	mg/l	0.19	4.73	
17.	Ammonia as Total Ammonia (N)	mg/l	ND	ND	
18.	Chemical Oxygen Demand (COD)		26.0	23.0	
19.	Biochemical Oxygen Demand at 27 ^o C for 3 days	mg/l	1.0	3.7	

S. No	Parameter	Unit	SW1	SW2	Test Method
20.	Dissolved Oxygen (DO)	mg/l	4.5	5.8	IS: 2720

The analysis for various parameters indicates the following:

- All the parameters are within permissible limits upon comparing with Surface Water Quality Standards (IS 2296-1982)-Class A Drinking Water without Conventional Treatment but after disinfection.
- Copper, Zinc, Cadmium, Lead, and Nickel parameters are below detection limits.
- pH of the samples varies from 7.5 to 8.0
- Water samples are clear as turbidity is less than 1.0 NTU
- Dissolved Oxygen varies from 4.0 to 6.0 mg/lit

4.4 Ambient Environment

All air pollutants emitted by point and non-point sources are transported, dispersed or concentrated by meteorological and topographical conditions. The meteorological parameters regulate the transport and diffusion of pollutants into the atmosphere. The ambient environmental status existing in the project area is discussed in different paragraphs as under.

4.4.1 Climate

The climate of the district is milder than that of Ladakh (Leh). The villages situated on the banks of Indus and on the Sangham of Suru and Drass rivers are very warm and fine. The snow falling happens to be quite heavy and rainfall normal, but it does not help in irrigating the fields. The crops are subjected to irrigation. In Nutshell, the winter season of the district experiences severe cold and temperature often goes down redundantly but summer season remains dry and little hot.

4.4.2 Air Quality

The prime objective of baseline air quality survey was to assess conformity to standards of ambient air quality. Air quality monitoring was carried out in the month of October 2024 at 2 location ie., at Near East Portal of Fotu La and South Portal of Namik La.

Five major air pollutants viz. particulate matter (PM10& PM2.5), Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO₂) and Carbon Monoxide (CO) representing the air quality was monitored. Results of the monitoring are tabulated in **Table 4-6**. The air quality monitoring results indicate that PM10, PM2.5, SO₂, and NO₂ were within the permissible limits for residential, Industrial and Sensitive areas at the location. CO is less than 0.2 mg/m³ at all locations. The reason for no pollution in the project area attributes to very less population density and higher wind speed.

Table 4-6: Ambient Air Quality Monitoring Results

Station ID	Location	Concentration				
		SO ₂	NO ₂	PM ₁₀	PM _{2.5}	CO

Unit		$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	mg/m^3
Permissible Limit		80	80	100	60	2
1.	Near East Portal of Fotu La Tunnel	9.96	11.6	54.0	22.0	1.5
2.	Near South Portal of Namik La Tunnel	8.97	7.84	36.98	19.54	1.45

4.4.3 Noise Environment

Noise exposure can lead to adverse effects on health. Noise level survey was conducted at 2 locations in the project area with an objective to establish the baseline noise levels and assess the impacts of the noise expected due to the proposed development. Noise levels were recorded on hourly basis for 24 hours continuously for one day to have an assessment of the Day and Nighttime noise levels. The noise levels so obtained are summarized in **Table 4-7**. It is observed from the table that L_{eq} for day and night at all monitoring locations were within the permissible limits for Residential zone as per National Ambient Noise Standards.

Table 4-7: Noise Levels in the Project Area

S. No	Location	Noise Level in dB (A) (Day)					
		L10	L50	L90	L_{eq}	Lmin	Lmax
1.	Near East Portal of Fotu La Tunnel	57.0	48.1	39.2	53.4	37.0	59.0
2.	Near South Portal of Namik La Tunnel	60.8	52.3	43.7	57.1	42.0	67.3

S. No	Location	Noise Level in dB (A) (Night)					
		L10	L50	L90	L_{eq}	Lmin	Lmax
1.	Near East Portal of Fotu La Tunnel	51.2	44.5	37.7	47.5	36.0	53.0
2.	Near South Portal of Namik La Tunnel	56.4	49.2	42.0	52.7	40.0	61.0

4.5 Ecological Environment

Ecological studies are one of the important aspects of Environmental Impact Assessment with a view to conserve environmental quality and biodiversity. Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition, and mutualism. The ecological study mainly consists of Random sampling of flora & Fauna.

4.5.1 Forest

There is no forest land in the project area. Most of the land is un-measured revenue Land.

4.5.2 Natural vegetation

The vegetation patches found in the region are alpine pastures and plantation distributed in nearby villages. Juniperus species plantation is also done by forest department in some patches. The proposed project is not located at forest land.

The important species in the study area are shrubs and grass. The region is virtually treeless except for isolated patches of juniper (*Juniperus macropoda*, *J. indica*) and birch (*Betula utilis*) in some valleys and mostly cultivated varieties of poplar (*Populus ssp*) and willow (*Salix*) along the major water courses. The vegetation changes gradually from alpine meadow (Kobresia, Carex, Potentilla, Nepeta) on the North side of the Himalayan crest to steppe vegetation (Caragana, Artemisia, Stachys, Ephedra, Stipa) to the North and East, with shrubland (Hippophae, Myricaria, Salix).

4.5.3 Natural fauna

The project area is habitat of Tibetan wildass, Snow leopard, Ibex, snow fox, wild yak, Blue sheep & Marmot species as per primary data collected from site, interaction with local villagers & forest officials. Photographs of the droppings of Bharal (Blue Sheep) and grazing of Tibetan wild ass found in the project area are shown in **Figure 4.1**. Many schedule-I animals are recorded from the study area. The status report of fauna in the project area is given **Table 4-8**.



Droppings of Blue sheep (Bharal)



Observation of Tibetan wild ass

Figure 4.1: Fauna in the Project Area

Table 4-8: Fauna and their Status Report in Project Area

S No	Scientific name	Common name	Status as per WPI 1972	IUCN status
Mammals				
1.	<i>Ursus arctos</i>	Himalayan brown Bear	Schedule -I	Vulnerable
2.	<i>*Equus kiang</i>	Tibetan wild ass (Kiang)	Schedule -I	Least Concern

3.	<i>Ursus thibetanus</i>	Himalayan black Bear	Schedule -II	Vulnerable
4.	<i>Capra sibirica hemalayanus</i>	Ibex	Schedule -I	Near Threatened
5.	<i>*Pseudois nayaur/Ovis nahura</i>	Blue sheep /Bharal	Schedule -I	Least Concern
6.	<i>*Marmota himalayana</i>	Himalayan Marmot	Schedule - II	Least Concern
7.	<i>Vulpes Montana</i>	Himalayan snow fox	Schedule -II	Not Evaluated
8.	<i>Felis chaus</i>	Himalayan Jungle cat	Schedule -II	Least Concern
9.	<i>*Naemorhedus goral</i>	Ghoral	Schedule - III	Near Threatened
Avifauna				
10.	<i>*Motacilla citreola</i>	Yellow headed wag-tail	Schedule -IV	Least Concern
11.	<i>*Pyrrhonorax pyrrhonorax</i>	Red billed chough	Schedule -IV	Least Concern
12.	<i>*Pyrrhonorax graculus</i>	Yellow billed chough	Schedule -IV	Least Concern
13.	<i>Aquila nipalensis</i>	Steppe eagle	Schedule -I	Endangered
14.	<i>Columba leuconota</i>	The snow pigeon	Schedule -IV	Least Concern
15.	<i>Spilopelia chinensis</i>	spotted dove	Schedule -IV	Least Concern

* reported by RITES Team, during field survey

4.5.4 Agro-Ecosystem in study area

No agriculture is practiced near Fotu La. It is acting as a cold desert because most of the seasons, this area occupied by Snow.

4.6 Socio-Economic Profile

The proposed Fotu LA pass is a high mountain pass in the Himalayas Zaskar Range. During site visits settlements in project influence area are identified and given in below **Table 4-9**.

Table 4-9: Major Settlement near Fotu La Tunnel

S. No	Name of Village	Tehsil	District	Households	Population
1.	Malbekh	Kargil	Kargil	189	1,393
2.	Nunamchey	Kargil	Kargil	24	199
3.	Wakhade	Kargil	Kargil	224	1,773
4.	Staktse	Kargil	Kargil	212	1,453
5.	Bodhkhharbu	Kargil	Kargil	138	970
6.	Lamayouro	Khalsi	Leh	117	667

Source- Census 2011

4.6.1 Demography

To understand the demographic profile of project influence area, secondary data has been collected from sample socio-economic survey and public consultations. The primary data was collected through District Statistical handbook. The demographic profile of Kargil District and Leh District is presented in **Table 4-10**.

Table 4-10: Demographic Profile of Union Territory of Ladakh and Leh District

S. No	Description	Kargil	Leh
1	Population	1,40,802	1,33,487
1.1	Male	77,785	78,971
1.2	Female	63,017	54,516
2	Area Sq. Km	14,036	45,110
3	Population Density/Sq. Km	10	3
4	Sex ratio (per 1000)	810	690
5	Child Sex Ratio (0-6 Age)	977	946
6	Average Literacy	71.34 %	77.20 %
6.1	Male Literacy	83.15 %	86.31 %
6.2	Female Literacy	56.30 %	63.56 %
7	Literates	86,236	93,770
7.1	Male Literates	56,301	62,834
7.2	Female Literates	29,935	30,936
8	Child Proportion (0-6 Age)	14.15 %	9.00 %
8.1	Boys Proportion (0-6 Age)	13.96 %	7.82 %
8.2	Girls Proportion (0-6 Age)	15.63 %	10.72 %

Source: Census, 2011

According to official data of census 2011, released by Directorate of Census operations in union Territory Ladakh, 11.60 percent lives in urban regions of Kargil district. In total 16,338 people lives in urban areas of which males are 10,082 and females are 6,256. Sex Ratio in urban region of Kargil district is 621 as per 2011 census data. Similarly, child sex ratio in Kargil district was 991 in 2011 census. Child population (0-6) in urban region was 1,569 of which males and females were 788 and 781. This child population figure of Kargil district is 7.82 % of total urban population. Average literacy rate in Kargil district as per census 2011 is 83.55 % of which males and females are 92.82 % and 67.82 % literates respectively. In actual number 12,340 people are literate in urban region of which males and females are 8,627 and 3,713 respectively.

88.40 % population of Kargil districts lives in rural areas of villages. The total Kargil district population living in rural areas is 124,464 of which males and females are 67,703 and 56,761 respectively. In rural areas of Kargil district, sex ratio is 838 females per 1000 males. If child sex ratio data of Kargil district is considered, figure is 976 girls per 1000 boys. Child population in the age 0-6 is 18,359 in rural areas of which males were 9,290 and females were 9,069. The child population comprises 13.72 % of total rural population of Kargil district. Literacy rate in rural areas of Kargil district is 69.64 % as per census data 2011. Gender wise, male and female literacy stood at 81.62 and 54.98 percent respectively. In total, 73,896 people were literate of which males and females were 47,674 and 26,222 respectively.

According to official data of census 2011, released by Directorate of Census operations in union Territory Ladakh, 34.21 percent lives in urban regions of Leh district. In total 45,671 people lives in urban areas of which males are 30,560 and females are 15,111. Sex Ratio in urban region of Leh district is 494 as per 2011 census data. Similarly, child sex ratio in Leh district was 989 in 2011 census. Child population (0-6) in urban region was 2,963 of which males and females were 1,490 and 1,473. This child population figure of Leh district is 4.88 % of total urban population. Average literacy rate in Leh district as per census 2011 is 86.59 % of which males and females are 92.09 % and 74.86 % literates respectively. In actual number 36,981 people are literate in urban region of which males and females are 26,772 and 10,209 respectively.

4.6.2 Literacy and Education

Average literacy rate of Leh and Kargil in 2011 were 72.10% and 69.64% respectively. If things are looked out at gender wise, male and female literacy rate in Leh were 82.47% and 59.16%. Similarly male and female literacy rate in Kargil were 81.61% and 54.98 % respectively.

Table 4-11: Literacy Level of Villages in Project Area

Village	Literacy (%)		
	Total	Male	Female
Malbekh	75.68	85.31	66.23
Nunamchey	69.09	84.88	51.90
Wakhade	76.20	86.79	65.75
Staktse	69.86	79.78	59.54
Bodhkharbu	72.81	80.90	64.08
Lamayouro	71.93	78.62	65.57

Source: Census, 2011

4.6.3 Work Participation

In Leh district out of total population, 75,079 were engaged in work activities. 76.1% of workers describe their work as Main Work (Employment or Earning more than 6 Months) while 23.9% were involved in Marginal activity providing livelihood for less than 6 months. of 57,136 workers engaged in Main Work, 11,175 were cultivators (owner or co-owner) while 593 were Agricultural labourers.

In Kargil district out of total population, 51,873 were engaged in work activities. 20.551% of workers describe their work as Main Work while 16.29% were involved in Marginal activity providing livelihood for less than 6 months. Of 28,940 workers engaged in Main Work, 8,266 were cultivators (owner or co-owner) while 3,763 were Agricultural labourers.

Table 4-12: Working Population of Villages in Project Area

Village	Total Workers			Main Workers			Marginal Workers		
	Total	Male	Female	Total	Male	Female	Total	Male	Female

Malbekh	690	353	337	266	--	--	424	162	262
Nunamchey	59	55	4	28	--	--	31	31	0
Wakhade	524	400	124	396	--	--	128	97	31
Staktse	420	314	106	265	--	--	155	81	74
Bodhkharbu	559	295	264	147	--	--	412	183	229
Lamayouro	397	202	195	197	153	44	200	49	151

Source: Census, 2011

4.6.4 Other Demographic Indicators

According to the National Family Health Survey (2015-16), the Leh district has 100% electricity in urban area and 99.3% in rural area. The survey also reported that 70.9% of households in the district had access to an improved source of drinking water. The household sanitation facility is reported 16.7% and the use of clean fuel in district is 87.7%.

Only 2.6% of the population is covered by health insurance facility.

Table 4-13: Other Demographic Indicators

Indicator	Kargil	Leh
Households with Electricity (%)	97.3	99.5
Households with improved drinking water (%)	86.7	70.9
Households with improved sanitation facility (%)	16.5	16.7
Households with Health Insurance (%)	1.9	2.6
Children fully immunized – 12 to 23 months old (%)	81.9	82

Source: National Family Health Survey, 2015-16 and District Statistical Handbook 2018-19.

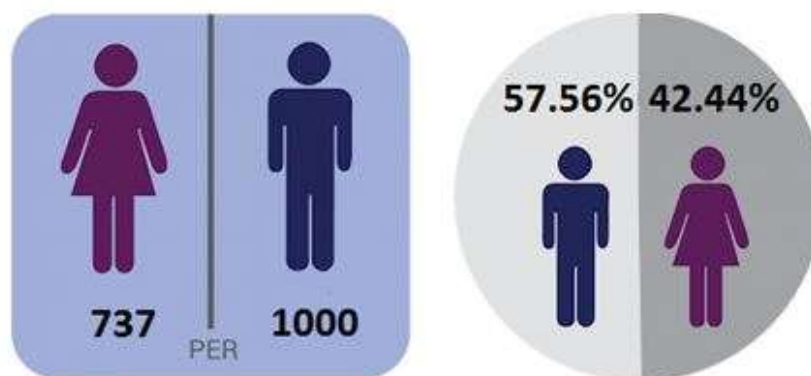
4.7 Households Profile of Project Influence Area

As per the TOR, census survey was to be conducted for the project affected families. There is no private land acquisition and displacement is taking place for Fotu La Tunnel project. As there is no PAFs were identified in the project site therefore census survey was not conducted. In order to understand the socio-economic profile of the region sample socio-economic survey was conducted in nearby villages located near to the tunnel portals. The 5 villages are located in Kargil district and 1 Village in Leh District of Union Territory of Ladakh. Approximately 20% to 25% of sample socio-economic survey was conducted in the villages. The na-

ture of the data collection was quantitative. Therefore, the analysis is based on the responses from the surveyed households. Total 6 villages were surveyed which were located in project influence area. Socio-economic survey was conducted for 30 Households. The data collected through socio-economic survey generated demographic and socio-economic profile of people in project influenced area. The data has been compiled and presented in tabular forms and charts.

4.7.1 Gender Ratio

The data on gender and sex ratio is very helpful indicator to know the participatory share of male and female in the society, which is also an important indicator for human development index. Among the surveyed household members, it is observed that 50.1% are male and 49.9% are female. The sex ratio is 998 females per 1000 male.

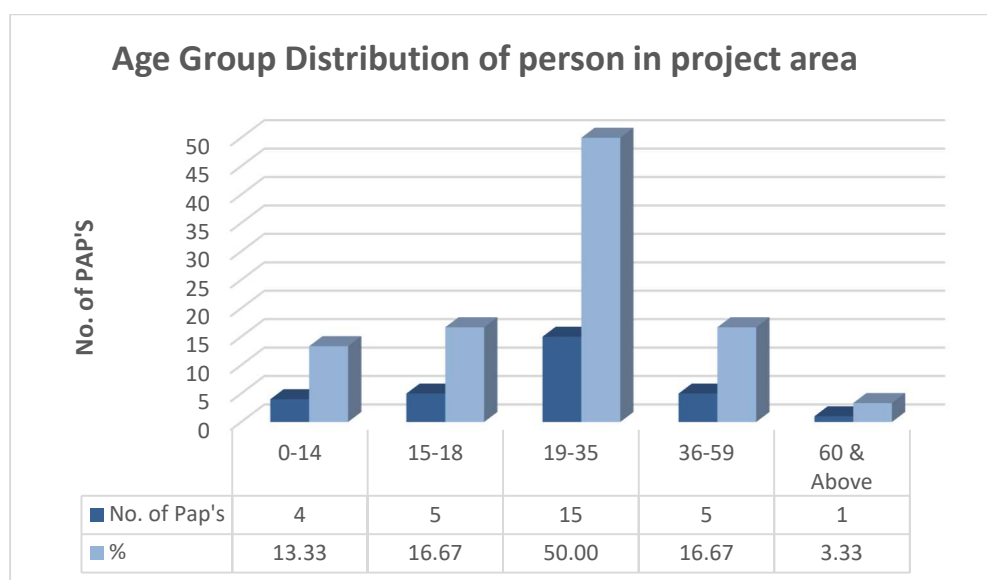


Source: RITES Field Survey, September 2022

Figure 4.2: Sex Ratio and Gender Distribution of Surveyed People

4.7.2 Age Group

The persons of surveyed households have been categorized into five age groups. The distribution of member's age in various group shows that 13.33% of the total surveyed members belong to age group of 0 to 14 years. 16.67% of members belong to the age group of 15-18 years. About 50.00% belong to the age group of 19 to 35 years. 16.67% of members belong to the age group of 36-59 years. About 3.33% of total members belong to age group of 60 years and above, who are dependent population. It is observed that majority of members belong to the age group of 19 to 35 years who are potentially productive group.

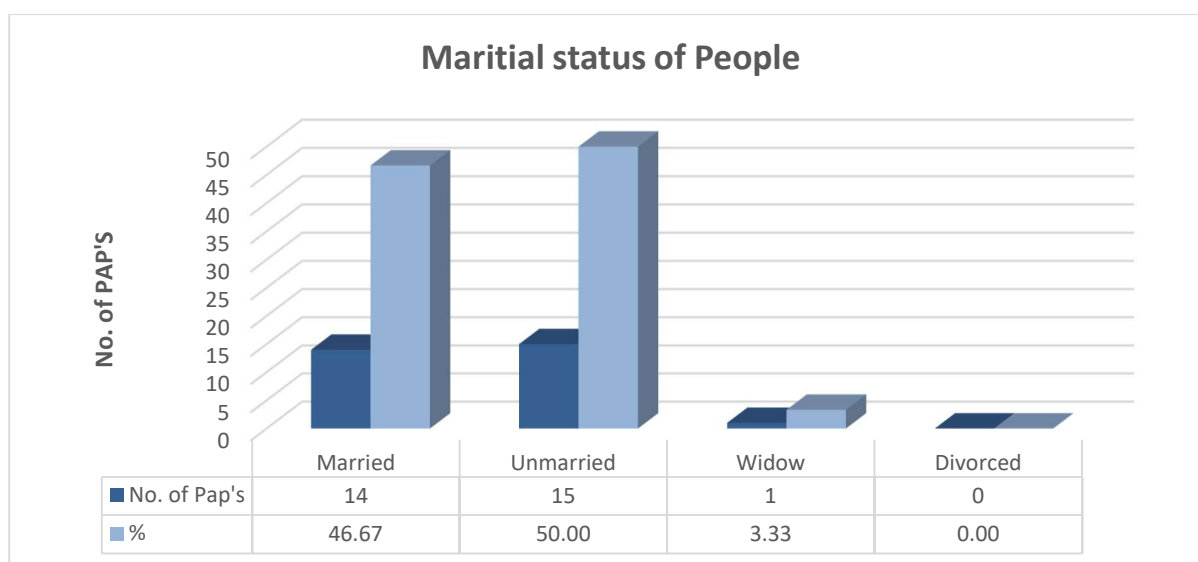


Source: RITES Field Survey, September 2022

Figure 4.3: Age Group Distribution of Surveyed People

4.7.3 Marital Status

The marital status of the surveyed household members is indicated under four categories – married, unmarried, divorced and widow. It is reported that out of total surveyed household members, 46.67% are married whereas 50.00% are unmarried population. No household reported divorced during survey and remaining 3.33% population is found widow.



Source: RITES Field Survey, September 2022

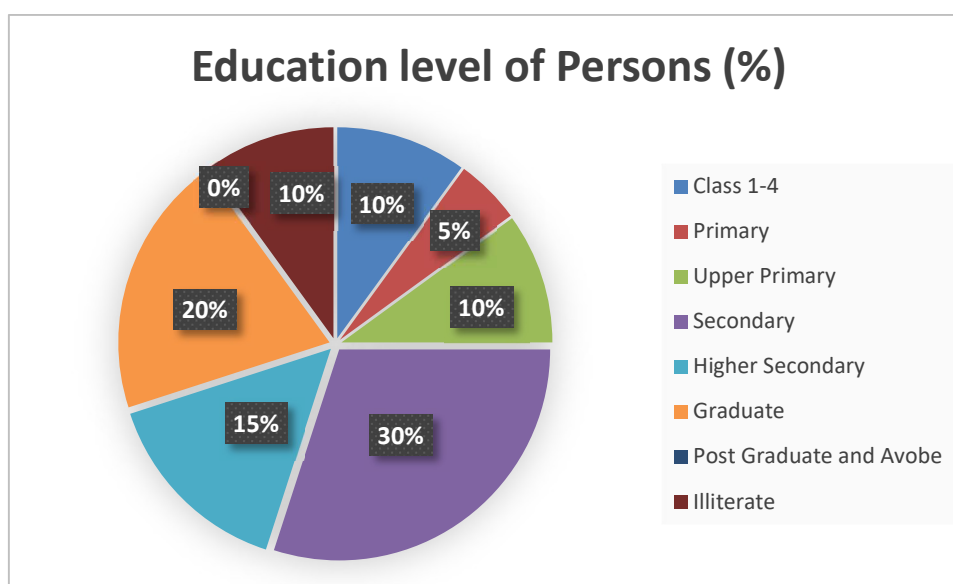
Note: The legal age for marriage in India is 18 for females and 21 for males

Figure 4.4: Marital Status of People in the Project Area

4.7.4 Educational Attainment

Education is a tool for vertical mobility in the society. It provides an opportunity to participate in the process of growth and development. However, it also creates differences among people and introduces a new kind of inequality between those who have it and those who do not. In

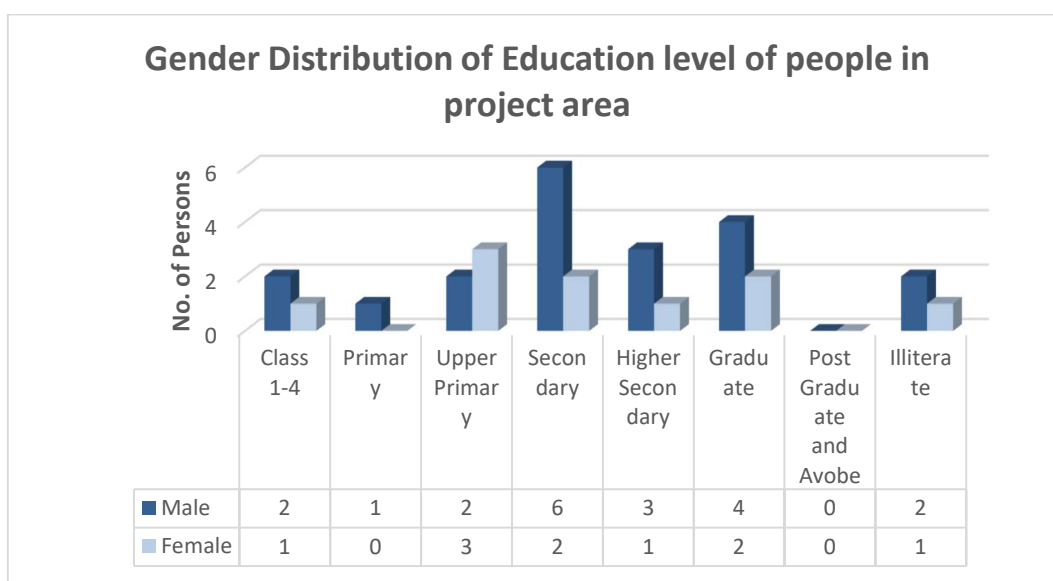
all the cases, education is a basic need and the best indicator of socio-economic development of a region. Figure below shows that out of the total surveyed families of project area, about 10% are illiterate (male 10% and female 10%). The male illiteracy rate is same as female illiteracy rate in project area. So far as educational attainment is concerned 5% and 10% family members are educated up to primary and upper primary respectively whereas 30% and 15% members have studied up to secondary and Higher secondary respectively. It is observed that majority of male and females have studied up to secondary level. 20% surveyed members have graduated whereas only 0% have done post-graduation. During survey the surveyed members reported that due to the geographical location and improper transport facility they find it challenging to access educational facilities. They have to travel far to access schools and colleges. They go to Srinagar, Jammu, Chandigarh and Delhi for higher studies.



Source: RITES Field Survey, September 2022

The age group of 0-6 years is not included in the above figure

Figure 4.5: Education Level of People in the Project Area



Source: RITES Field Survey, September 2022

The age group of 0-6 years is not included in the above figure

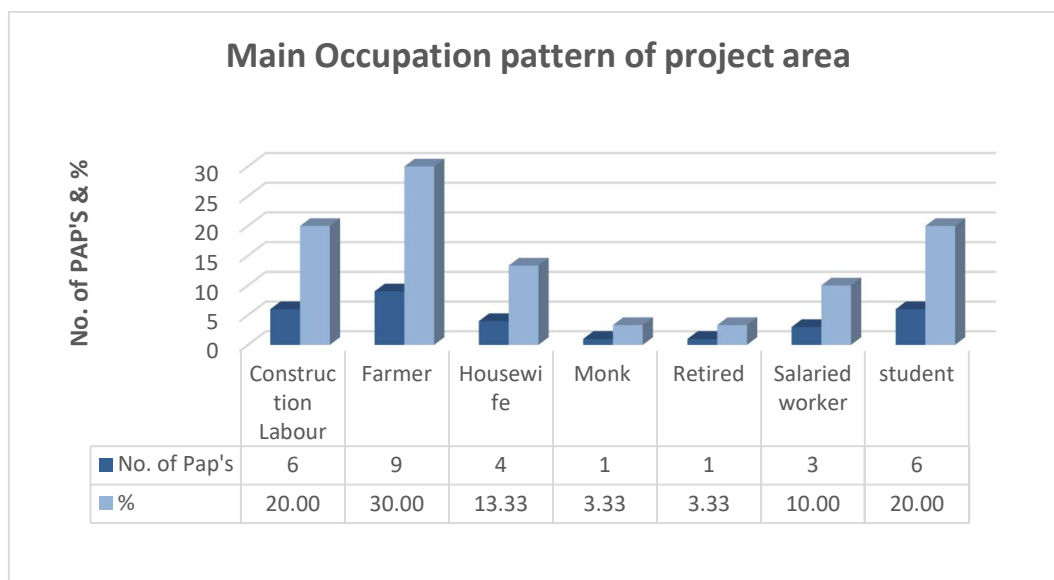
Figure 4.6: Gender Distribution of Education Level of People in the Project Area

4.8 Economic Conditions

The economic condition of surveyed households describes occupational pattern, total household income, expenditure and household's consumption pattern. The occupational pattern includes work in which the surveyed household members are involved. The household income includes the income of all the earning members in each household. The earning members include the people who work and earn to contribute to the family; however, dependents include housewife, children, elderly people and others who cannot work and earn.

4.8.1 Main occupation of Household Members

Occupational pattern of the surveyed household members in project area is recorded to assess their skill. Occupational pattern helps in identifying dominating economic activity in the area. The survey result in below figure shows that majority (30.00%) of household members are engaged in farming and other agriculture activities. Out of the total surveyed population 10.0% are salaried worker, 13.33% housewives and 3.33% are monks. 20.00% members are reported as students. The surveyed households reported that they only get to work for six months from April to September due to extreme cold desert climate. During field survey it was observed that the young students (both male and female) also engage themselves in farming and other household activities.



Source: RITES Field Survey, September 2022

Note: 0-6 years of age group are not included

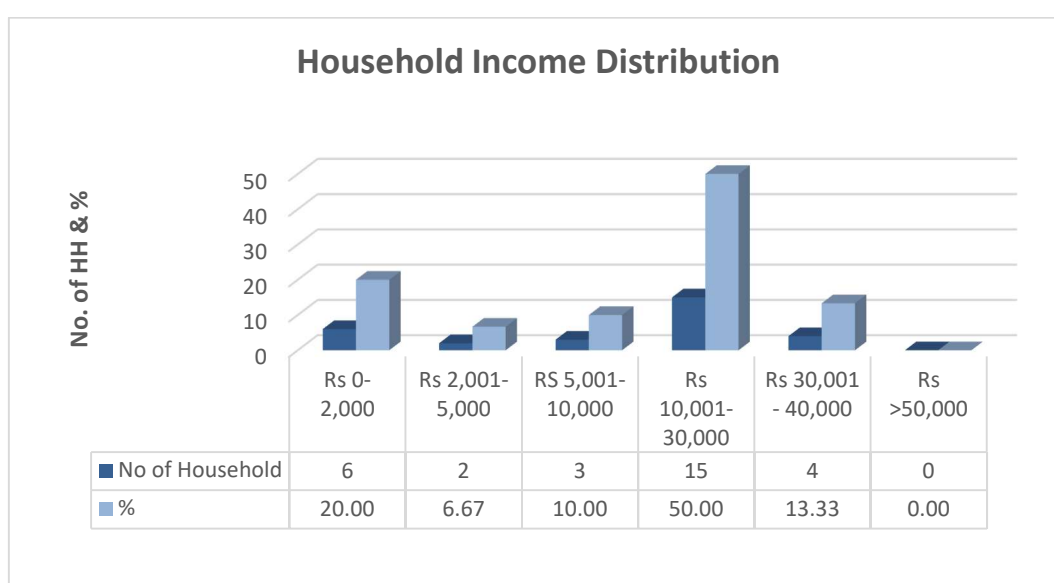
Figure 4.7: Occupation Pattern of People in the Project Area

4.8.2 Marginal Occupation of Household Members

The survey data reveals that the main occupation of the household members is farming but they also work as a construction worker (44.93%) in the ongoing road construction projects carried out BRO (Border Road Organisation) during summertime and non-cultivation period. They reported that they only get to work for six months from April to September due to extreme cold desert climate.

4.9 Household Monthly Income

Below figure shows monthly income of surveyed households. The figure shows that majority of households (50.00%) have monthly income in between Rs.10,001 to Rs. 30,000. The average monthly income of a household is Rs. 22,421/-.

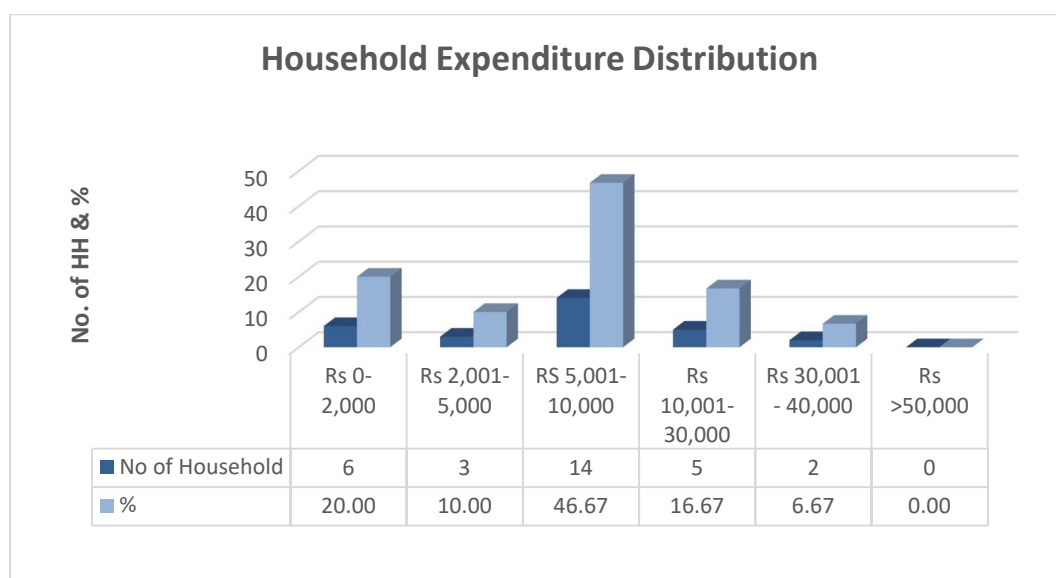


Source: RITES Field Survey, September 2022

Figure 4.8: Household Income Distribution

4.9.1 Household Monthly Expenditure and Distribution

Below figure shows that surveyed households are mostly spending on food, education, clothing, transport, health and social function. This reflects the basic necessity of the households. It is reported that 60% households fall under the expenditure range of Rs. 5,001- Rs.10,000. The average monthly expenditure of a household is Rs. 10,185/-.



Source: RITES Field Survey, September 2022

Figure 4.9: Household Expenditure Distribution

4.10 Social Characteristics

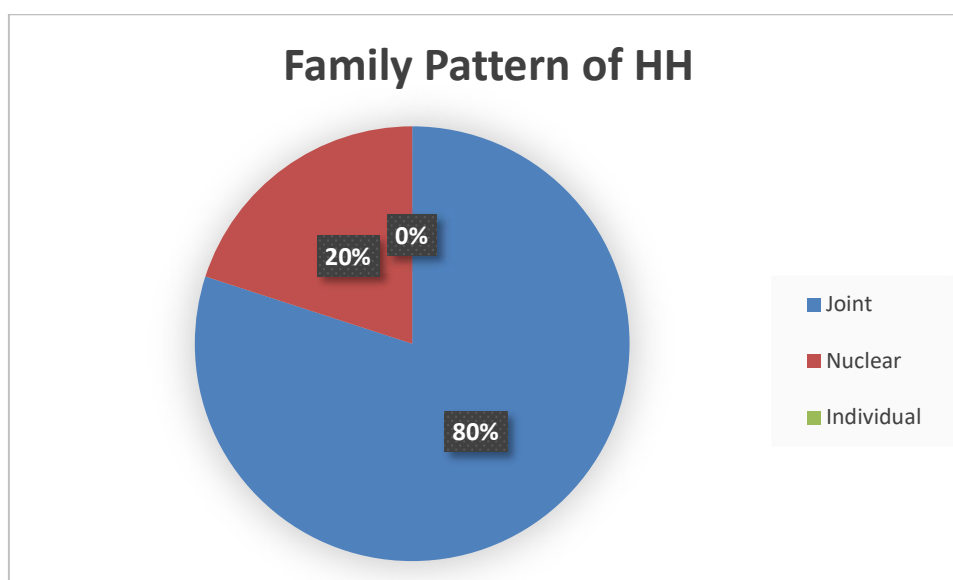
4.10.1 Religious and Social Groups

Data on religious groups was collected in order to identify people with the specific religious belief among the surveyed households. The religious beliefs and social affiliation of the people are indicators that help to understand cultural behaviour of the groups. The social and cultural behaviour will help to understand the desires and preferences of surveyed households. The study result shows that 100% of the surveyed households are Buddhists.

The social affiliation of the group differentiates them for benefits under government development schemes. Social groups indicate status within the society, preferences and vulnerability. The households belonging to Scheduled Castes (SC) and Scheduled Tribes (ST) falls under the provisions of Constitution of India and get preferential treatment in the government benefits because the group includes the people who are traditionally vulnerable. Except general category, all other groups need attention and to be addressed for their backward socio-economic conditions. The survey results show that 100% households belong to ST social group.

4.10.2 Family Pattern and Family Size

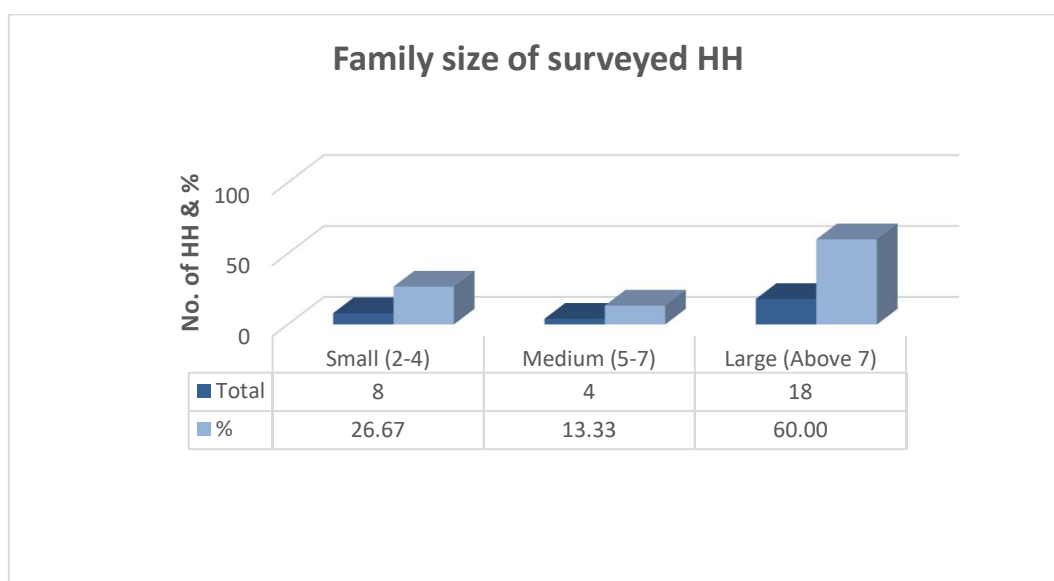
Family Pattern and Family Size indicate the fabric of sentimental attachment among the family members, social value, economic structures and financial burden. It is observed from the figure that majority of surveyed households are joint (80%) followed by nuclear (20%). No individual families are identified.



Source: RITES Field Survey, September 2022

Figure 4.10: Family Size of Surveyed Household

Family size has been classified into three categories i.e., small (2-4), medium (5-7) and large (7 & above). The below figure shows that majority of households (60%) are Large in size followed by 26.67% households are small and remaining 13.33% households are medium in size. Majority of Large size households are found.



Source: RITES Field Survey, September 2022

Figure 4.11: Family Size of Surveyed Household

4.11 Economic Indicators

The table shows the economic indicators of the surveyed household. From the table it is observed that the wall type of the majority of household (76.67%) is made of mud and brick. All the households have their own house. Majority of households (93.33%) have a separate

kitchen which is a very common factor in the region. 16.67% households have access to latrine whereas 16.67% households have access to bathroom. Most of the households in the region use open latrine. 76.67% surveyed households do not have electricity connection. Therefore, they use solar lights which has a demand in the region. 100% households reported that tap water/handpump is the source of drinking water to them. 6.67% households use firewood as fuel for cooking.

Table 4-14: Economic Indicators of Household

S. No	Type of Indicator	No. of Households	In Percentage (%)
1.	Type of Roof: Thatched	30	100
2.	Wall type		
a	Bricks	5	16.67
b	Mud Brick	23	76.67
c	Stone	2	6.66
3.	Ownership of the house		
a	Own	30	100
b	Rented	-	-
4.	Separate Kitchen		
a	Yes	28	93.33
b	No	2	6.67
5.	Latrine		
a	Yes	5	16.67
b	No	25	83.33
6.	Bathroom		
a	Yes	5	16.67
b	No	25	83.33
7.	Electricity Connection		
a	Yes	0	0
b	No	23	76.67
c	Solar	7	6.66
8.	Access to drinking water		
a	Public tap/ Hand Pump	30	100
b	River	0	0
9.	Type of fuel for Cooking		
a	LPG Gas	25	83.33
b	Gober Gas	3	10.00

c	Firewood	2	6.67
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Source: RITES Field Survey, September 2022

4.11.1 Possession of Household Assets

The figure shows possession of household assets and cattle. It is observed from the table that majority of the households have mobile phone (40%) and television (6.67%). Only one household have a motor bike and 2 have bull cart. Most of the households reported that though they have mobile phone, but they are not able to use it due network problem and lack of electricity. Majority of the households have goat/sheep followed by buffalo and yak.

4.11.2 Gender Issues

It is reported that 92% of the women are involved in financial decision of household. About 36% of the women go out to fetch water from river. Majorly (43%) both male and female member of the households fetches water from the river.

4.11.3 Indebtedness of Households

The table shows loan and indebtedness of surveyed households. It is observed that 6.67% households have taken loan from bank. The average loan amount Rs. 70,000. The major purpose of the loan was for house construction or repair and educational loan.

Table 4-15: Loan and Indebtedness of Household

S. No	Loan and Indebtedness	No. of persons	%
1	Have you taken any loan?		
a	Yes	2	6.67
b	No	28	93.33
c	Total	30	100
2	Source of loan		
a	Bank	2	100
b	Non- Institutional	0	
3	Avg. amount of loan	70,000	-
4	Purpose of loan		
a	Educational loan	1	50
b	House repair/construction	1	50

Source: RITES Field Survey, September 2022

4.11.4 Health Seeking Behavior

About 1 of the household members have suffered from diseases in past one year. It is reported that has suffered from Pneumonia. Generally, elderly family members have suffered from this kind of problem. It is observed that the patient travel 50- 60 km to access health services.

The households reported that during health emergency in winter season they request the district administration through proper channel to access airlift facility.

4.11.5 Awareness about HIV/AIDS

It is reported that 93.33% of surveyed households are aware about HIV/AIDS whereas 6.67% are unaware. More than 95% of the persons in project area are aware about the preventive measures. Majority of surveyed households have heard about HIV/AIDS from sources like print media, radio, television. Government awareness camps are the major source of information for the awareness among people.

4.12 Perceived Benefits about the Project

The table shows benefits of the proposed project perceived by the surveyed households in the project area. The impacts are reported considering the construction and operation of the project. The table comprises of both positive and negative impacts reported during socio-economic survey. Under the scope of positive impact, the households reported better connectivity in all seasons (36%), improvement of business in terms of goods and services (20%), better transport facility and time saving (16%), development of nation (12%) and agricultural benefits and production (12%). Few of them (4%) reported that the proposed project will enhance the tourism business as well. Talking about negative impacts, majority (44%) of respondents reported that air pollution due to dust during construction of the project. About 28% households reported that the project will have impact on ecology and environment followed by land and soil pollution (20%). In few villages the households (8%) reported that as because the proposed project is located far from the village therefore, they would not be able to use it.

Table 4-16: Perceived Benefits of the Project

S. No	Perceived Benefits	Percentage (%)
A.	Positive Impacts	
1	Agriculture benefits and production	13.33
2	Better connectivity in all season	36.67
3	Better Transport Facility and Time saving	16.67
4	Improvement Business in terms goods and services	20.00
5	Tourism will increase	3.33
6	Development of Nation	10.00
	<i>Total</i>	100
B.	Negative Impacts	
1	Air Pollution due to dust	43.33
2	Negative impact on ecology and environment	26.67
3	Villagers won't be able to use tunnel	10.00
4	Land and Soil Pollution	20.00
	<i>Total</i>	100

Source: RITES Field Survey, September 2022

5 ENVIRONMENTAL IMPACTS

5.1 Impact Identification

The project impacts are identified based on the available data. The potential impact of the proposed project on the environment can be in different phases of project cycles i.e. pre-construction, construction and operation. The type and magnitude of the impacts, however depends on the specific attributes of the given environment. Leopold matrix has been used to show possible interaction between developmental activities and a set of environmental characteristics. On top on X-axis, project cycle activities are considered while on Y-axis, Valued Environmental Components (VEC) are taken to identify the impacts, through interaction method. The boxes are marked with possible impact during different phases of project cycles. Impacts on environmental component due to project activities are summarized in **Table 5-1**.

Table 5-1: Impact Matrix for Potential Environmental Impacts

	Pre construction phase	Construction Phase							Operation Phase
Project Activity Component Affected	Land Acquisition	Site clearance	Removing trees and vegetation	Contractor camps	Vehicles & Machines operation and maintenance	Quarries	Construction	Asphalt crusher plants	Operation
Soil	Loss of Vegetation	Loss of Vegetation	Erosion and loss of topsoil	Contamination from wastes	Contamination by fuel and lubricants Compaction of soil	Increase in erosion, siltation and slope instability	Soil pollution	Pollution due to spills	-
Surface water	Loss of water body	Change in water quality and siltation	Siltation	Pollution from sanitary & other wastes	Contamination by fuel & lubricants	Water logging and mosquito breeding	Change in water quality	Pollution due to spill into water bodies	Degradation due to spillovers & road runoff
Drainage	-	Change in natural drainage pattern	Change in natural drainage pattern	Change in drainage pattern due to disposal of wastes on soils	Change in natural drainage pattern due to spills	Change in drainage pattern	Interference with natural drainage and water logging		Cleaning & maintenance
Air Quality	-	Increase in PM	Reduced buffering of air pollution, change in climatic conditions	Pollution due to fuel burning	Dust & air pollution	Dust pollution	Dust pollution and odor problems	PM, SO ₂	Increase in PM, SO ₂ and NO _x
Noise	-	Increase	Reduced	-	Increase in	Vibration	Vibrators,	In-	In-

Quality		in Noise level	buffering of Noise		Noise level	from blasting operations	mixing plant noise etc.	crease in Noise	crease in noise levels due to increased traffic.
Flora & Fauna	-	Loss of Vegetation and migration of wildlife	Loss of vegetation and disturbance to wildlife	-	-	Loss of Vegetation and migration of wildlife	Disturbance of Wildlife	Loss of Vegetation	Collision with Wildlife
Forest	-	Habitat loss and vegetation	Loss of forest	Encroachment into forest areas	Disturbance to Wildlife	Loss of habitat/cover	Loss of forest	-	Disturbance to wildlife

This Chapter identifies and assesses various impacts likely to result from the proposed development on environmental baseline conditions. The impacts are categorized as Direct and Indirect impacts. Direct impacts are those which are attributed directly by the project on environmental attributes, whereas indirect impacts are those which are associated with long term changes on the environmental settings.

5.2 Impact on Natural Environment

The main impact likely to take place on the Natural environment is the climate. Though no change in the macro-climatic setting (precipitation, temperature, and wind) is envisaged due to the project, the microclimate is likely to be temporarily modified by vegetation removal and the addition of increased pavement surface. The impact will be felt more by the slow-moving traffic and pedestrians along the project road.

5.3 Impact on Land Environment

The impacts which are likely to take place due to the project location on land environment have been assessed and described in subsequent sections.

5.3.1 Change of Land Use Pattern

The development in the study area will bring substantial change in the land use pattern of the area as the tunnel and its approach road construction will require cut and fill operations on the barren land. The land requirement details will be worked out during the DPR stage of the project, based on the road design and geometry. The land to be acquired is predominantly unmeasured barren land.

5.3.2 Impact on Soil

The impact on soil quality will be in terms of topsoil erosion and its compaction due to location of labour camps, buildings, borrow pits, asphalt plant, concrete plant, quarries, and storage of material and machines. The construction will be completed in 3 Years. Moreover, soil quality may change due the disposal of waste material on the open ground. The waste likely to fall on the ground will be solid waste / liquid waste form labour camps. Proper care should be taken

while locating the above utilities / facilities to minimize the impact on soil in nearby areas. The impacts are of short duration and will be reversible.

5.3.3 Soil Erosion

The soil erosion is likely to take place due to the proposed tunnelling and its approach roads. The Environmental Management Plan (EMP) can ensure that no productive areas are used for borrow pit for the requirement of earthwork.

5.3.4 Borrow/Quarry Areas

The excavations of earth from borrow areas will require cutting of the soil, which could lead to:

- Loss of productive soil/ land,
- Disruption in the drainage pattern,
- Ponding / water logging problem and
- Increase in siltation rates.

Under the management plan the excavated pit sites are required to be restored and reclaimed in a satisfactory manner on completion of quarry operations. As the quarry will be restored and reclaimed by the contractor, impact on land environment will be of short duration and could be managed by the management plans. Though the impact on productive soil is unavoidable, adequate measures need to be worked out for minimizing the loss of soil, as by storing of topsoil to be laid back after the construction period etc. Emphasis should be laid on maximum use of the stripped topsoil.

5.3.5 Muck Disposal

A large quantity of muck is expected to be generated because of tunnelling operations, construction of temporary service roads, etc. Muck generated from tunnelling activities is required to be disposed in a planned manner so that it takes a least possible space and is not hazardous to the environment. The muck disposal sites may cause increased sedimentation in the surface runoffs and impact the aesthetics of the area.

Part of the muck generated shall be reused for production of aggregate and the balance muck shall be disposed of in an environmentally friendly manner.

5.3.6 Impact due to Snow Avalanche

The avalanche occurs on hill slopes due to loss of balance between gravitational force component and resisting forces. The resisting force is frictional resistance of the slope or the anchoring effects of shrubs. Avalanches are rarely observed closely since they normally occur during a short time of one or two minutes. Avalanches are river-like flow of snow or ice descending from mountain tops and are common in the high ranges of the Himalayas. Avalanches also cause great damage to life and property. Some of the impacts of the avalanches are

- Roads are damaged by snow of the avalanches.

- Traffic is blocked when an avalanche falls on a road.
- Road structures such as retaining walls are overturned.
- Structures coming in the way of an avalanche are damaged.

The project area of proposed tunnels and its approach roads are in avalanche prone area. Engineering measures shall be considered while designing the Tunnel and its approach roads in consultation with SASE.

5.3.7 Risk due to Seismicity

The project area lies in Zone IV as per revised Seismic Zoning Map of India corresponding to high seismic hazard. Engineering measures shall be considered to meet the regulatory codal provisions.

5.4 Air Environment - Impacts

The impacts on air environmental, which will be during project construction and operation phases are described below:

5.4.1 Impact during Construction

Although, in the construction phase, air quality impacts are of short duration. Consumption of diesel during construction activities will be the principal cause of incremental air pollution. Diesel powered trucks required for the haulage of aggregates, earth and other construction material and running of construction machinery at the construction yards are the major sources of air pollution.

Transportation of borrow earth, other construction material and disposal of muck which shows the rise in traffic volume due to the material haulage and other construction activities during the period of major material transport. The air quality will be impacted due to the movement of trucks. These impacts can be minimized by transporting the materials during the off-peak hours and adopting other mitigation measures.

5.4.2 Impact during Operation

The extent of these impacts will depend upon i) the rate of vehicular emission and ii) the prevailing meteorological conditions. Air quality impact during operation phase is considered as negligible, as the density of traffic is very less in the project area and existing air quality parameters are well within the prescribed limits.

5.5 Impacts on Water Environment

Water environment consists of water bodies, water supply sources such as ponds, natural drains, rivers and nallas etc. The impacts on water environment will be both during project construction and operation phases.

5.5.1 Change in Natural Drainage Pattern

The roads that intersect drainage basins generally modify the natural flow of surface water by concentrating the flow to certain points and increasing the velocity of flow. Depending upon the flow, these changes can contribute to flooding, soil erosion, channel modification, siltation of streams etc. These effects are often felt well beyond the immediate vicinity of the road.

5.5.2 Pollution at Construction Site

Construction materials will be required for the construction of road pavement, bridges and culverts, roadside amenities etc. About 10-15% of the construction material is left behind by the contractor as construction waste / spoils. Dumping of construction waste / spoil in haphazard manner may cause surface and ground water pollution near the construction sites, hence, it is proposed to clean the area and dump/dispose the construction spoils at the dumping site specified by the local municipality / authority to avoid any adverse impact on health and well-being of people.

5.5.3 Health Risks due to Waste Disposal

Health risks include disease hazards due to lack of sanitation facilities (water supply and human waste disposal) to the workers during construction both at construction site and at Contractor's camp. Unscientific disposal of waste from contractor's camp can lead to contamination of both ground and surface water. This could lead to outbreak of water borne disease such as diarrhoea, dysentery, typhoid etc due to lack of sanitation facilities (water supply and human waste disposal) to the workers both at construction site and at contractor's camp. The solid waste generated in contractor's camp if not treated properly may cause leaching and environmental pollution. Mitigation measures include proper sanitation, health care, and solid waste disposal facilities. In addition to these, efforts need to be made to avoid water spills, adopt disease control measures.

5.5.4 Water requirement for project

The water requirement will be increased during construction phase. Sufficient water for construction purpose is available from streams and rivers in the project area. Identification of suitable locations should be carried out to safeguard the nearby environment.

5.5.5 Water Quality

The construction of the proposed project will not have any major impact on the surface water quality in the area. Contamination of water bodies may result due to spilling of construction materials, oils and greases and paint during transportation and at the equipment yards and asphalt plants. But the quantity of such spill will be negligible. Care needs to be taken to provide adequate sanitary facilities and drainage in the temporary colonies of the construction workers. Provision of adequate washing and toilet facilities with septic tanks and appropriate refuse collection and disposal system should be made obligatory.

Ground water contamination can take place only if chemical substances get leached by precipitation of water and percolate to the ground water table and by dumping of the used waste from construction colony. This is not the case with the present project, as the activity does not

contain any harmful ingredients, which could leach down to water table. Therefore, no impact on ground water quality is anticipated from the project during the construction and operation phase.

5.6 Impact on Noise Environment

Noise associated with the proposed tunnel and road development affects the environment. The main sources of noise are vehicles, friction between vehicles and the road surface, driver behaviour, and construction & maintenance activity.

Vehicle noise comes from the engine, transmission, exhaust, and suspension, and is greatest during acceleration, on upgrades, during engine braking, on rough roads, and in stop-and-go traffic conditions. Poor vehicle maintenance is a contributing factor to this noise source. Frictional noise from the contact between tires and pavement contributes significantly to overall traffic noise. The level depends on the type and condition of tires and pavement. Frictional noise is generally greatest at high speed and during quick braking. Drivers contribute to road noise by using their vehicles' horns, by playing loud music, and sudden braking or acceleration. Road construction and maintenance generally require the use of heavy machinery, and although these activities may be intermittent and localized, they nevertheless contribute sustained noise during equipment operation.

5.6.1 Impact during Construction

During the construction phase of project, noise will be generated from the various sources. For prediction, no ground attenuation has been considered as ground was assumed to be undisturbed, consolidated, and hard. Estimation of noise levels during construction phase has been done as per guidelines specified in "Transit Noise and Vibration Impact Assessment, May 2006 by Federal Transit Administration (FTA)". Noise Levels for all equipment have been modelled and given in **Table 5-2**.

Table 5-2: Construction Equipment Noise

Equipment	Noise level (in Leq dB(A) at 50 ft)	Equipment Noise (Leq) in dB (A) at various distances				
		50m	100m	200m	300m	400m
Auger drill	84	72	64	57	53	50
Generator	81	69	61	54	50	47
Chiseling	88	76	68	61	57	54
Crane	88	76	68	61	57	54
Concrete Pump truck	81	69	61	54	50	47
Dumper	76	64	56	49	45	42
Dozer	85	73	65	58	54	51
Compactor	82	70	62	55	51	48
Grader	85	73	65	58	54	51
Concrete Mixer	85	73	65	58	54	51
Truck	88	76	68	61	57	54

Construction activities are expected to produce noise levels in the range of 76-88 dB(A) at 15 m distance which will decrease with increase in distance. As noted from the table, at 400 m away from the source, the noise attenuates up to the standards of daytime for residential areas.

There are no sensitive receptors around the project site which will have direct noise impact due to construction activity. It could therefore be concluded that the construction activities would not have a significant impact on existing ambient noise levels. Secondly, major construction activities are within tunnel, hence there will not be significant impact on the ambient environment. The overall impact of noise during construction will be for short-term (for daytime only) and can be mitigated.

Due to the high noise levels of some construction machinery, the personnel operating near the machines and the workers stationed close to the machines are prone to exposure of high levels of noise. Use of personal protective equipment will reduce noise impact on personnel.

5.6.2 Impact during Operation

During the operation phase of the road, movement of heavy and light vehicles is expected to give rise to higher ambient noise levels. Assessment of noise impacts due to the project have been carried out using Highway Noise Model based on the guidelines suggested by Federal Highway Administration (FHWA).

The vehicular noise emission levels vary significantly with speed. It therefore becomes necessary that speed dependency of the noise emissions for different categories of vehicles should be considered. Noise emitted by different vehicles at 60 KMPH speed is given in **Table 5-3**.

Table 5-3: Noise Emitted by different Vehicles

Speed (KMPH)	Vehicle Type			
	Cars	Trucks	Buses	2-Wheelers
60	65.0	81.0	81.0	68.0

5.7 Impact on Ecological Environment

The construction works at the project site involving land clearance, cutting, filling, levelling, and tunnelling will lead to loss of vegetation cover. Most of the land in the project area is barren land without any vegetation; hence no impact is anticipated.

5.7.1 Loss of Biomass

Land use of the proposed tunnel portals and its south approach road is alpine pastures. Vegetation cover is very less in the project area due to heavy snowfall in winter and the snow remains almost throughout the year. During the survey, no trees are observed within ROW and in project area, hence no loss of biomass is anticipated.

5.7.2 Forest & Wildlife

The proposed tunnels and its approach roads not passing through any type of forest. The project area is habitat for snow leopard, Tibetan Wildass, Snow Fox, Wild Yak, Blue Sheep, Marmot, and Ibex etc. The site does not form a part of any National Park, Wildlife Sanctuary, Biosphere Reserve, Tiger Reserve, Elephant corridor etc. The construction of the proposed project and other activities related to the project does not encroach into any National Park or wildlife sanctuary. Wildlife conservation plan is required to protect the fauna in the project area.

5.8 Other Impacts

5.8.1 Impact due to Hazardous Waste

Hazardous waste would mainly arise from the maintenance of equipment which may include used engine oils, hydraulic fluids, waste fuel, spent mineral oil/cleaning fluids from mechanical machinery, scrap batteries or spent acid/alkali, spent solvents etc. Unsafe disposal can result in water and soil pollution.

5.8.2 Impacts due to Labour Camps

Improper disposal of municipal solid waste generated by labour camps can pollute surface water bodies and groundwater. Burning of waste can cause air pollution. Construction workers are more prone to infectious diseases due to unsafe sexual activity and lack of sanitation facilities (water supply and human waste disposal) and insect vectors. Problems could arise due

to cultural differences between workers from outside and residents. About 500 persons are likely to work during peak construction activity. Two labour camps will be proposed at appropriate locations. The water requirement at labour camp at each camp will be 33.75 KLD, wastewater generation 27.0 KLD & Municipal solid waste generation 75 Kg per day.

5.8.3 Welfare of Labour on construction site

Facilities such as shelter at workplace, canteen, first aid and day crèche are statutory requirement and essential to productivity.

5.8.4 Safety of Labour

Safety of labour during construction on elevated and underground sections is a statutory requirement and has impact on progress of work.

5.8.5 Vibration Impacts

A blast during tunnel construction generates ground shock and vibration which may cause damage to the surrounding structures. No structure is located near to the proposed tunnel. However, the vibration may trigger landslide/avalanches in the project area. Necessary engineering measures need to be taken during blasts.

5.9 Socio-Economic Impacts

5.9.1 Potential Social Impacts

There is no private land acquisition is required for the proposed Fotu La Tunnel project and its approach roads. No structures are affected in the project area. Therefore, no displacement is going to take place.

5.9.2 Health Impacts

The construction of the proposed project may take approximately 3 years, during which manpower will be required for various construction activities. A large force of labours may be required during construction of the project. The major and most immediate adverse health impacts are expected in the project area where construction and camps of workers and camp followers (families of workers and service providers) are concentrated. These impacts would consist of communicable diseases (food, water-borne, sexually transmitted disease and HIV/AIDS) and road traffic and construction related accidents.

5.9.3 Pressure on Existing Infrastructure

The construction of the proposed project may take about 3 years, during which manpower will be required for various construction activities. The workers migrating from outside of the project area, aggregation of workers along with their families is likely to put significant pressure on existing infrastructure facilities in the project area. Necessary infrastructure shall be developed in the workers camp area. As the project is proposed in remote area, no pressure on ex-

isting infrastructure is anticipated. In addition to that preference shall be given to local people for employment during construction.

5.9.4 Cultural Conflicts

The project area has unique culture having distinct habit of food and clothing. The people have deep faiths in religions. During construction period of the project, migrant population is expected from other parts of the country having different cultural beliefs and practices. However, no cultural conflict is foreseen as

- The workers camps are located far away from the local settlements.
- Preference will be given to local people for employment during construction
- Local people are accustomed to multicultural interfaces as the project area has so many tourist places

5.9.5 Woman and Gender Issues

It is observed during the field study and discussion with the women that no negative impacts were reported on the woman population in the project area. In the project area, woman population fully participates in ongoing construction and agricultural works. Hence no impact on Woman and gender issues are anticipated.

5.9.6 Anticipated Change

The proposed project will improve the communication in between Manali and Leh. The proposed project may lead to development of the remote Himalayan Range which may lead to overall growth of the region.

6 ENVIRONMENTAL MONITORING PLAN

The environmental monitoring programmes of development project are a vital process of any Environmental Management Plan (EMP) for review of indicators and take immediate preventive action. This helps in signalling the potential problems resulting from the proposed project activities and will allow for prompt implementation of corrective measures. The environmental monitoring will be required during both construction and operational phases. The following parameters are proposed to be monitored:

- Water Quality,
- Air Quality and Noise,
- Soil Quality monitoring,
- Ecological Monitoring,

6.1 Construction Phase

Monitoring schedule for the entire period of construction is summarized in **Table 6-1**. The number of locations could be modified based on need when the construction commences. Monitoring should be carried out by NABL Accredited/MoEFCC recognized private or Government agency. The contractor will be responsible for carrying out monitoring during construction under the supervision of PIU. The results of air, noise, soil, ecology water quality and wastewater monitoring will be submitted to management quarterly during construction phase.

Table 6-1: Construction Stage Monitoring Schedule

Parameter	Frequency	Locations (Numbers)	Reference/ Standard	Implementation by / Approval by
Air	Twice (48 hours) in Two weeks for entire construction period.	5	<ul style="list-style-type: none"> • Guidelines for Ambient Air Quality Monitoring, CPCB, 2003 • National Ambient Air Quality Standards 2009 	Contractor/PWD Ladhak
Noise	Twice (48 hours) in Two weeks for entire construction period.	5	<ul style="list-style-type: none"> • Protocol for Ambient Level Noise Monitoring, CPCB, May 2015 	Contractor/PWD Ladhak
Water and wastewater	Once in a season, Two seasons in a Year	Water: 7 Wastewater: 2	<ul style="list-style-type: none"> • Guide Manual – Water and wastewater analysis, CPCB • Drinking water – Specifications IS 10500: 2012 and CPHEEO Manual 2012 	Contractor/PWD Ladhak
Soil	Once in a season, Two seasons in a Year	6	As per EMP	Contractor/PWD Ladhak

Ecology	Two times in a year for entire construction period	Muck Dumping sites	As per Forest authorities	Contractor/PWD Ladhak
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Epidemiological studies at construction sites will be performed to monitor the potential spread of diseases. Regular inspection and medical check-ups shall be carried out to workers health and safety monitoring. Any recurrence of health incidents shall be recorded, and appropriate mitigation measures shall be taken. Contractor will be responsible to take care of health and safety of workers during construction and project proponent is responsible to review/audit the health and safety measures/plans.

The estimated environmental monitoring cost during construction phase will be Rs 23.48 Lakh per Year. The estimated cost towards environmental monitoring during construction will be part of civil contract.

6.2 Operation Phase

The monitoring schedule is presented in **Table 6-2**. The results of air quality, water quality and wastewater will be submitted to management bi-annually during operation phase. The estimated environmental monitoring cost during operation phase is Rs 16.46 Lakh per Year.

Table 6-2: Operation Stage Monitoring Schedule

Parameter	Frequency	Locations (Numbers)	Reference/ Standard	Implementation by / Approval by	Period (Years)
Air	2x24 hours in a season, Two seasons in a year	3	<ul style="list-style-type: none"> Guidelines for Ambient Air Quality Monitoring, CPCB, 2003 National Ambient Air Quality Standards 2009 	PWD Ladakh	4
Noise	2x24 hours in a season, Two seasons in a year	3	<ul style="list-style-type: none"> Protocol for Ambient Level Noise Monitoring, CPCB, May 2015 	PWD Ladakh	4
Water	Once in a season, Two seasons in a Year	Water: 5	<ul style="list-style-type: none"> Guide Manual – Water and wastewater analysis, CPCB Drinking water – Specifications IS 10500: 2012 and CPHEEO Manual 2012 	PWD Ladakh	4
Soil	Once in a season, Two seasons in a Year	4	As per EMP	PWD Ladakh	4
Ecology	Once in a Year	Muck Dumping sites	As per Forest authorities	PWD Ladakh	4

7 PROJECT BENEFITS

Based on project particulars and the existing environmental conditions project benefits have been identified that are likely to result from the proposed project.

7.1 All Weather Connectivity

The proposed project seeks to introduce a tunnel across the Fotu La pass, thereby facilitating reduction in travel time & distance between Leh and Kargil. The road intends to achieve all weather connectivity by introducing the tunnels between Kargil to Leh, by further Development of road networks in the Union Territory of Ladakh.

7.2 Employment Opportunities

The project is likely to be completed in 3 years. During this period, the manpower will be needed to take part in various project activities. It is assumed that 500 persons per day are likely to work directly and indirectly during the peak construction periods. In the post construction phase the project will provide social benefits in terms of direct employment by way of better development of the area. Additionally, more people may be indirectly employed in allied activities and trade.

7.3 Enhancement of Rural Economy

The project is a major link for all weather connectivity between Kargil and Leh. With the commissioning of the project overall conditions in the project area will improve. This will facilitate the rural population to move from one place to another to bring and sell their produce. The national highway will facilitate rural population to move quickly towards urban centres and return there from. With the development of the project, more people from the region will be involved in trade, commerce, and allied services. With the availability of dependable road connection, commercial growth of the region is also likely to witness accelerated growth of economy.

7.4 Reduction in Length and Travel Time

The existing road from Kargil to Leh is non operable during a significant time of the year. Any kind of improvement to existing road cannot make it all- weather road without a tunnel proposal. The incremental benefits of an improved alignment with tunnel would be higher compared to its current state. The proposed tunnel and its approach roads provide faster access between Kargil and Leh results in reduction in length and travel time.

7.5 Enhanced Social Interaction

With the construction of proposed tunnel and its approaches, social interaction among villages shall be strengthened. The general quality of life along the route will be enhanced.

7.6 Increased Tourism Potential

The proposed project provides better infrastructure to the area which will act as a catalyst for economic development and employment generation by enhancing the tourism potential. The tourist can also visit in winter as the proposed project have all weather connectivity.

7.7 Revenue Generation

The construction of the project will generate indirect revenue to the local people due to employment opportunity as working in shops, transport, restaurant, hotel etc.

8 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) contains set of mitigation measures for lessening of negative environmental impacts. The aim of mitigation measures is to protect and enhance the existing environment of the project. Mitigation measures require implementation during pre-construction, construction, and operation phase to ensure that proposed actions are carried out at the correct times. An abstract of the EMP for the project has been prepared and presented in **Table 8-1**.

Table 8-1: Environmental Management Plan

Environmental Impact/ Issue	Mitigation Measure	Location	Time Frame	Responsibility	
				Implementation	Supervision
1. PRE-CONSTRUCTION/PROJECT LOCATION					
Failure to include environmental clauses in contracts defining the mitigation actions with time frame and measurable	Incorporate works contract clauses with reference to EMP.	As required	Before construction begins	PWD Ladhak	PWD Ladhak
2. CONSTRUCTION					
Lack of environmental awareness among project engineers/ managers	Environmental training programs should be organized for effective implementation of the EMP	On project sites	During construction	Training consultant/ or PIU	PWD Ladhak
Uncontrolled erosion of soil	Selection of appropriate site for muck disposal, compaction, and its maintenance.	Muck disposal area, cutting and filling area	Entire construction period	Contractor	PWD Ladhak
Unscheduled felling of trees	Provide cooking fuel at workers camp to control unauthorized tree cutting for fuel wood.	All labour camps	Entire construction period	Contractor	PWD Ladhak
Air and noise pollution	Implement pollution control measures.	Throughout project area	Entire construction period	Contractor	PWD Ladhak
Drinking water facility and Pollution Control	Provide drinking water facility and wastewater /solid waste	All workers camp	Throughout construction period	Contractor	PWD Ladhak

Environmental Impact/ Issue	Mitigation Measure	Location	Time Frame	Responsibility	
				Implementation	Supervision
at Workers Camp	management facility				
Workers health hazard on site	First aid facilities, canteen, creche etc at every work site should be provided at contractors cost, which need to be mentioned in the Tender conditions	At construction site and labour camp	Throughout construction period	Contractor	PWD Ladhak
Cultural hazards	Priority to local people for employment	All construction works	Throughout construction period	Contractor	PWD Ladhak

8.1 EMP during Pre-Construction Phase

8.1.1 Wildlife Conservation plan

Wildlife Conservation Plan is proposed to safeguard and conserve the wildlife in the project area. The study area consists of REET species flora and fauna; therefore, conservation plan is important. Various tasks to be followed under the Wildlife Conservation Plan are as follows:

A. Identification of Wildlife

During the survey, identification of wildlife in various categories has been accomplished based on the discussion with local people and consultation with Divisional Forest Officer (DFO) (wildlife). During the survey, it was found that there are Schedule 1 species like Snow Leopard, Brown Bear, Ibex, Blue Sheep, and Steppe eagle. Out of these, Steppe Eagle is endangered; Snow Leopard, Brown Bear are vulnerable; Ibex and Blue Sheep are near threatened. Along with the endangered vulnerable group, protection of other common wildlife has also been taken into consideration.

B. Creation of a Separate Taskforce

During the execution and operation of the project, a separate task force will be created. This task force will consist of a wildlife expert with support staffs. The cell shall remain under administrative control of Project Manager; PWD Ladhak. The taskforce will take assistance from concerned DFO of the region. It shall be responsibility of taskforce to identify the area of thrust methodology and implementation of wildlife rehabilitation plan. It is also proposed to setup few forest check posts in the project area for checking the illegal poaching activities which is very much essential that these wild animals may move into the project area during winters due to snow fall in upper reaches.

C. Conservation of Wildlife

The isolation of animal species due to fragmentation of habitats reduces relict populations to unviable levels, leading to local extinction. For the vulnerable and endangered species, provisions of alternative homes are imperative. If in-situ conservation is not feasible, ex-situ conservation should be adopted to receive back the captive population.

D. Creation of New Habitats and Restoration of degraded Habitats

Creation of new habitats and the restoration and management of degraded habitat is a vital objective to provide sufficient habitat for the affected species. Sites for new habitats and the degraded habitats must urgently be identified for creation/restoration, which would involve a combination of protection, soil and water conservation and planting of local species, coupled with the removal of exotics. The primary strategy for restoration should be through natural regeneration with the help of wild pollinators and seed dispersal. Grasslands, wetlands and common grazing lands are extremely valuable for wildlife conservation.

E. Monitoring

Monitoring and research are tools for a better understanding of nature, its functions and to enable optimum or sustainable utilization of its resources, as well as to evaluate the conservation status of species and habitats and the extent of impact of conservation endeavours undertaken. Such understanding will also help reduce man-animal conflicts. Implementation of wildlife conservation and protection will be done through the task force deputed for the work and monitoring of the work will be done by DFO.

8.1.2 Snow Avalanche Mitigation

The following preventive measures are to be considered when avalanche hazard prone slopes are identified in the project area.

- a) Afforestation programmes for areas where there is risk of avalanches.
- b) Maintain and update the Map of snow avalanche prone areas.
- c) Developing designs and plans for evacuations and closure of traffic routes.
- d) Trapping the avalanche by control measures.
- e) Disposing the avalanche potential snow-packs by artificial triggering
- f) Predicting the occurrence of avalanches through stability analysis and issuing warning about impending avalanche.
- g) Guiding the residents about the emergency evacuation shelters.
- h) Concerned agencies will have a close coordination with SASE.

Prevention Structures: These structures are meant for preventing the occurrence of avalanches. Following are the major preventive structures.

- (i) Avalanches Prevention Forest: These prevent the movement of avalanches by the resistance of tree trunks and branches, increase the stability of snow cover by uniformly distributing it and control quick changes in snow cover.
- (ii) Stepped Terraces: These help in stabilising the snow cover. Stepped terraces are easy to construct but are not effective in controlling surface layer avalanches.
- (iii) Avalanche Control Piles: Avalanche Control Piles are assemblies of single piles driven into slopes in avalanche zones to control surface layer avalanches. Spacing of piles

depends upon the type of snow or topographical features. The average spacing is about 5 metres.

- (iv) **Avalanche Control Fence:** Avalanche Control Fence is installed on slopes of avalanche zones to prevent full depth or surface layer avalanches.
- (v) **Suspended Fences:** Suspended fences are used in steep slopes or in areas where foundations cannot be properly installed because of poor ground conditions. These are useful in small area.
- (vi) **Snow Cornice Control Structures:** These structures are installed at tops of mountain areas to prevent the development of snow cornices that can cause avalanches.

Protection Structures: These structures are installed in the path of the avalanche or in snow deposit areas to change the flow of direction of avalanches, to reduce their energy to block their flow or to allow their passage. Following are the main protective structures.

- (i) **Protective Fences:** These are installed to block the avalanches and their action as like that of retaining walls. They are normally constructed of steel and are used mainly for blocking small avalanches.
- (ii) **Retaining Walls:** Retaining walls are normally installed in snow deposit areas to block the flow of avalanches before they reach the roadside. These walls need a pocket large enough to store snow deposited by avalanches and are not very effective unless they are installed on gentle slopes of 20 degrees or less.
- (iii) **Deflecting Structure:** As the name indicates, these structures are installed to deflect the flow of an avalanche. This is done particularly to avoid interference of the avalanche in road traffic.
- (iv) **Snow sheds:** Snow shed is a roofed structure installed over a road to allow the flow of an avalanche over the roof. This is most reliable of the various avalanche protection structures.
- (v) **Retarding Structure:** These are structures to reduce the flow velocity or the scale of the avalanches. There are various types such as earth mounds, retarding piles, grating crib work and retarding fences.

Other Control Measures: Apart from the above-mentioned measures, there are other control measures which are briefly described as under.

- (i) **Prediction and Forecasting:** Prediction and forecasting is a very effective method of reducing the risk from avalanches. These measures can not only prevent avalanche disasters but can also make it efficiently dispose of dangerous snow deposits and cornices.
- (ii) **Disposal of Avalanches Potential Snow-packs:** disposal of snow-packs on hazardous slopes by the use blasting powder. In general, small avalanches are usually disposed of by blasting.

8.2 EMP during Construction

8.2.1 Construction Material Management and Housekeeping

Procedures for storage, handling and transport of construction material shall be prescribed in SHE method statement approved for construction.

Housekeeping is to keep the working environment cleared of all unnecessary waste, thereby providing a firstline of defence against accidents and injuries. It is the responsibility of Contractor and all site personnel. Some of the measures are listed below:

- a) Full height fence, barriers, barricades etc. shall be erected around the site to prevent the surrounding area from excavated soil, rubbish etc, which may cause inconvenience to and endanger the public.
- b) All stairways, passageways and gangways shall be maintained without any blockages or obstructions. All emergency exits passageways, exits fire doors, break-glass alarm points, fire-fighting equipment, first aid stations, and other emergency stations shall be kept clean, unobstructed and in good working order.
- c) All surplus earth and debris shall be removed/disposed off from the working areas to officially designated dumpsites. Trucks carrying sand, earth and any pulverized materials etc. shall be covered while moving.
- d) Unused/surplus cables, steel items and steel scrap within the working areas shall be removed to identified locations.
- e) All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations.
- f) Empty cement bags and other packaging material shall be properly stacked and removed.
- g) Proper and safe stacking of material is of paramount importance at yards, stores, and such locations for future use. The storage area shall be well laid out with easy access and material stored / stacked in an orderly and safe manner.
- h) Flammable chemicals/compressed gas cylinders shall be safely stored.

8.2.2 Hazardous Waste Management

It shall be the responsibility of the contractor to ensure that hazardous wastes are labeled, recorded, stored in impermeable containment and for periods not exceeding mandated periods and, in a manner, suitable for handling storage and transport. The contractor shall maintain a record of sale, transfer, storage of such waste and make these records available for inspection. The contractor shall approach only Authorized Recyclers for treatment and disposal of Hazardous Waste, under intimation to the Project Authority. The treatment and disposal sites will be identified by PWD such that pollution of water bodies and green areas are not impacted, and displacement of persons is not involved.

8.2.3 Muck Disposal

The muck /excavated material shall be graded such that part can be re-used in construction; balance will be disposed. Before start of tunnelling works, the Contractor will be required to test the muck/soil quality including heavy metals and the results will be compared with standards. If the soil is contaminated, disposal will be done with due treatment or isolation of such muck.

Disposal sites will be identified by PWD in consultation with Revenue and Forest authorities such that pollution of water bodies and green areas are not impacted, and displacement of persons is not involved. The following activities are involved:

- Disposal sites shall be cleaned and then treated so that leached water does not contaminate the Ground Water.
- Material will be stock piled with suitable slopes
- Material will be stabilised each day by watering or other accepted dust suppression techniques. The muck shall be filled in the dumping site in layers and compacted mechanically.
- Once the filling is complete, the entire muck disposal area shall be provided with a layer of good earth on the top and covered with vegetation.

8.2.4 Labour Camp

The Contractor during the progress of work will provide, erect, and maintain necessary (temporary) living accommodation and ancillary facilities for labour.

Water supply, wastewater, and sewage treatment: Uncontaminated water for drinking, cooking, and washing, health care, latrines and urinals, system for conveyance, treatment and disposal of sewage and solid waste shall be provided at each labour camp. Adequate washing and bathing places shall be provided, and the place should be kept in clean and drained condition. Water requirement of 33.75 KLD for drinking, washing and other uses at each camp will be provided by the contractor from nearby sources. Wastewater generated from each camp will be 27.0 KLD, which should be treated by sludge digesters and the effluent will be disposed of on the land after confirming to inland discharge standards.

Solid Waste Management: The waste generated at each camp will be 75 Kg per day. Garbage bins must be provided in the camp for collection and the bins should be regularly emptied and the garbage should be disposed of in a hygienic manner. Solid waste generated will be collected and transported to local municipal bins for onward disposal to nearby disposal site.

8.2.5 Welfare of Labour on Construction Site

At every workplace, shelter shall be provided free of cost, separately for use of men and women labourers. The height of shelter shall not be less than 3m from floor level to lowest part of the roof. Sheds shall be kept clean and the space provided shall be of at least 0.5m² per head.

Canteen Facilities: A cooked food canteen on a moderate scale shall be provided for the benefit of workers. The contractor shall conform generally to sanitary requirements of local medical, health and municipal authorities.

First aid facilities: At every workplace, a readily available first-aid unit will be provided. Suitable transport will be provided to facilitate taking injured and ill persons to the nearest hospital.

Day Crèche Facilities: Provision of a day crèche shall be made to enable women workers to leave behind their children. At construction sites where 20 or more women are ordinarily employed, there shall be provided at least one temporary structure with sufficient openings for light and ventilation for use of children under the age of 6 years belonging to such women. There shall be adequate provision of sweepers and maidservants to keep the places clean. Size of crèches shall vary according to the number of women workers employed.

Health care awareness and clinics: Construction workers are more prone to Infectious diseases such as HIV/AIDS. It should be prevented by counselling, community events, clinic, co-ordination with local health authorities.

8.2.6 Safety of Labour

Construction works shall be executed as laid down in the Safety Health and Environment (SHE) manual prepared by the Contractor and approved by PIU. The SHE manual

- a) Describes the SHE interfaces between Employer and the Contractor.
- b) Details the processes by which the contractor shall manage SHE issues while carrying out the work under the contract.
- c) Describes by reference, the practices, and procedures

The construction works shall be undertaken in accordance with all applicable legislation and Indian statutory requirements and guidelines-OHSAS 18001-2007: Occupational Health and Safety Management System and ISO 14001-2015: Environmental Management Systems. The key elements of the SHE manual are as follows:

1. Identification of the unit responsible for co-ordinating and monitoring the Contractor's SHE performance.
2. Procedures for identifying and estimating hazards, and the measures for addressing the same; a list of SHE hazards anticipated
3. SHE training courses and emergency drills
4. SHE inspections to identify any variation in construction activities and operations, machineries, plant and equipment and processes against the SHE Plan and its supplementary procedures and programs: Planned General Inspection, Routine Inspection, Specific Inspection and Other Inspection
5. Safety Audit: SHE Audit to assess potential risk, liabilities, and the degree of compliance of construction Safety, Health & Environmental plan and its supplementary procedures and programs against applicable and current SHE legalisation regulations and requirements of the employer; Electrical Safety Audit; External SHE Audit
6. SHE Communication to communicate the Safety, Occupational health and Environment management measures through posters campaigns / billboards / banners / glow signs being displayed around the work site
7. SHE Reports – reports, minutes, inspection reports, audit reports
8. Accident reporting and investigation
 - a) Reports of all accidents (fatal/injury) and dangerous occurrences to the Employer
 - b) Reporting to Govt. organisations
9. Investigations of Accidents and Dangerous Occurrences, Near misses and minor accidents
10. Prepare an Emergency Response Plan for all work sites including injury, sickness, evacuation, fire, chemical spillage, severe weather (avalanche), and rescue.

Workplace safety and occupational health shall be ensured with special focus on following areas:

- a) Housekeeping
- b) Working at Height and Falling objects and Danger areas

- c) Lifting Appliances
- d) Launching Operation
- e) Construction machinery, tools equipment - Safe worthiness
- f) employ qualified electrical personnel on site and requirements of electrical equipment, distribution etc
- g) Lighting
- h) Exposure of worker to use of exhaust or harmful gases in confined locations
- i) Fire prevention, protection and fighting system
- j) Corrosive substances
- k) Demolition
- l) Excavation and Tunnelling
- m) Traffic Management
- n) Personal Protective Equipment (PPE)
- o) Reporting which will contain results of monitoring and inspection programs
- p) Process of response to Inquiries, complaints, and requests for information from private and government entities
- q) Physical fitness of workmen
- r) Medical Facilities on site: Occupational Health Centre, Ambulance van and room HIV/ AIDS prevention and control
- s) Exposure to Noise – prevention measures
- t) Ventilation and illumination

8.2.7 Safety Precautions in Tunnel Construction

The project authorities must recognize the causes of safety hazards in tunnel construction and establish programs, rules, regulations, guidelines to reduce accidents. Measures, which can provide guidelines for preparation of a comprehensive safety program achieving better safety performance for tunnel works are:

- a) Deployment of a full-time safety engineer, who will also prepare a safety program tailored to the project
- b) Emergency measures, which should include tunnel evacuation plan and procedures independent of the tunnel power supply
- c) Tunnel personnel should wear protective headgear, footwear, and any other special garments
- d) Specific working areas in tunnel construction can have their own unique hazards that personnel should be made aware of
- e) Weatherproof first aid kits should be provided at appropriate locations
- f) Tunnel should be provided with mechanically induced reversible flow primary ventilation for all work areas
- g) detailed guidelines for handling and storage of explosives
- h) Awareness to workers about the safe layout in the construction plant

8.2.8 Air Pollution Control Measures

During the construction period, the impact on air quality will be mainly due to increase in Particulate Matter (PM) along haul roads and emission from vehicles and construction machinery. Mitigation measures which shall be adopted to reduce the air pollution are presented below:

- a) The Contractor shall take all necessary precautions to minimize fugitive dust emissions from operations involving excavation, grading, and clearing of land and disposal of waste. He shall not allow emissions of fugitive dust from any transport, handling, con-

struction, or storage activity to remain visible in atmosphere beyond the construction area.

- b) Contractor's transport vehicles and other equipment shall conform to emission standards fixed by Statutory Agencies of Government of India or the State Government from time to time. The Contractor shall carry out periodical checks and undertake remedial measures including replacement, if required, to operate within permissible norms.
- c) The Contractor shall cover loads of dust generating materials like muck and material being transported from construction sites. All trucks carrying loose material should be covered and loaded with sufficient free - board to avoid spills through the tailboard or sideboards.
- d) Dust control activities shall continue even the construction activities are stopped/halted.
- e) To extent feasible site shall be wetted during excavation and demolition
- f) Dust screens will be used especially where the work is near sensitive receptors, if any.
- g) The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from work sites such as construction depots and batching plants. At such facility, high-pressure water jets will be directed at the wheels of vehicles to remove all spoil and dirt.

8.2.9 Noise Control Measures

There will be an increase in noise level in the ambient air due to construction and operation of the tunnel and its approach roads. Exposure of workers to high noise levels need to be minimized by measures such as the following:

- a) Use of electric equipment instead of diesel-powered equipment,
- b) Use of hydraulic tools instead of pneumatic tools,
- c) Acoustic enclosures should be provided for individual noise generating construction equipment like DG sets,
- d) Scheduling work to avoid simultaneous activities that generates high noise levels,
- e) Job rotation where feasible
- f) Soundproof control rooms etc.

Automation of equipment and machineries, wherever possible, should be done to avoid continuous exposure of workers to noise. The workers employed in high noise level area should be provided with protective devices.

8.2.10 Water pollution Control

Wastewater generated from the site during the construction contains suspended materials, spillage and washings which can pollute surface and ground water; such washings shall be led through separate drains into precipitation chambers before discharge into the Rivers/ natural drains. The wastewater generated from the site should adhere to the regulatory standards prescribed for disposal.

8.2.11 Soil Erosion

Careful planning for excavation, filling and dumping along with re-vegetation are required to mitigate the soil erosion. A general guideline to control soil erosion shall be to stop all the earthwork activities during rainy season so that surfaces having loose earth are not exposed

to rains. The cutting and filling area, on completion of the work shall be dressed well, compacted, and covered with plantation.

8.2.12 Measures for Road Construction

Following guidelines need to be followed for construction of roads providing access to portals and muck disposal sites:

- The cut and fill shall be scheduled to avoid large accumulation of earth/ soil
- The slopes shall be stabilized and retaining wall shall be provided wherever required
- In case of rock blasting, controlled blasting techniques shall be followed.
- Excavated material shall be stored properly for reuse/ refill/disposal and
- The diversion drains during construction shall be connected with natural drains.

8.3 EMP during Operation

8.3.1 Air Pollution

The ambient air quality levels in future years will increase due to increase in traffic. The mitigation measures are suggested as under:

- It should be made compulsory by government authorities for all vehicles to adhere to the engine maintenance schedule and standards to reduce the air pollution due to vehicular emissions.

8.3.2 Noise Pollution

Noise levels in the project area may exceed the existing noise levels due to increased traffic. However, these noise levels will be within the permissible limits specified for Residential areas.

8.4 Human Health and Safety

The Project will have no significant impact on disease transmission or other health factors. Positive health impacts will include improved access to health care facilities and quicker response time in emergency situations. No additional mitigation actions related to health are warranted.

Mitigation related to potential safety impacts will include improved road standards, and improved signage.

8.5 Implementation Arrangements

Institutional strengthening will be undertaken to achieve the goals of the project including sound environmental management. Steps to be taken are discussed under the following sub-headings:

8.5.1 Organization and Staffing

The implementation of mitigation measures requires supervision from adequately trained staff within the PWD Ladakh, which will designate one of its officers to act as Environmental Officer (EO), to formally address environmental issues on a routine basis. The officer will have an oversight of environmental aspects of the construction contracts, including the enforcement of all monitoring provisions, the locations of construction and labour camps, etc. Before the commencement of construction, the designated EO will receive training in the environmental issues associated with Tunnel & road construction and maintenance projects. The designated EO will organise the training to other officials. The main duties of the designated EO will include:

- Review of bids to ensure their adherence to the environmental specifications and the requirements of the Environmental Management Plan (EMP).
- Collection and dissemination of relevant environmental documents including amendments to environmental protection acts issued by MOEFCC, SPCB.
- Co-ordination with government departments on environmental issues and obtaining the necessary clearances from the regulatory authorities.
- Monitoring the environmental aspects during construction to ensure that the environmental requirements of the contract and the mitigation measures proposed in the EMP are implemented.
- Supervising contractors and preparation of environmental input to the quarterly progress report.

8.5.2 Environmental Training

short-term training will be required for the Project in-charge and designated Environmental Officer for environmental awareness. The training institutions in India, the World Bank's Economic Development Institute (Environment and Natural Resources Division), the Central Pollution Control Board, and the State Pollution Control Board conducts regular training and access to these resources will be sought. The need for additional and specialised training will be examined and appropriate training will be undertaken as required. Training of personnel to be deployed on the proposed project during construction and operation, about environmental requirements should be an integral part of the planning.

The project authority should be asked to submit a detailed programme for training of personnel and implementation to the environmental requirements. Apart from the training, such programme should include guidelines for safety, methods of disaster prevention, action required in case of emergency, fire protection, environmental risk analysis etc. Capacity to quantitatively monitor water sediments or turbidity (by suitable portable test equipment) and noise is always advantageous, but monitoring will primarily involve ensuring that actions taken are in accordance with contract and specification clauses, and specified mitigation measures. Some awareness training will be provided to the contractor personnel to ensure that this occurs effectively.

8.5.3 Monitoring and Reporting Procedures

The project in charge and designated EO will visually assess contractor's practices and, if high pollutant levels are suspected, will direct the contractor to SPCB or private sector laboratories to verify measurements on a routine basis. Photographic records will be established to

provide useful environmental monitoring tools. A full record will be kept as part of normal contract monitoring. All applicable regulations need to be enforced by the Project In charge and designated EO. Under the Environment (Protection) Second Amendment Rules 1993, for example, water quality discharge standards have been established for inland surface waters and land for irrigation. It is a legal obligation of the Contractor that any discharges from the work sites meet these standards. Steps will be taken by the Project In charge and designated EO to ensure that regular monitoring of water quality parameters such as pH, suspended solids, BOD, COD, oil and grease be carried out as provided in the contract. Regular monitoring of noise and dust will also be carried out as provided in the contract document.

8.6 Corporate Environmental Responsibility

MoEFCC issued various notifications for implementation of the Corporate Environment Responsibility. The CER is to be in addition to the cost envisaged for the implementation of the EIA/EMP which includes the measures for the pollution control, environmental protection and conservation, R&R, wildlife, and forest conservation/protection measures including the NPV and Compensatory Afforestation, required, if any, and any other activities, to be derived as part of the EIA process.

As per the MoEFCC notification vide File No 22-65/2017-IA.III dated 20/0/2020, Expert Appraisal Committee or State Level Expert Appraisal Committee shall deliberate on the commitments made by the project proponent to address the concerns raised during the public consultation and prescribe specific condition in physical terms while recommending the proposal, for grant of prior environment clearance instead of allocation of funds under Corporate Environment Responsibility. The activities proposed to the affected area around the project under CER will be

- Drinking Water Supply, Sanitation & Health
- Solid Waste Management
- Skill Development
- Solar Street Lights in the surrounding villages
- Plantation in community areas

The above activities under CER will be finalized by the Project Developer in consultation with the local government in the project affected villages.

9 ENVIRONMENTAL COSTS

Most of the items mentioned in the environmental management plan make part of the project cost. Certain items like health care and medical facility to workers make part of the contractual obligations of the construction contractor. The environmental costs towards implementation of environmental management and monitoring plans during construction phase and operation phase of the proposed project are presented in **Table 9-1**. Environmental Monitoring cost per year during construction phase will be Rs. 23.48 Lakh per year; and during operation phase will be Rs. 16.46 Lakh per year.

Table 9-1: Environmental Monitoring Cost per Year

S. No	Item	Total Cost (Rs. In Lakh)
1.	Environmental Monitoring Cost during Construction	
a)	Air Quality Monitoring	4.80
b)	Noise Quality Monitoring	0.60
c)	Soil Quality Monitoring	1.08
d)	Water Quality Monitoring	1.40
e)	Wastewater from STP	0.40
f)	Ecological Monitoring	2.00
g)	Environmental Cell	13.20
Environmental Monitoring cost per Year during Construction		23.48
2.	Environmental Monitoring during Operation	
a)	Air Quality Monitoring	0.48
b)	Noise Quality Monitoring	0.06

c)	Soil Quality Monitoring	0.72
d)	Water Quality Monitoring	1.00
e)	Ecological Monitoring	1.00
f)	Environmental Cell	13.20
Environmental Monitoring cost per Year during Operation		16.46

----- End of main document -----

9.1 TABLE OF ANNEXURES

Sr No.	Topic	Pages
1.	Drinking Water Quality Standards (IS 10500:2012)	2
2.	Effluent Discharge Standards (Inland Surface Water)	1
3.	Tolerance Limits for Inland Surface Water Quality	1
4.	National Ambient Air Quality Standards	1
5.	National Ambient Noise Standards	1

Annexure 2.1

DRINKING WATER QUALITY STANDARDS (IS 10500:2012)

S. No.	Characteristic	Requirement (Acceptable Limit)	Permissible limit in the absence of alternate source	Remarks
Essential Characteristics				
1	Colour, Hazen units, Max	5	15	Extended to 15 only, if toxic substances are not suspected in absence of alternate source
2	Odour	Agreeable	Agreeable	a) Test cold and when heated b) Test at several dilutions
3	pH Value	6.5 to 8.5	No relaxation	-
4	Taste	Agreeable	Agreeable	Test to be conducted only after safety has been established
5	Turbidity NTU, max	1	5	-
6	Total dissolved solids, mg/l, Max	500	2000	-
7	Aluminium (as Al), mg/l Max	0.03	0.2	-
8	Ammonia (as total ammonia-N), mg/l Max	0.5	No relaxation	-
9	Anionic detergents (as MBAS), mg/l, Max	0.2	1.0	-
10	Barium (as Ba), mg/l, max	0.7	No relaxation	-
11	Boron (as B), mg/l Max	0.5	1.0	-
12	Calcium (as Ca) mg/l, Max	75	200	-
13	Chloramines (as Cl ₂), mg/l, Max	4.0	No relaxation	-
14	Chloride (as Cl) mg/l, Max	250	1000	-
15	Copper (as Cu) mg/l, Max	0.05	1.5	-
16	Fluoride (as F) mg/l, Max	1.0	1.5	-
17	Free residual Chlorine, mg/l, Min	0.2	1	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/l
18	Iron (as Fe) mg/l, max	0.3	No relaxation	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3mg/l
19	Magnesium (as Mg) mg/l, Max	30	100	-
20	Manganese (as Mn) mg/l, Max	0.1	0.3	-
21	Mineral oil, mg/l Max	0.5	No relaxation	-
22	Nitrate (as NO ₃) mg/l, Max	45	No relaxation	-
23	Phenolic compounds (as C ₆ H ₅ OH) mg/l, Max	0.001	0.002	-
24	Selenium (as Se), mg/l, Max	0.01	No relaxation	-
25	Silver (as Ag), mg/l, Max	0.1	No relaxation	-

S. No.	Characteristic	Requirement (Acceptable Limit)	Permissible limit in the absence of alternate source	Remarks
2	Sulphate (as SO ₄) mg/l, Max	200	400	May be extended to 400 provided that Magnesium does not exceed 30
27	Sulphide (as H ₂ S) mg/l, max	0.05	No relaxation	-
28	Total alkalinity as calcium carbonate, mg/l Max	200	600	-
29	Total Hardness (as CaCO ₃) mg/l, Max	200	600	-
30	Zinc (as zn), mg/l, Max	5	15	-
31	Cadmium (as Cd), mg/l, Max	0.003	No relaxation	-
32	Cyanide (as CN), mg/l, Max	0.05	No relaxation	-
33	Lead (as Pb), mg/l, Max	0.01	No relaxation	-
34	Mercury (as Hg) mg/l, Max	0.001	No relaxation	-
35	Molybdenum (as Mo) mg/l, max	0.07	No relaxation	-
36	Nickle (as Ni), mg/l, max	0.02	No relaxation	-
37	Polychlorinated biphenyls, mg/l, max	0.0005	No relaxation	-
38	Polynuclear aromatic hydrocarbons (as PAH) mg/l, Max	0.0001	No relaxation	-
39	Total Arsenic (as As), mg/l, Max	0.01	0.05	-
40	Total Chromium (as Cr) mg/l, Max	0.05	No relaxation	-
41	Trihalomethanes Bromoform, mg/l, max Dibromochloromethane, mg/l, max Bromodichloromethane, mg/l, max Chloroform, mg/l, max	0.1 0.1 0.06 0.2	No relaxation No relaxation No relaxation No relaxation	-
42	Radioactive materials a) Alpha emitters Bq/l max b) Beta emitters pci/l, Max	0.1 1.0	No relaxation No relaxation	-

Annexure 2.2

EFFLUENT DISCHARGE STANDARDS (INLAND SURFACE WATER)

S. No.	Parameter	Unit	Standards
1	Colour & Odour	--	All efforts should be made to remove colour and unpleasant odour as far as practicable.
2	Suspended Solids Max.	mg/l	100
3	Particle size of Suspended Solids	--	Shall pass 850 micron IS Sieve
4	pH value	--	5.5 to 9.0
5	Temperature, Max.	°C	Shall not exceed 5°C above the receiving water temperature
6	Oil and grease, Max.	mg/l	10
7	Total residual Chlorine, Max.	mg/l	1.0
8	Ammonical Nitrogen (as N), Max.	mg/l	50
9	Total Kjeldah Nitrogen (as N), Max.	mg/l	100
10	Free Ammonia (as NH ₃), Max.	mg/l	5
11	Biochemical Oxygen Demand (5 days at 20°C), Max.	mg/l	30
12	Chemical Oxygen Demand Max.	mg/l	250
13	Arsenic (as As), Max.	mg/l	0.2
14	Mercury (as Hg), Max.	mg/l	0.01
15	Lead (as Pb), Max.	mg/l	0.1
16	Cadmium (as Cd), Max.	mg/l	2.0
17	Hexavalent Chromium (as Cr ⁺⁶), Max.	mg/l	0.1
18	Total Chromium (as Cr) Max.	mg/l	2.0
19	Copper (as Cu), Max.	mg/l	3.0
20	Zinc (as Zn), Max.	mg/l	5.0
21	Selenium (as Se), Max.	mg/l	0.05
22	Nickel (as Ni), Max.	mg/l	3.0
23	Cyanide (as CN), Max.	mg/l	0.2
24	Fluorides (as F), Max.	mg/l	2.0
25	Dissolved phosphates (as P), Max.	mg/l	5.0
26	Sulphides (as S), Max.	mg/l	2.0
27	Phenolic compounds (as C ₆ H ₅ OH), Max.	mg/l	1.0
28	Radioactive Materials α Emitters, μcurie/ml, Max. β Emitters, μcurie/ml, Max.	mg/l	10 ⁻⁷ 10 ⁻⁶
29	Bio-assay test	mg/l	90% survival of fish after 96 hours in 100% effluent
30	Manganese (as Mn)	mg/l	2.0
31	Iron (as Fe)	mg/l	3.0
32	Vanadium (as V)	mg/l	0.2
33	Nitrate Nitrogen	mg/l	10.0

Annexure 2.3

TOLERANCE LIMITS FOR INLAND SURFACE WATER QUALITY

Characteristic	Designated Use Class of Inland Waters				
	A	B	C	D	E
pH value	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.0 to 8.5
Dissolved Oxygen, mg/l, Min.	6	5	4	4	-
Biochemical Oxygen Demand (5 days at 20°C), mg/l	2	3	3	-	-
Total coliform organisms, MPN/100 ml. Max.	50	500	5000	-	-
Colour Hazen units	10	300	300	-	-
Chlorides (as Cl), mg/l Max.	250	-	600	-	600
Sodium Adsorption ratio Max.	-	-	-	-	26
Boron (as B), mg/l. Max.	-	-	-	-	2
Sulphates (as SO ₄), mg/ l	400	-	400	-	1000
Nitrates (as NO ₃), mg/l Max.	20	-	50	-	-
Free Ammonia (as NH ₃), mg/l	-	-	-	1.2	-
Conductivity at 25° C microhm / cm Max.	-	-	-	1000	2250
Arsenic (as As), mg/l. Max.	0.05	0.2	0.2	-	-
Iron (as Fe), mg/l	0.3	-	50	-	-
Fluorides (as F), mg/l	1.5	1.5	1.5	-	-
Lead (as Pb), mg/l. Max.	0.1	-	0.1	-	-
Copper (as Cu), mg/l	1.5	-	1.5	-	-
Zinc (as Zn) mg/l/ Max.	1.5	-	1.5	-	-
Manganese (as Mn), mg/l	0.5	-	-	-	-
Total Dissolved Solids, mg/l	500	-	1500	-	2100
Total Hardness (CaCO ₃), mg/l	300	-	-	-	-
Magnesium (as Mg), mg/l	100	-	-	-	-
Chlorides (as Cl), mg/l	250	600	-	-	600
Cyanides (as CN), mg/l	0.05	0.05	0.05	-	-

A: Drinking Water Source without conventional treatment but after disinfections;

B: Outdoor bathing organized;

C: drinking water source with conventional treatment followed by disinfections;

D: propagation of wildlife and fisheries;

E: irrigation, industrial cooling, controlled waste disposal.

Source: Central Pollution Control Board

Annexure 2.4

NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Time Weighted Average	Industrial, Residential, Rural & Other Area	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO ₂) µg/m ³	Annual 24 Hours**	50 80	20 80
Nitrogen Dioxide (NO ₂) µg/m ³	Annual 24 Hours**	40 80	30 80
Particulate Matter (PM ₁₀ Size less than 10µm) µg/m ³	Annual 24 Hours**	60 100	60 100
Particulate Matter (PM _{2.5} Size less than 2.5µm) µg/m ³	Annual * 24 Hours**	40 60	40 60
Ozone (O ₃) µg/m ³	8 hours** 24 Hours**	100 180	100 180
Lead (Pb) µg/m ³	Annual * 24 Hours**	0.50 1.0	0.50 1.0
Carbon Monoxide (CO) mg/m ³	8 Hours** 1 Hour**	02 04	02 04
Ammonia (NH ₃) µg/m ³	Annual * 24 Hours**	100 400	100 400
Benzene (C ₆ H ₆) µg/m ³	Annual *	05	05
Benzo (a)Pyrene (BaP) - Particulate Phase only ng/m ³	Annual *	01	01
Arsenic (As) ng/m ³	Annual *	06	06
Nickel (Ni) ng/m ³	Annual *	20	20

Source: Central Pollution Control Board Notification dated 18th November 2009

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week hourly at uniform intervals

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Annexure 2.5

NATIONAL AMBIENT NOISE STANDARDS

Category of Zones	Leq in dB (A)	
	Day Time	Nighttime
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence Zone	50	40

Source: Central Pollution Control Board

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Nighttime shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places, or any other area which is declared as such by the competent authority
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq: It is an energy mean of the noise level over a specified period