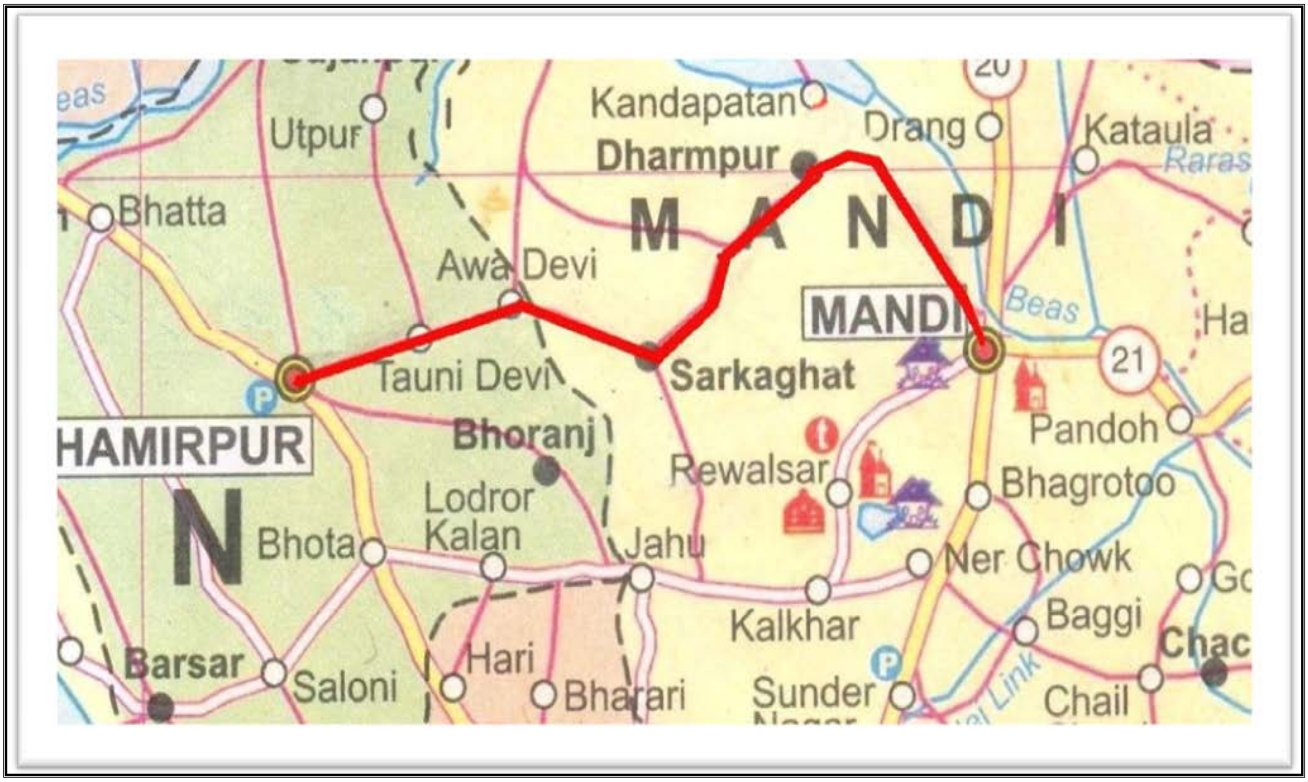
सत्यमेव जयते
MORTH
Government of India

Rehabilitation and Upgrading to 2 lanes/2 lane with paved shoulders configuration and strengthening of Hamirpur-Mandi Section (Km 141- Km 265) of NH-70 in the state of Himachal Pradesh (Package no: SP/D/3)



ENVIRONMENT IMPACT ASSESSMENT AND ENVIROMENT MANAGEMENT PLAN

List of Acronyms

ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
AMSL	Above Mean Sea Level
HPPCB	Himachal Pradesh Pollution Control Board
ASI	Archaeological Survey of India
BDL	Below Detection Limit
BOQ	Bill of Quantities
CCE	Chief Controller of Explosives
CD	Cross Drainage
CFE	Consent for Establish
CFO	Consent for Operate
CE	Chief Engineer
CGWA	Central Ground Water Authority
CoI	Corridor of Impact
CPCB	Central Pollution Control Board
CO	Carbon Monoxide
DEIAA	District Level Environmental Impact Assessment Authority
DFO	Divisional Forest Officer
DPR	Detailed Project Report
EC	Environmental Clearance
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMF	Environment Management Framework
EMP	Environment Management Plan
ESO	Environment & Safety Officer
ESR	Environmental Screening Report
FRO	Forest Range Officer
GHG	Green House Gas
GNHCP	Green National Highways Corridor Project
GoI	Government of India
IRC	Indian Roads Congress
IS	Indian Standards
LCV	Light Commercial Vehicle
LHS	Left Hand Side
Km	Kilometer
MoEFCC	Ministry of Environment, Forest and Climate Change, Govt. of India
MoRTH	Ministry of Road Transport and Highways, Govt. of India
NBWL	National Board for Wildlife
NAAQS	National Ambient Air Quality Standards
NGHM	National Green Highways Mission
NGO	Non-Governmental Organization
NH	National Highways
NHDP	National Highways Development Program
NOC	No Objection Certificate
NO_2	Nitrogen Dioxide
NRSC	National Remote Sensing Centre
OD	Origin and Destination
OP	Operational Policies

PCU	Passenger Car Units
PIU	Project Implementation Unit
POL	Petroleum, Oil and Lubricants
PMC	Project Management Cell
PROW	Proposed Right of Way
PUP	Pedestrian Under Pass
PWD	Public Works Department
RCC	Reinforced Cement Concrete
RET	Rare, Threaten and Endangered
RHS	Right Hand Side
RoW	Right of Way
ROB	Rail Over Bridge
SEAC	State Expert Appraisal Committee
SEIAA	State Level Environmental Impact Assessment Authority
SEI	Significant Environmental Issues
SO_2	Sulphur Dioxide
SIA	Social Impact Assessment
SOI	Survey of India
SH	State Highway
TCS	Typical Cross Section
ToR	Terms of Reference
VEC	Valued Ecosystem Components
PUP	Vehicular Under Pass
WB	The World Bank
WMM	Wet Mix Macadam

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CHAPTER-1

INTRODUCTION

1.1 PROJECT BACKGROUND

India's road network of 5.48 million kilometers is the second largest and most dense[1] in the world. It carries 65 percent of freight traffic, 85 percent of the total passenger traffic in the country and comprises of a primary network of 116,000 km of National Highways (NH), a secondary network of 160,000 km of State Highways (SH) along with Major and Other District Roads (MDR & ODR), and a tertiary network of Rural Roads. The responsibility for planning, construction and maintenance of the primary network lies with the Ministry of Road Transport and Highways (MoRTH), Govt. of India. The MoRTH also formulates national policies and legislations governing road transport.

In the last sixty years, the vehicle population grew at a Compound Annual Growth Rate (CAGR) of 10.8 percent putting pressure on the road network. The current passenger traffic is 12,000 Billion passenger-kilometer (BPKM) and it is projected to grow at an annual rate of 15 percent and become 168,000 BPKM by 2032. The current freight traffic is 2,000 Billion ton-kilometer (BTKM) and it is projected to grow at an annual rate of 9.7 percent and become 13,000 BTKM by 2032. In contrast with these growth rates, the NH network, which comprise only 2 percent of the total road network but carries about 40 percent of the road traffic, has grown at a rate of only 2.2 percent over the last sixty years and about 40 percent of the network is in poor condition.

In 1998, the Govt. of India (GoI) launched the NHDP covering 56,000 km of NH for development, spread across 7 phases. It is the biggest program (of value about $50 billion) so far that has been taken up by MoRTH primarily through the National Highways Authority of India (NHAI), an independent entity under the aegis of the same ministry. It also consisted of four/six laning of the Golden Quadrilateral (the highways connecting the four metros of Delhi, Mumbai, Chennai and Kolkata) and the North-South and East-West Corridors.

The national highways not covered under the NHDP form a part of non-NHDP network. Most of the roads that form this network are of poor quality and capacity (single/intermediate/two-lane width) and thereby present unsafe and poor traveling conditions. In the recent years, the Govt. of India has launched some specific programs to develop these roads as these connect the hinterland of the country and are key to the government's objective of equitable and inclusive growth. These programs among others include the National Highways Interconnectivity Improvement Project (NHIIP), funded by the World Bank and is currently under implementation.

[1] At 1.66 km/sq km of area, which is higher than that of USA, China, Japan and Russia

Considering that the sector still faces major challenges in terms of efficient movement of goods, the MoRTH has recently launched the Bharatmala Pariyojana Program (BPP) which aims to enhance effectiveness of already built infrastructure; support multi-modal integration, bridging infrastructure gaps for seamless movement; augment inclusiveness by connecting 550 districts through highway linkages; improvement of Logistics Performance Index (LPI) of the country and; creation of jobs. It envisages development of about 26,000 km of economic corridors; 8,000 km of Inter-Corridors; 7,500 km of Feeder Roads; 1,800 km of Expressways; 1,300 km of Port-Connectivity Roads; 2,000 km of Coastal Roads; 2,000 km of International Connectivity Roads; 3,300 km of border roads; 28 ring roads; 35 logistic parks; and improvement of 66 congestion points and 125 choke points.

1.2 GREEN NATIONAL HIGHWAYS CORRIDOR PROJECT

Creation of infrastructure to meet the burgeoning transport demand has resulted in improved connectivity in India but a lot needs to be done for seamless movement of traffic and efficient movement of logistics. Focusing primarily on ramping up connectivity of the NH network, little attention has been given on enhancing effectiveness of the infrastructure being built.

Most of the non-NHDP network is not built on a trunk transport and feeder route corridor-based approach. In addition to capacity constraints, poor maintenance and disregard for extreme and routine climatic impacts on the built infrastructure are directly affecting Vehicle Operating Costs. Consequently, the cost of movement of logistics in India is one of the highest (about 14 percent of GDP as against about 8-9 percent in developed countries). The road network is not integrated well with other modes of transport resulting in choke points especially around cities and at main intersections. An integrated approach based on enabling the seamless flow of freight and passengers through transport network needs to be built.

The Green National Highways Corridor Project (GNHCP) through its support to the Govt. of India's Bharatmala Pariyojana, will promote the vision of enhancing effectiveness of the transport network of India with cost and natural resources efficiency and safe high capacity highways.

One such road corridor out of the nine proposed for funding under GNHCP is Hamirpur Mandi Section (Km 141.000 to Km 265.00) of NH-70 in the Himachal Pradesh State. The MoRTH intends to rehabilitate and up-grade the existing single lane/intermediate lane between Hamirpur Mandi Section of NH–70 to 2-lane/2-lane with paved shoulders configuration. The implementation of rehabilitation and up-gradation of this corridor is proposed to be taken up with World Bank assistance. The design length of the project road is 124.000 Km.

In the present study project stretch Hamirpur (Km 141) to Mandi (Km 265) in DPR study. Location of the Project highway is given in **Figure 1.1.** Important religious, tourist, agro based industruial and other economical spot along Project Road are given in **Figure 1.2:**

1.3 Brief Description of the Project Road

The Project Highway section from Hamirpur (Km 141.00) to Mandi (Km 265.00) via Awah Devi, Tauni Devi, Sarkaghat and Dharampur is a part of NH-70 and it falls in Himachal State. The total length of this project section is 124.0 km, out of which initial 23 km (from km 141 to km 163) falls in Hamirpur district and remaining part from km 163 to km 265.00) falls in Mandi District.

The entire project highway section is passing through Mountainous to steep terrain and traversing in a very few length near Hamirpur on ridge and in most of the length in hill side cut with hill on one side and valley on other side and situated in between 31°42'56.68"N, 76°32'29.73"E (Start Point at Hamirpur) and 31°41'14.54"N, 76°56'7.05"E (End Point at Mandi).

The altitude is ranging in between 666 meter to 1385 meter above mean sea level. The land use along the project road section is mainly agriculture, settlements and demarcated forest and open forest areas.

Detailed project report (DPR) has been prepared for upgradation and widening of the project. The final Highway design will be verified and finalised by the contractor within the Scope of Services given by MORTH before the initiation of construction.

Figure 1.1: **Loaction Map of National Highway 70**

1.4 NEED AND JUSTIFICATION OF THE PROJECT ROAD

The proposed project highway had been functionally upgraded as a National Highway in the year 1999 but no improvements have been made to the geometry and capacity of the road, which was a local road. The highway is only of substandard single-lane configuration.

The constraints are: (i) the existing highway is only of non-uniform substandard single lane configuration, (ii) there are two major landslide zones along the highway, one about 2 km-long and the other about 5 km-long, (iii) the existing road passes through 70 villages/settlements in a total length of about 11 km making it unsafe, (iv) the alignment of the existing road has numerous geometric deficiencies including 343 sharp horizontal curves with less than 30 m radius of curvature and several deficient vertical curves, (v) the existing highway in a length of 34 km is steeper than 6%, in 18 km is steeper than 7%, and in 8 km is steeper than 8% (with a maximum gradient of about 18%), (vi) there are neither longitudinal drains on the hillside nor subsurface drains, and the sections of highway with sunshade have been heavily damaged, (vii) the condition of the existing pavement and cross-drainage structures is very poor and unsuited to heavier traffic, e.g. 9 of the 13 minor bridges have inadequate width and poor structural condition, (viii) culverts are required at 50 new locations where cross-drainage is inadequate, also a number of existing culverts are in poor condition, and (ix) a number of unsafe junctions (5 major and 71 minor) and lack of road.

The proposed project road is based on its importance of strengthening a road stretch that would help connect the interiors of two important districts of H.P. - Hamirpur and Mandi (specifically, Bhoranj, Sarkaghat, Dharampur, Kotli), by strengthening this road linkage both as a through route for traffic to/from Hamirpur to Kullu, Manali, Lahual, Spiti, Leh, as well as a feeder route connecting to the NH network in its surroundings, which is being developed by National Highways Authority of India (NHAI)2. Strengthening this route would also provide an important missing link to the Bharatmala Pariyojana, as some important centres, namely Hoshiarpur, Jalandhar and Chandigarh lie on its proposed Inter Corridor and Feeder routes. The stretch from Hamirpur to Mandi is connected with both Hoshiarpur and Jalandhar through NH-70, and with Chandigarh through NH-21 and NH-88. The proposed Delhi-Amritsar-Katra Expressway under the Bharatmala Pariyojana, after its completion, can also be accessed by traffic on the Hamirpur-Mandi stretch through the existing NH network. NH-70 itself is a strategically important corridor as it connects to the Indo-Tibet border up to Leh-Ladakh. Further, developing and maintaining alternate routes in hilly terrains such as in H.P. is important because of their significance in helping evacuate the affected population in times of disasters and calamities.

The proposed project upgradation includes several interventions to address the above constraints for better connectivity and efficient movement of logistics following the aspects of resource efficiency, climate resilience, green, and safety.

[2] The following NH are being upgraded by NHAI: NH-88 from Mataur (near Kangra) to Shimla via Jwalamukhi, Naduan, Hamirpur, Ghagas; NH-21 from Kiratpur Saheb to Manali via Bilaspur, Mandi, Kullu; NH-20 from Pathankot to Mandi via Mataur, Joginder Nagar.

The proposed project highway will have a uniform standard two-lane configuration. The final alignment of the highway will have several realignments to ensure safety of the habitations through which the existing road is passing through. The deficiencies in the horizontal and vertical geometry in the alignment of the existing road will be corrected and junctions will be improved, 9 new minor bridges will be constructed in lieu of the damaged/inadequate capacity existing minor bridges, 50 new culverts will be added to the drainage system to improve the cross-drainage, several culverts will be widened/repaired/rehabilitated and sub-surface drains and hillside longitudinal drains will be constructed, slope protection measures and enhanced safety features will be provided.

The proposed interventions also include 40 bus bays, 3 traffic aid centres equipped with crane and other facilities and medical aid centres, as well as 7 dumping locations developed as parking lots, recreational facilities and viewpoints. Additional features include measures for curve improvement, provision of crash barriers on the valley side including W beam crash barriers for a length of 85 km, improvement of road junctions, provision of sub-surface drainage (15 km) and roadside drainage, solar lighting (91 areas), rainwater harvesting (27 locations), 50,000 tree plantation, footpaths with paver blocks (2 km), etc.

The proposed project road is based on its importance of strengthening a road stretch that would help connect the interiors of two important districts of H.P. - Hamirpur and Mandi (specifically, Bhoranj, Sarkaghat, Dharampur, Kotli), by strengthening this road linkage both as a through route for traffic to/from Hamirpur to Kullu, Manali, Lahual Spiti, Leh, as well as a feeder route connecting to the NH network in its surroundings, which is being developed by National Highways Authority of India. NH-70 itself is a strategically important corridor as it connects to the Indo-Tibet border up to Leh-Ladakh. Further, developing and maintaining alternate routes in hilly terrains such as in H.P. is important because of their significance in helping evacuate the affected population in times of disasters and calamities.

The Proposed Road would improve connectivity for tourists visiting various famous religious and pilgrimage destinations in H.P., such as the Tauni Devi Temple, Awah Devi Temple, Sujanpur Fort in Hamirpur, Kamlah Fort in Dharampur, Janitri Temple Kotli near Lagdhar, and the pilgrimage site of Rewalsar. Better connectivity would enable work force participation and tourism related activities in the region.

The project road with a total length of 124 km would directly service a population of about 84000 and bring about 31,907 under its major influence areas. The PR would help connect various agro production centres, vegetable markets (mandis), and milk collection centres, at various places along the project highway, to markets in the state as well as outside. The area is famous for citrus fruit (Mandi), mushroom and bamboo cultivation (Dharampur), tea cultivation (Palampur). Additionally, the PR would provide connectivity to the various educational institutes, which are located along the road.

The interconnectivity would also provide a safe route for passage of commercial and other traffic. Currently, the alternative route connecting Hamirpur to Mandi (Bhota-Jahu-Khalkar-Ner Chowk- Mandi), has a stretch from Khalkar to Ner Chowk (about 15

km) which is of single lane carriageway and not in good condition. The geometry of this last stretch is also very deficient with steep gradient and sharp curves, making it unsafe for loaded trucks to ply on this stretch.

Origin-destination surveys undertaken to map goods and passenger trips on the PR and to assess likely future traffic diversions to or from the project road indicate a high percentage of empty truck movement. Proposed interventions include construction of truck parking areas and wayside amenities, and increased use of ICT solutions for freight efficiency such as digital enabling platform of “track and trace” offering real-time visibility and goods information. The road would also provide a safe last mile connectivity route for movement of loaded trucks, while also providing a linkage to major centres like Hoshiarpur, Jalandhar and Chandigar. All these interventions would allow more truck traffic to ply and lead to fuller and more efficient trucks being able to carry the goods, reducing empty truck movement and increasing logistics efficiency. The important religious & tourist spots, agrobased industrial spots and other economical importance areas are shown in **Figure 1.2.**

1.5 BENEFITS OF THE PROJECT

The proposed project corridor shall have tangible and non-tangible benefits. The proposed project shall contribute to reduce in road traffic and road stress, fuel consumption, air pollution, travel time, vehicle operating cost, accidents and road maintenance. The proposed road shall increase mobility, better accessibility to facilitates the influence area, increase economic stimulation in the micro region of infrastructure, increase business opportunities, improve aesthetics and image of the city.

The proposed road project lies on hilly region and due to poor road geometry, sharp horizontal and vertical curves, and poor safety measures need to be upgraded. This stretch provides road connectivity to remote areas, tourist as well as religious spots such as Tauni Devi Temple, Awah Devi Temple, Kamla Fort in Dharampur, Shiv Dwala Temple, Ardhanareshwar Temple, Panchvaktra Mahadev Temple, Bhootnath Temple, Trilokinath Temple, vegetable & market in Mandi, under constructed 119 MW NTPC plant in Kotli, under constructed agro based Mushroom & bamboo industries in Dharmpur etc. It’s also provide alternative route for Chandigarh-Mandi NH and Hamirpur-Jahu-Rewalsar-Mandi routes, in condition of heavy snow/rain fall or heavy landslides. Due to above mentioned reasons Rehabilitation and Up-gradation of existing single/inter mediate/2-lane to to 2 lanes/2 lane with paved shoulders configuration and strengthening of Hamirpur- Mandi section (Km 141- Km 265) is taken up.

The project is aimed to benefit the local population by increasing tourism, reducing travel time. This project will also make the journey safe in the state and the highway will be beautified. The major benefits of the proposed road:

- Will reduce road length between Hamirpur to Mandi to 109.592 km from the existing 124 km reducing travel time up to 02 hours.
- Will create access to better healthcare facilities for the people.

- Will reduce the number of road accidents and ensure free flow of traffic.
- Will give boost to tourism/ religious tourism in the area.
- A single multi axle vehicle travelling on this stretch shall economize the fuel consumption and wear and tear by 50%, thus increasing efficiency.
- Will substantially reduce environmental pollution.
- Perishable commodities such as horticulture, agriculture and floriculture produce which have a key role to play in economic health of the state can be transported faster.
- The project will also generate direct and indirect employment opportunities to the local people of the area.
- Proper implementation with international good practices would help in demonstrating sustainable road sector development practices.
- Enhancement measures such as rain shelters, parking areas, planting of trees and religious property rehabilitation will also benefit local communities.
- Bio- engineering interventions through the project would help in slope protection even in some of the existing degraded areas.

1.6 OBJECTIVE OF ENVIRONMENTAL IMPACT ASSESSMENT

The main aim of the Environmental Impact Assessment (EIA) is to ensure that this project proposal may be environmentally sound and sustainable on a long-term basis. The adverse impacts of the proposal need to be identified in advance and duly considered in preparation of project's engineering designs.

To assess the status of various environmental parameters in pre and post project period, environmental standards fixed by the World Bank, Ministry of Environment Forest & Climate Change (MoEF&CC) and Bureau of Indian Standards are referred.

The Environmental Assessment provides tool for decision-making as well as it helps in ensuring the sustainable development with mitigating adverse environmental impacts by providing site specific Environmental Management Plan (EMP). In order to achieve these objectives, detailed surveys and monitoring have been carried out along the proposed project road to identify Valued Ecosystem Components (VEC) and project specific significant environmental issues (SEI).

1.7 SCOPE OF ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

The scope of EIA is to meet the Environmental Framework requirements and environmental assessment guidelines of the World Bank.

- Collecting primary and secondary environmental baseline data within the project boundary and surrounding areas;
- Assessing potential adverse environmental impacts that might arise during design, construction and operation phases with respect to design proposal of the project and using the environmental baseline study;

- Suggesting appropriate mitigation measures to effectively manage potential adverse environmental impacts; and
- Analyse the alternatives in terms of alternatives of upgradation of the alignment, technology, design and operation, including the "without and with project" situation. A detailed analysis for each of the alternatives, was carried out to analyse the feasibility in terms of capital and recurrent costs; their suitability under local conditions and quantify the environmental impacts to the extent possible, and attach economic values where feasible and explain the rationale behind the preferred/chosen option
- Consultation with the Public/key Stakeholders and incorporate their concerns into the project design;
- Developing an Environmental Management Plan (EMP) including environmental monitoring plan to implement suggested mitigation measures and management plans to minimise adverse impacts through effective management systems including formulation of monitoring and reporting requirements;

1.7.1 Approach And Methodology of EIA Studies

The methodology for the EIA study employs a traditional approach of identifying the environmental sensitivities along the project corridor and analysing the environmental issues identified. The EIA process simultaneously informs the design of the project road about these issues so that necessary modification can be carried to minimise these environmental concerns. Thereafter the impact assessment that is carried out would identify the impacts which are still likely and also identify mitigation measures which need to be adopted during the construction and operation of the National highway.

1.7.2 Environmental Screening And Scoping

Environmental screening exercise of the project road was undertaken to facilitate inputs on environmental considerations; apart from social, economic and traffic & transport considerations. Further, this report will also provide scoping inputs in determining the major environmental issues and defines the scope of work for conducting environmental assessment. As per the recommendation of the Environmental Screening report, detailed Environmental Assessment will be taken up as a next step of the consultants in the assignment. The scoping exercise defines geographical boundaries for the project road for impact assessment as well as defining the project influence area to assess the impacts due to project interventions during construction and operation phases.

The environmental screening typically identifies the natural habitats (e.g. national parks, wildlife sanctuaries, sacred groves, protected areas, forests, water bodies etc.), major rivers and waterways, notified cultural heritage sites and any other potentially sensitive areas. The information available from secondary sources along with the inputs from the site visits and consultation with local people are used to identify these issues and sensitive receptors which might be located along the project corridor.

1.7.3 Delineation of The Project Impact Zone

For carrying out further environmental studies and subsequently the assessment, it was required to delineate the Corridor of Impacts (COI) and project influence zone. Depending on the severity of impact the project influence zone has been classified as:

1.7.4 Corridor of Impact (COI) And Project Influence Zone

The area of the proposed Right of Way (ROW) has been considered as the Corridor of Impact. The proposed RoW is 30m at re-alignments and bypass. The project influence zone has been considered as 10 km either side of the project road.

1.7.5 Collection of Primary And Secondary Environmental Data

Primary and secondary data were collected through field monitoring and various verifiable sources for different environmental components e.g. ambient air, soil, water, noise, climate, physiography, ecology, etc.

1.7.6 Collection of Primary Baseline Information

For gathering the baseline environmental condition along the project corridor baselines studies were conducted. These baseline studies carried out included:

- Baseline environmental surveys for assessing the ambient air, ground and surface water, soil and noise levels;
- numeration of trees to identify the location, number, types spread, girth etc. Local name, value of the trees within the proposed RoW;
- Ecological surveys to identify the habitats and the flora and fauna;
- Structure enumeration to identify the one likely to be impacted;
- Socio-economic surveys to identify the condition of the impacted persons.

In addition to the above survey interactions were carried out with the populations along the project corridor to gather local level information on the following:

- Local practices and traditions with respect to conservation and use of natural resources;
- Farming practices and Cropping pattern;
- Perception of the people about the project
- Traffic surveys were used to estimate the present and future traffic
- Preliminary engineering surveys to identify the topographical features

This information was used to develop the baseline environmental condition in the project area and identify the environmental sensitivities which might still get affected by the proposed alignment.

The sources from which baseline information gathered, are presented in **Table 1.1** below:

Table 1.1: Primary and Secondary Data Collected for EIA Studies

S.No.	Primary Data	Source
1.	Primary Data Source	
2.	Baseline Data	Environment Monitoring done by Enviro Infra Solutions Pvt. Ltd. Ghaziabad 2014
3.	Surface Water bodies	Site Survey Conducted by THEME Engineering Services Pvt. Ltd., Jaipur 2018
4.	Sensitive Receptors and CPRs	Site Survey Conducted by THEME Engineering Services Pvt. Ltd., Jaipur 2018
5.	Directed impacted Trees species along the project stretch	Site Survey Conducted by THEME Engineering Services Pvt. Ltd., Jaipur 2018
6.	Secondary Data Sources	
7.	Hydrological Data	Hydrological Dept. (HP)
8.	Survey of India Topo Sheet	Survey of India
9.	Topographical data	District information center of Hamirpur and Mandi
10.	Mineral Resources of Himachal Pradesh	Handbook of Mineral Resources of Himachal Pradesh written by Sharma A.K., Sharma R. and Dandi H.R.
		Geology and Mineral Resources of Himachal Pradesh Miscellaneous Publication no. 30 : Part XVII
11.	Soil Type of Hamirpur and Mandi	NBSS & LUP regional center Delhi
		Agriculture contingency plan for Hamirpur and Mandi district.
12.	Metrological Data	Customized Rainfall Information System, Indian Meteorological Dept. New Delhi.
		World Weathernoline.com
13.	Local Biodiversity of Hamirpur and Mandi District	Forest Dept. of Himachal Pradesh
14.	Tourism Network	Tourism Dept.
15.	Local Agriculture Based Products	Agriculture Dept of Himachal Pradesh
16.	Drainage System of Hamirpur and Mandi districts	Ground Water information booklet of Hamirpur and Mandi district Central Government Water Dept. Report
17.	Population Data	Census Data 2011

1.7.7 Consultation With Key Stack Holders

During the EIA process, a preliminary identification of key stakeholders was carried out. An inventory of actual / potential stakeholders, including local groups and individuals, local institutions which may be directly or indirectly affected by the project or with interest in the development activities in the region was made at a preliminary stage. This inventory was arrived through discussions with local official and also in consultation with members of the local community.

Consultation with the community is a continual process that was carried out during the EIA study and would also be continued during the construction and operation phases of the project. The consultations with community and local institution like panchayat also helped in developing preliminary understanding of the requirement of people in the area and identification of the enhancement proposals.

1.7.8 Impacts Identification And Evaluation

The principal impact assessment (IA) steps comprise of the following:

- Impact prediction: to determine what could potentially happen to resources/ receptors as a consequence of the project and its associated activities.
- Impact evaluation: to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/ receptor.
- Mitigation and enhancement: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- Residual impact evaluation: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

1.7.9 Environmental Management And Monitoring

The final stage in the EIA Process is preparation of the management and monitoring measures that are needed to ensure:

a) Environmental impacts and their associated Project components remain in conformance with applicable regulations and standards; and
b) Mitigation measures are effectively implemented within permissible level..
An Environmental Management Plan, which is compilation of control and mitigation measures to be implemented with respect to environmental performance for the project road. The Environmental Management Plan includes mitigation measures, budgetary estimates, performance indicators, reporting and monitoring activities.

1.8 LIMITATIONS OF EIA STUDY

The EIA report is based on the preliminary designs which were prepared for the road. The final Highway design will be verified and finalised by the contractor within the Scope of Services given by MORTH before the initiation of construction. Even though no major changes are expected in the design the EIA report needs to be verified against the final engineering design. Further, the report has been developed on certain information available at this point of time, scientific principles and professional judgement to certain facts with resultant subjective interpretation. Professional judgement expressed herein is based on the available data and information.

1.9 STRUCTURE OF EIA REPORT

The EIA report for the project road has been prepared complying country's regulations and The World Bank Guidelines for Environmental Assessment. The report has been structured in the following Chapters:

Executive Summary

Chapter 1 as Introduction describes background, brief description of project road, needs and benefits of the project road, scope of environmental assessment, needs of EIA study, approach and methodology adopted and structure for EIA report.

Chapter 2 as Project Description describes existing road conditions and facilities, traffic projections, right of way, proposed bypass and realignment, proposed roadway improvements, bridge and cross drainage structures, junctions improvement, community facilities, construction materials requirement and sources, way side amenities, road safety improvement proposal, etc.

Chapter 3 as Policy, Legal and Regulatory Framework presents the legal and administrative framework of World Bank, Government of India and Government of Himachal Pradesh. This section underlines various clearances, permissions, consents involved for the project road at the State level and at the Central level.

Chapter 4 as Baseline Environmental Conditions presents the existing environmental conditions along the corridor, which were ascertained by conducting a field survey along with collection of secondary information pertaining to the corridor. Primary data for various environmental parameters was generated using suitable monitoring devises. The methodology was strictly adhered to the stipulated guidelines by MOEF&CC and CPCB.

Chapter 5 as Assessment of Potential Impacts describe identification and evaluation of anticipated environmental impacts caused on various environmental and social parameters by the various activities proposed for the upgradation of the project corridor.

Chapter 6 as Analysis of Alternatives presents analysis of alternatives carried out during EIA studies considering with and without project, alternatives for bypasses and realignments, pavement technologies, construction materials, etc.

Chapter 7 as Consultations with Key Stakeholders provide details of consultation carried out in order to know the feedbacks of local population and the project affected people (PAP). Public consultation meetings were held with the stake holders to record their views on the environmental issues pertaining to the road and the suggested remedies to be adopted for the proposed project corridor.

Chapter 8 as Environmental Management Plan describes mitigation measures to avoid or minimization of anticipated environmental impacts during design, preconstruction, construction and de-mobilization phases. Environmental Management Plan that include institutional aspects of the project implementation and cost estimates for implementation of EMP.

Annexures

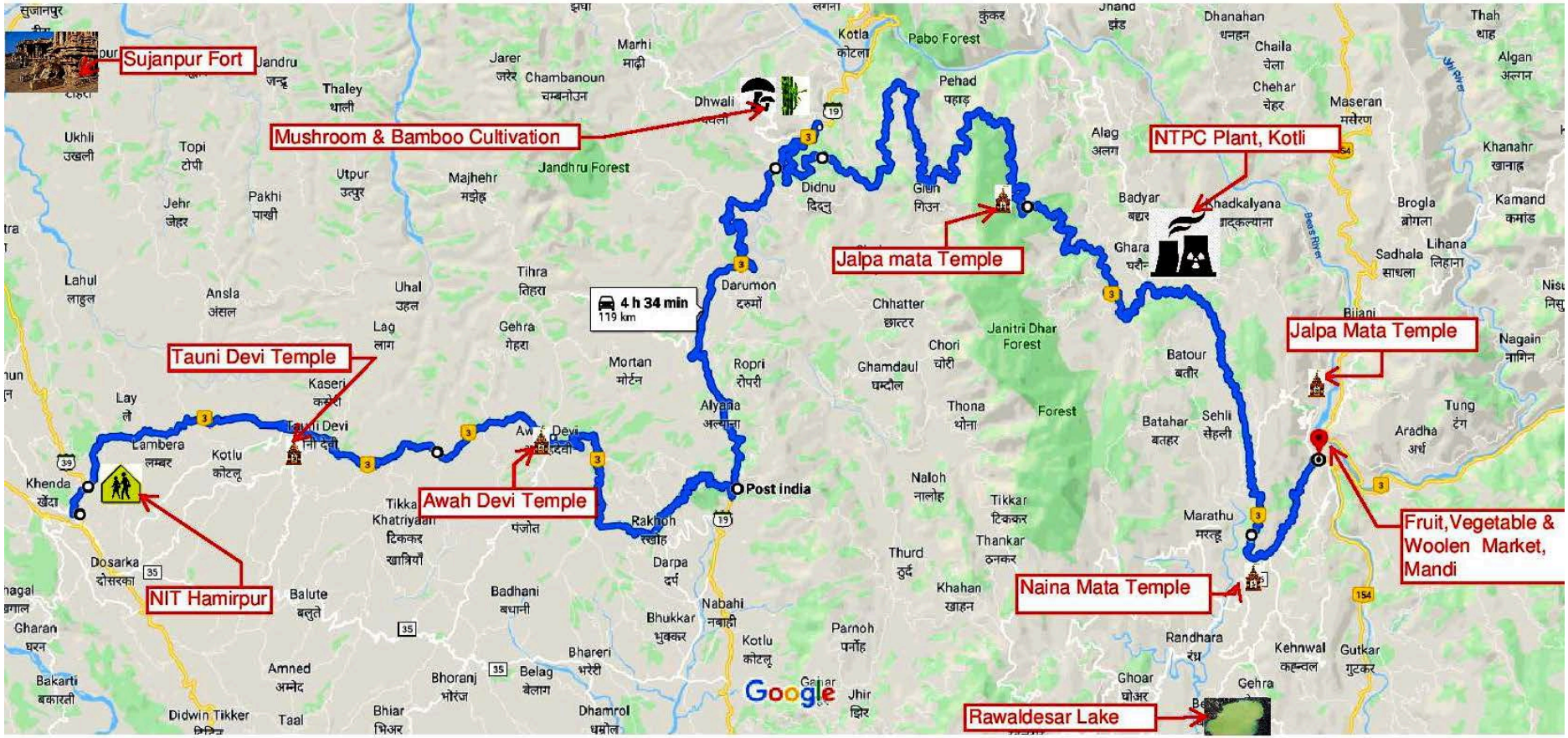

Figure 1.2: Important Religious, Rourist, Agro Based Industrial and Other Economical Spot Along Project Road

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CHAPTER-2

PROJECT DESCRIPTION

2.1 PROJECT BACKGROUND

The project starts from Hamirpur at Km 141 and ends at Mandi at Km 265.00 and passes via Awah Devi, Tauni Devi, Sarkaghat and Dharampur is a part of NH-70. The total length of this project section is 124.0 km. The entire project highway section is passing through mountainous to steep terrain and traversing in a very few length near Hamirpur on ridge and in most of the length in hill side cut with hill on one side and valley on other side.

The project rehabilitation and up-gradation of the existing single/intermediate/2-lane to 2-lane with paved/ earthen shoulder is proposed from km 141 to km 265 of Hamirpur-Mandi, Section of NH –70 in the state of Himachal Pradesh. The proposed length is 109.952 (km 141.0 to km 250.592) and exiting length is 124.0 km. The project road has been divided in three packages for construction purpose. The package wise length of proposed project road is given in **Table 2.1** below:

Table 2.1: Package-wise Length of Project Road

Package No.	Place		Existing Chainage		Total Existing Length (km)	Design Chainage		Total Proposed Length (km)
	From	To	From	To		From	To	(km)
I	Garna-Gallu	Padchu	141.000	184.758	43.758	141.000	181.000	40
II	Padchu	Hazkara	184.758	217.014	32.256	181.000	208.950	27.95
III	Hazkara	Mandi	217.014	**265.550**	48.536	208.950	250.592	41.642

There is a provision of review of the C- ESMP and to update in a timely manner as per Clause 10.3.1 of Contract agreement. The last revision was done by EPC Contractor and reviewed by the Authority Engineer. Approval was accorded by the AE on 28th March, 2023 and the same was submitted to the World Bank for review. Further, the Occupational Health & Safety manual was also prepared by the EPC Contractor and approved by the Authority Engineer.

2.2 EXISTING FEATURE OF THE PROJECT

The proposed highway project is lies in Himachal Pradesh and its confined within 10-15 m width of ROW. Encroachers, squatters and those, whose land is being acquired for the development of the road, are mostly among affected people within available ROW for

realignments and for geometric improvements. The main project details are provided in **Table 2.2.**

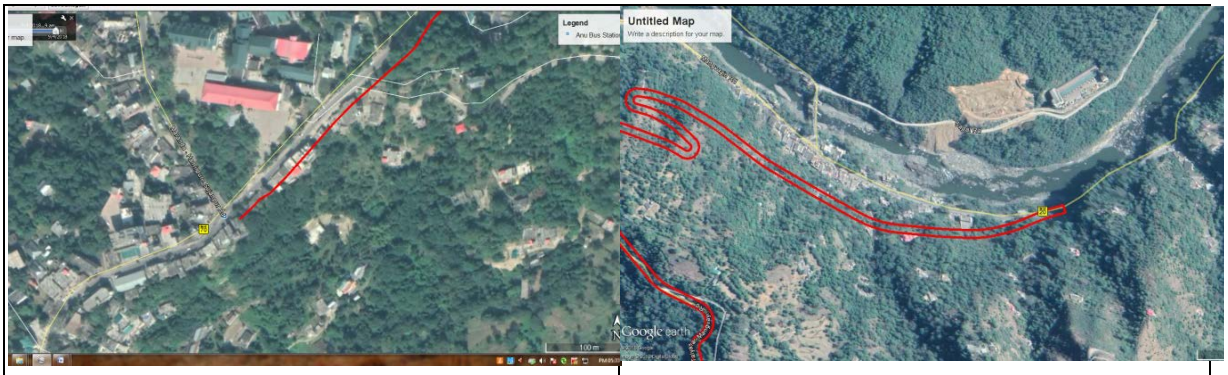
Table 2.2: Details of Project Road

S. No.	Type	Features
1.	Project stretch	Km 141.0 to Km 250.592 Section of NH 70
2.	Length (Km)	124 Km
3.	District	Km 141 to Km 163 falls in Hamirpur District, and Km 163 to Km 265.00 falls in Mandi District.
4.	Existing ROW available	The existing available ROW is varying from 5.4m to 15m in pkg-I, 7.5m to 15m in pkg-II and 6.91m to 15m in pkg-III.
5	Existing Carriageway	Varies from 3-7m 2-lane- 1.70 km (1.5%) Intermediate Lane - 10.00 km (8.8%) Single lane - 101.70 (89.7)
6.	Existing No. of Junctions and Intersection	There are 77 nos. of Junctions are existing on project road. Major junctions involved are NH, SH and MDR intersecting with the project road. Village and other roads intersecting with project have been considered as minor junctions.
7.	Existing Pavement Condition	Good -19.82 km Fair – 49.00 km Poor – 36.30 km Very Poor – 8.28 km
8	Utilities	OFC line, Electric power supply line and Telephone line are running parallel, crossing the project road at many locations. Shifting of utilities may be required during Improvement of existing project road.
9.	Existing Bridges and Culverts	There is only one major bridge on Sonkhad (Shivdwala) (Total span length > 60m) in km 193.736. There exist 8 minor bridges on various Khads and natural falling streams from side hills on this project road. All minor bridges are having single span arrangement either of RCC 'T' beam/RCC slab or steel truss. RCC Slab - 33 Nos. Hume Pipes - 345 Nos. Stone Scuppers - 107 Nos. Flush Causeway - 2 Nos Total 487 Nos.
10	Connectivity	The project highway will increase interconnectivity among SH-39, 19, 32, MDR-26 and other associated intermediate roads. Trade of local produce like agriculture, milk and small scale industrial products (handicraft & textiles) will increase. This is very important road project for the development of the Kot, Daroghan, Tauni Devi, Ambi, Bahal, Badehru, Awah

S. No.	Type	Features
		Devi, Cholthara, Kothi, Sangroh Kurd, Bhuana, Rakhoh, Sarkaghat, Alyana, Dham Sera, Kotli, Parchhu Hukkal, Laungani, Dharmpur, Hawani, Thana, kumnarda, Ladhar, Balahar, Batahar, Bahin, Chera, Panjethi and other associated villages with NH-70.
11	Settlements	The project highway has got settlements throughout its length with more than 28 major and minor habitations.
12	Land Use	The land use pattern along the project area is predominating by agriculture, forest and built-up areas. In the proposed development curve improvement & realignment are proposed to avoid negative social and environmental impacts due to more land acquisition. Land use map of the study area on scale 1:25000 delineating forest land, agriculture land, open areas, water bodies, built up areas and other important features has been prepared and provided in **Annexure 2.1.**
13	Topography	The Project Highway traverses through hilly terrain
14	Hydrology and Drainage pattern	Cross drainage will taken be care by 1 nos. major bridges, 6 nos. minor bridges, and 497 nos. culverts. The cross sections and longitudinal sections of stream/Nalah, HFL has been collected from local enquiry during detailed site investigation.

2.3 PROJECT LOCATION

The project stretch starts near Hamirpur at km 141 (31°42'56.68"N, 76°32'29.73"E) and ends near Mandi at km 265 (31°41'14.54"N, 76°56'7.05"E) as shown in **Figure 2.1.**



Start Point | End Point

Figure 2.1 : Starting and End Point of Project Stretch

2.4 EXISTING ROAD ATTRIBUTES

2.4.1 Existing Road Configuration

The existing road consists of 1.70 km 2-lane, 10 km Intermediate lane and 101.70 km single lane sections. Details of various sections are given in **Table 2.3.**

Table 2.3: Details of Road Sections

S.No	Description of Lane	Length in km.	Abutting Land Use
1	Single	101.700	Mostly steep terrain hills
	Intermediate	10.000	Urban, scattered built up and open land
	Two lane	6.700	Urban, scattered built up and open land

2.4.2 Existing ROW

The existing available ROW is varying from 5.4m to 15m in pkg-I, 7.5m to 15m in pkg-II and 6.91m to 15m in pkg-III. Package wise details of existing ROW are provided in **Annexure 2.2.**

2.4.3 Embankment Height and Pavement Condition

All entire project road length lies on hilly terrain. The existing road alignment is not as per IRC standard. The grade and the curves are very steep. The side slope of the existing embankment varies 1.5:1 to 2:1.

Pavement Condition: Pavement condition of the existing road has been taken based upon crack area, pot-hole area, and raveling area. **P**avement condition has been divided into three categories, Good, Fair and Poor. Summary of **p**avement condition is presented in **Table 2.4**.

Table 2.4: Summary of Pavement Condition

Pavement Condition	Length (km)	Percentage Length (%)
Good	19.82	17.5
Fair	49.00	43.2
Poor	36.30	32.0
Very Poor	8.28	3.3

Pavement Roughness Survey: Roughness survey was carried out using TRL's Car Mounted Bump Integrator. The Summary for Roughness survey data is given in **Table 2.5.**

Table 2.5: Summary for Roughness Value

Ranges of Road condition / Roughness(mm/km) and Road Length		
Good	Fair	Poor
3000 - 4000	4000 - 5000	> 5000
17.800	51.020	44.580

Source: Site Inventory conducted by THEME ngineering Pvt. Ltd. 2018-19

2.4.4 Road Side Drain

The roadside drains / longitudinal drains are observed in built-up sections and Unlined earth ditches in open areas. The condition of unlined drains is mostly poor except at some stretches. Inventory & condition of the existing longitudinal drains and water logging locations have been shown in T**able 2.6**.

Table 2.6: Location of Existing Road Side Drains

Left Side Drainage			Right Side Drainage		
FROM	**To**	**DRAINAGE (LINED/ UNLINED)**	**FROM**	**To**	**DRAINAGE (LINED/ UNLINED)**
Pkg-II					
187/925	188/475	Lined -475 m	145/940	146/440	Lined-60 m
188/475	188/975	Lined	191/925	192/380	Lined-330 m
188/975	189/425	Lined	192/380	192/880	Lined-320 m
189/425	189/975	Lined	192/880	193/295	Lined-275 m
189/975	190/400	Lined	193/775	194/260	Lined-160 m
190/400	190/900	Lined	194/260	194/760	Lined-325 m
190/900	191/425	Lined	201/290	201/960	Lined-100 m
191/425	191/925	Lined-275 m	218/275	218/775	Unlined
191/925	192/380	Lined	218/775	219/300	Unlined
192/380	192/880	Lined-245 m	219/300	219/750	Unlined
193/295	193/775	Lined-130 m	219/750	220/150	Unlined
200/425	200/790	Lined-290 m	220/150	220/500	Unlined
200/790	201/290	Lined-110 m	220/500	220/950	Unlined
Pkg-III					
242/000	242/460	Lined -285 m	220/950	221/300	Unlined
242/460	242/950	Lined	221/300	221/750	Unlined
242/950	243/400	Lined	221/750	222/100	Unlined
243/400	243/900	Lined	222/100	222/675	Unlined
243/900	244/340	Lined	222/675	223/000	Unlined
244/340	244/850	Lined	223/000	223/425	Unlined

Left Side Drainage			Right Side Drainage		
FROM	**To**	**DRAINAGE (LINED/ UNLINED)**	**FROM**	**To**	**DRAINAGE (LINED/ UNLINED)**
244/850	245/240	Lined	223/425	223/900	Unlined
245/240	245/700	Lined	223/900	224/400	Unlined
245/700	246/180	Lined	224/400	224/900	Unlined
246/180	246/650	Lined	224/900	225/410	Unlined
246/650	247/100	Lined	225/410	225/900	Unlined
247/100	247/600	Lined	225/900	226/370	Unlined
247/600	248/040	Lined	232/000	232/475	Unlined
248/040	248/500	Lined	232/475	232/975	Unlined
248/500	248/910	Lined	232/975	233/450	Unlined
248/910	249/350	Lined	233/450	233/970	Unlined
249/350	249/870	Lined	235/900	236/300	Lined-300 m
249/870	250/350	Lined	236/300	236/785	Lined-285 m
250/350	250/800	Lined	236/785	237/250	Lined-215 m
250/800	251/250	Lined	237/250	237/765	Lined -165 m
251/250	251/700	Lined	237/765	238/200	Lined
251/700	252/150	Lined	238/200	238/760	Lined
252/150	252/625	Lined	238/760	239/250	Lined -465 m
252/625	253/000	Lined	239/250	239/710	Lined
253/000	253/510	Lined	239/710	240/200	Lined
253/510	254/000	Lined	240/200	240/660	Lined

Source: Site Inventory conducted by THEME Engineering Pvt. Ltd. 2018-19

2.4.5 Road Geometry

Since the present road has been declared as NH in the year 1999, prior to that it was combination of SH, MDR & DDR, hence the existing geometric of the project road is quite deficient. In relative terms, the horizontal geometry is more deficient than the vertical geometric. The status of existing geometric is presented in Tables given **Table 2.7**:

Table 2.7: **Summary of Existing Horizontal Curves**

Sl. No.	Range of Radius of Curve		No. of Curves	% of Total
	From	To		
1	0	20	337	18.98
2	20	30	612	34.46
3	30	50	495	27.87
4	50	70	90	5.07
5	70	100	187	10.53
6	100	300	45	2.53
7	300	>300	10	0.56
Total			1776	100%

Source: Site Inventory conducted by THEME Engineering Pvt. Ltd. 2018-19

The tabular data shows that 53.44% curves are less than minimum radius of 30m while 27.87% curves are having radius between 30m to 50m. There are 58 nos. hair pin bends also exist.

2.4.6 Junctions

In the entire length of road **77** nos. of Junctions are observed.

2.4.7 Cross Drainage Structures

On the existing road, cross drainage is maintained through 8 bridges (1 minor and 7minor) and 487 culverts.

Major Bridges

Structures having a length of more than 60.0m are called major bridges. There is one major bridge along the road.

Minor Bridges

Structures having a length of more than 6.0m and up to 60.0m are called minor bridges. There are 7 no. of minor bridges exists along the project road.

Culverts

As defined in IRC:5-1998, Culvert is a cross drainage structure having a total length of 6.0 meters or less between the inner faces of the dirt walls or extreme vent way boundaries measured at right angles thereto. A total of 487 culverts are exists on project road. Out of which 33 nos. are slab/stone slab culverts, 345 nos. are pipe culverts, 2 nos. are causeway and the remaining 107 are Scuppers. Details of CD structures are given in **Table** 2.8;

Table 2.8: **Details of Major and Minor Bridges**

	Chainage (km)	Span Arrangement No. x span (m)	Carriageway width(m)	Total width of Bridge(m)	Total Length of Bridge(m)	Remarks
Major Bridge						
1	195+463	1x28.7+1x47.2+1x28.7	4.25	5.20	104.75	RCC Girder, On Sone Khad Crossing,
Minor Bridges						
1	184+364	1 x 41.95	4.35	5.05	43.4	**Steel Truss**, on Padchoo Khad
2	185+717	1 x 12.20	3.8	5.6	12.7	RCC T-Beam, On Tor Nallah Crossing
3	197+361	-	-	-	-	-

	Chainage (km)	Span Arrangement No. x span (m)	Carriageway width(m)	Total width of Bridge(m)	Total Length of Bridge(m)	Remarks
Major Bridge						
4	230+228	1 x 6.1	6.0	3.4	6.8	RCC Solid Slab, On Nallah Crossing
5	235+318	1 x 19.75	4.3	5.1	20.45	RCC T-Beam, On Nallah Crossing
6	238+933	1 x 19.75	4.1	5.3	22.5	RCC Girder, On Nallah Crossing
7	240+486	1 x 31.75	4.2	5.2	32.4	Steel Truss Girder,On Khad Crossinf0

Source: Site Inventory conducted by THEME ngineering Pvt. Ltd. 2018-19

Existing Minor Bridge at km 238/933 is having span arrangement of 1x19.75 RCC T-Beam girder superstructure and stone masonry in substructure and foundation. As per the condition survey and visual inspection as the Bridge condition holds fair but possess inadequate carriageway width.

Existing Minor Bridge at km 240/486, is having span arrangement of 1x31.75 PSC girder superstructure and stone masonry in substructure and foundation. As per the condition survey and visual inspection as the Bridge condition holds fair but possess inadequate carriageway width.

From the above details the Minor Bridges between km 145/950 to km 259/350 has been proposed for reconstruction.

Water Storage pits for Drinking Water (Khaatary/Bowaris)

Water storage pits locally known as “Khaatary” is a traditionally rain water harvesting structures, which is the source for drinking water, available all along the stretches, the locations of Khaatarys are given in **Table 2.9.**

Table 2.9: Details of Rain water harvesting structures “Khaatary/Bawadi & Water Percolation Well”

S.N.	Existing km	Nome of Environment Sensitive Item	Side
1.	151.814	Water Bawdi	RHS
2.	153.050	Water Bawadi	LHS
3.	154.550	Water Bawadi	RHS
4.	156.500	Water Bawadi	RHS
5.	156.970	Water Percolation Well	RHS
6.	158.100	Water Percolation Well	RHS
7.	159.000	Water Percolation Well	LHS
8.	159.010	Water Percolation Well	LHS
9.	160.350	Water Percolation Well	RHS
10.	160.350	Water Percolation Well	RHS
11.	160.364	Water Percolation Well	RHS

S.N.	Existing km	Nome of Environment Sensitive Item	Side
12.	160.380	Water Percolation Well	RHS
13.	160.384	Water Percolation Well	RHS
14.	160.392	Water Percolation Well	RHS
15.	160.392	Water Percolation Well	RHS
16.	160.392	Water Percolation Well	RHS
17.	160.392	Water Percolation Well	RHS
18.	160.397	Water Percolation Well	RHS
19.	160.403	Water Percolation Well	RHS
20.	160.410	Water Percolation Well	RHS
21.	160.415	Water Percolation Well	RHS
22.	160.415	Water Percolation Well	RHS
23.	168.800	Water Bawadi	LHS
24.	169.290	Water Bawadi	RHS
25.	176.211	Water Bawadi	RHS
26.	181.007	Water Bawadi	RHS
27.	184.556	Water Bawadi	LHS
28.	189.410	Water Bawadi	LHS
29.	197.670	Water Bawadi	RHS
30.	204.010	Water Bawadi	RHS
31.	210.980	Water Bawadi	RHS
32.	210.990	Water Bawadi	RHS
33.	225.950	Water Bawadi	RHS
34.	230.326	Water Bawadi	RHS
35.	231.473	Water Bawadi	RHS
36.	237.600	Water Bawadi	RHS
37.	239.385	Water Bawadi	RHS
38.	240.285	Water Bawadi	RHS
39.	242.00	Water Bawadi	RHS
40.	249.500	Water Bawadi	RHS
41.	251.700	Water Bawadi	LHS
42.	256.599	Water Bawadi	LHS
43.	260.814	Water Bawadi	RHS
44.	261.823	Water Bawadi	RHS
45.	263.050	Water Bawadi	RHS
46.	266	Water Bawadi	RHS

Source: Site Inventory conducted by THEME ngineering Pvt. Ltd. 2018-19

2.4.8 Existing Way side Utilities

Along the existing road alignment, various types of wayside utilities like electric pole, telephone line, optical fiber cable, hand pumps, overhead transmission transformer, water tap and Bawadi are observed. Summary of existing wayside utilities is given in **Table 2.10.**

Table 2.10: Summary of existing wayside utilities

S.N	Utility Item	LHS	RHS
1	Electric Pole	231	101
2	Telephone Pole	263	89
3	Optical fiber Cable	45	42

S.N	Utility Item	LHS	RHS
4	Hand Pump	40	40
5	Over Head Transmission	61	46
6	Transformer	15	12
7	Water Tap	2	7
8	Bawadi	8	38
9	Khatri	19	30

Source: Site Inventory conducted by THEME Engineering Pvt. Ltd. 2011.

2.4.9 Existing Way side Amenities

Details of wayside amenities along the existing road alignment are given in **Table 2.11.** There are 72 nos. bus shelters, 25 nos. rain shelters and 31 nos. schools/colleges.

Table 2.11: Details of Wayside Amenities

S.No.	Items	RHS	LHS
1	Temple	15	12
2	School/College	15	16
3	Hospital	2	2
4	Petrol Pump		
5	Bus - Stop	48	24
6	Hotel		
7	Teashops	19	17
8	Dhaba	4	4
9	Rain Shelter	13	12
10	Automobile Shop	2	0
11	Repair Shop	3	1
12	Others	21	

Source: Site Inventory conducted by THEME Engineering Pvt. Ltd. 2018-19.

2.4.10 Projected Traffic

The projected traffic for the project road is given in **Tables 2.12**.

Table 2.12: The Projected traffic on the Project Road

Year	AADT Section1 (PCU)	AADT Section2 (PCU)	Section3AADT (PCU)	AADT Section4 (PCU)
2010	2936	2145	194	2814
2011	3237	2377	214	3133
2012	3580	2638	239	3490
2013	3961	2929	266	3889
2014	4386	3254	297	4335
2015	4860	3615	332	4833
2016	5387	4018	370	5390
2017	5881	4395	407	5923
2018	6422	4809	446	6509

Year	AADT Section1 (PCU)	AADT Section2 (PCU)	Section3AADT (PCU)	AADT Section4 (PCU)
2019	7017	5263	490	7155
2020	7669	5761	538	7866
2021	8385	6309	591	8650
2022	9171	6910	650	9514
2023	9866	7439	701	10297
2024	10619	8011	757	11146
2025	11434	8630	817	12070
2026	12316	9300	882	13073
2027	13272	10026	953	14163
2028	14307	10813	1030	15349
2029	15429	11665	1114	16638
2030	16645	12588	1204	18039
2031	17963	13589	1303	19564
2032	19393	14675	1410	21222
2033	20944	15853	1526	23027
2034	22628	17130	1652	24991
2035	24455	18517	1790	27129
2036	26439	20022	1939	29456
2037	28593	21657	2101	31989
2038	30934	23432	2278	34749
2039	33477	25360	2470	37754
2040	36242	27455	2679	41028

2.4.11 Road Accident data analysis

Accident data for last 5 years was collected from different police stations along the project road on NH-70. The 5 years data provides an adequate source of analysis about accidents in project road reach. Accident data relates to number of accidents for different sections. The accident details are furnished in **Table 2.13.**

Table 2.13: Accident Characteristics Along the Project Road

Accident Data along the Project Road: At Hamirpur	
Year	**No. of Accidents**
2005-2006	3
2006-2007	4
2007-2008	3
2008-2009	4
2009-2010	4

Accident Data along the Project Road: At Mandi	
Year	**No. of Accidents**
2007-2008	5
2008-2009	8
2009-2010	2

Based on analysis of accidents for the past 5 years, it can be seen that there is no location of severe accident where the ASI exceeds the accident threshold value.

2.5 PROPOSED DESIGN IMPROVEMENT

2.5.1 Proposed Right of Way

The proposed road configuration is 2-lane with paved at settlement portion and earthen shoulder at open areas. As per the requirement of 2-lane with paved and unpaved shoulder, 15 ROW is required at open area, realignments & curve improvement portions, and 10 m ROW at settlements & markets portions. Chainage wise details of PROW are given in **Annexure 2.3.**

2.5.2 Proposed Carriageway Configuration

The existing single/intermediate/2-lanes carrageway is for 2- lane with paved/earthen shoulder. Width of carriageway and shoulder adopted in Normal Scenario and Constraint Scenario, is given in **Table 2.14.**

Table 2.14: Proposed Carriageway and Shoulder Width

Scenario	Component of Roadway	IRC Recommendation, as per		Adopted for Project Road
		IRC:SP:48-1998	IRC:SP:74-2009	
Normal Scenario	Shoulder on Hill side	0.9 m	1.0 m	1.0 m
	Carriageway	7.0 m	7.0 m	7.0 m
	Shoulder on Valley side	0.9 m	2.0 m	2.0 m
	Total Roadway*	8.8 m	10.0 m	10.0 m
Constraint Scenario	Shoulder on Hill side	0.9 m	1.0 m	1.0 m
	Carriageway	7.0 m	7.0 m	7.0 m
	Shoulder on Valley side	0.9 m	2.0 m	2.0 m
	Total Roadway*	8.8 m	10.0 m	10.0 m

2.5.3 Road Widening Scheme

The availability of RoW is not uniform along the project road and it varies 5.4 to 15 m. In order to minimize the environmental and social impacts, concentric and eccentric widenings are proposed as per the availability of land. A total of 36.646 km length is proposed for concentric widening, 13.085 km length for LHS widening, 37.151 km length for RHS widening, 11.072 km for realignment and 11.138 km length is proposed for curve

improvement. Details of proposed widening scheme are provided in **Annexure 2.4.** Various types of TCS (TCS-1, TCS-2, TCS-3, TCS-4 and TCS-5) have been used in the proposed road alignment. The details of widening scheme with TCS used in proposed alignment, are given in **Table 2.15.**

Table 2.15: Details of Widening Scheme with TCS

Typical Cross Section	Applicability	Cross-Sectional Elements
Type - 1 (Fig 5.1)	Both Side Hill (Cut Portion)	Total width of Roadway – 11.250 m (inclusive of drain on both side) • Carriageway – 7.00 m • Both side Granular shoulder – 1.0 m • Both side Lined Drain – 1.125 m
Type – 2 (Fig 5.2)	One Side Hill other side Valley	Total width of Roadway – 11.525 m (inclusive of drain and parapet) • Carriageway – 7.00 m • Hill side Granular shoulder – 1.0 m • Hill side Lined drain – 1.125 m • Valley Side Earthen Shoulder – 2.0 m • Parapet on Valley side – 0.40 m
Type – 3 (Fig 5.3)	Both Side Valley (Both side Retaining wall)	Total width of Roadway – 11.80 m (inclusive of parapet on both side) • Carriageway – 7.00 m • Both Side Earthen Shoulder – 2.0 m • Both side Parapet – 0.4 m
Type – 4 (Fig 5.4)	Plain section	Total width of Roadway – 12.00 m • Carriageway – 7.00 m • Both side Earthen Shoulder – 2.50 m
Type – 5 (Fig 5.5)	Built up section	Total width of Roadway – 10.80 m (inclusive of both side Covered Drain) • Carriageway – 7.00 m • Both side Granular shoulder – 0.9 m • Both side Covered Drain – 1.00 m

TCS type 1 is adopted for sections having both side hill with both side kerb and channel drain or where whole road is in cutting, TCS Type 2 is adopted where there is one side hill having kerb and channel drain and other side valley, TCS type 3 is provided in sections where there is both side valley, TCS type 4 is adopted where there is plain terrain and TSC type 5 is adopted in built up sections.

2.5.4 Horizontal Curve Improvement

The horizontal curves have been designed in accordance with the requirements stipulated in IRC: 38-1988 (Design Table for Horizontal Curves for Highways) and each curve has consisted of a circular arc spiral transitions between the arc and the straights. Reverse curves, compound curves and hair pin bands have been provided as per the procedure laid down in hill road manual. Proposed horizontal curve have been designed in the range of 5 to 500 m radius with 5 to 50 km /hours design speed of on various curves. Various type of horizontal curves along with length, are listed in **Table 2.16.**

Table 2.16: Summary of Proposed Horizontal Curves

S.No.	Radius (m)	Curve Length (m)
1	5	10.35
2	10	199.48
3	13	33.21
4	15	1738.23
5	17	30.91
6	18	62.41
7	20	4949.57
8	25	6811.81
9	30	11942.2
10	35	1414.07
11	40	4485.16
12	45	361.48
13	50	8895.1
14	60	3010.64
15	70	622.8
16	75	273.11
17	80	2550.11
18	90	185.93
19	100	4490
20	120	103.1
21	150	670.05
22	200	1555.34
23	250	145.17
24	300	330.06
25	500	132.76

2.5.5 Regiment and Curve Improvement

In lieu the minimization the demolition of settlements and straight the sharp curves, realignment and curve improvement are proposed at 114 nos. locations. Summary of realignment and curve improvement is given in **Table 2.17.**

Table 2.17: Curve Improvement and Realignment

S.N.	Item	Locations	Length (m)
1	Realignment	25	10926
2	Curve improvement	89	11138

Details of realignments proposed in the project road are given in **Table 2.18**.

Table 2.18: Details of Realignments

S.No.	Package	Design Chainage (km)		Length (m)
		Start	End	
1.	**Package I**	141+753	141+900	147.000
2..		146+834	147+256	422.000
3.		148+275	148+717	442.000
4.		149+275	149+606	331.000
5.		149+697	149+959	262.000
6.		150+171	150+485	314.000
7.		151+621	151+881	260.000
8.		152+843	153+098	255.000
9.		153+323	153+776	453.000
10.		154+957	155+444	487.000
11.		159+013	159+721	708.000
12.		162+785	163+165	380.000
13.		165+558	165+676	118.000
14.		185+106	185+731	625.000
15.		185+855	186+313	458.000
16.		187+695	187+966	271.000
17.	**Package II**	189+613	189+955	342.000
18.		192+388	193+089	701.000
19.		200+322	200+843	521.000
20.	**Package II**	218+034	218+261	227.000
21.		219+508	219+830	322.000
22.		227+951	228+259	308.000
23.		229+161	229+475	314.000
24.		233+427	233+705	278.000
25.		249+101	250+503	1402.000

2.5.6 Road Geometry

The entire geometric design has been based on the ground modelling by highway design software MOSS/ MX. The design of proposed alignment for 2- lane has been carried out by using various design modules contained in “MX”.

(a) HORIZONTAL ALIGNMENT: The summary of proposed horizontal curves is given in **Table 2.19**:

Table 2.19: Summary of Proposed Horizontal Curves

Sl. No.	Range of Radius (m) of Curve		No. of Curves	% of Total
	From	To		
1	0	20	246	14.50
2	20	30	607	35.79
3	30	50	452	26.65
4	50	70	99	5.84
5	70	100	222	13.09
6	100	300	64	3.77
7	300	>300	6	0.35
Total			**1696**	**100%**

The provision of extra widening at curves has been adopted, where ever required, as per specifications. Extra widening provided by increasing the width at uniform rate along transition curve and full width given along circular curve.

(b) VERTICAL ALIGNMENT / GRADIENT: The summary vertical alignment is given in **Table 2.20.**.

Table 2.20: Summary of Proposed Vertical Alignment

S. No.	Grade Range (%)		Length		Remarks
	From	To	Km	% of Total Length	
1	0.0	1.0	20.974	20.02%	Within Ruling Gradient
2	1.0	2.0	17.499	16.70%	
3	2.0	3.0	13.62	13.00%	
4	3.0	4.0	10.299	9.83%	
5	4.0	5.0	9.652	9.21%	
6	5.0	6.0	18.911	18.05%	
7	6.0	7.0	12.74	12.16%	Limiting
8	7.0	8	1.072	1.02%	Exceptional
	Total		**104.767**	**100%**	

At some places exceptional vertical gradient is adopted due to difficult site constraints and limitations. At these places, passing places has provided to facilitate the traffic. The **Table 2.21** of such passing places is given below:

Table 2.21 : Crawling Lane / Passing Areas

S. No.	Location	Grade (%)
1.	180+402	8.00%
2.	188+772	8.00%
3.	188+843	8.00%
4.	189+177	8.00%
5..	189+268	8.00%
6.	189+398	8.00%
7.	189+492	8.00%
8.	189+613	8.00%

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.The proposed geometric design standard used for the project is given in **Table 2.22.**

Table 2.22: **Proposed geometric design standard**

S. No.	Geometric Element	IRC Standards		Proposed
		Mountainous terrain	Steep terrain	
1	Design Speed (Km/hr)			
	Ruling	50	40	40
	Minimum	40	30	30
	Exceptional	-	-	Up to 20
2	Carriage Way Width (m) 2 lane carriageway	7.0	7.0	As per TCS
3	Shoulder width (m)			
	(i) Paved hard shoulder	2 X 0.9	2 X 0.9	
	(ii) Earth hard shoulder	2 X 0.9	2 X 0.9	
4	Formation width (m)			As per TCS
	(i) Two lane carriageway	8.8	8.8	
	(ii) Two lane with paved shoulder	10.6	10.6	
5	Right of way (ROW) m			
	open areas……..Normal	24	24	15
	Exceptional	18	18	-
	Built up areas……Normal	20	20	10

S. No.	Geometric Element	IRC Standards		Proposed
		Mountainous terrain	Steep terrain	
	Exceptional	18	18	-
6	Camber/Cross fall (In straight section)			
	Thin bituminous surfacing	2-2.5%	2.0-2.5%	2.5%
	High type bituminous surfacing	1.7 - 2%	1.7 - 2.0%	
	Shoulders	Min 3% or 0.5% more than pavement	Min 3% or 0.5% more than pavement	3.5%
7	Minimum Curve Radius (Area not effected by snow)			
	Ruling (m)	80	50	50
	Absolute (m)	50	30	30
	Note :- Radius are for ruling design speed and minimum design speed respectively			
8	Superelevation not bound by snow	Limiting to 10%	Limiting to 10%	Limiting to 10%
9	Stopping sight distance (m)			
	For Design Speed 40 Km/hr	45	45	45
	30 Km/hr	30	30	30
10	Min. Vertical Curve Length (M)			
	For Design Speed 40 Km/hr	20	20	20
	upto 35 Km/hr	15	15	15
11	Gradient			
	Ruling	5% (1 in 20)	6% (1 in 16.7)	6%
	Limiting	6% (1 in 16.7)	7% (1 in 14.3)	7%
	Exceptional	7% (1 in 14.3)	8% (1 in 12.5)	8%
12	Hair Pin Bends			
	Minimum Design speed (Km/hr)	20	20	20
	Minimum Roadway width at apex	11.5	11.5	11.5
	Minimum Radius for inner curve	14	14	14
	Minimum Length of transition curve	15	15	15
	Maximum Gradient	2.5% (1 in 40)	2.5% (1 in 40)	2.50%
	Minimum Gradient	0.5% (1 in 200)	0.5% (1 in 200)	0.50%

S. No.	Geometric Element	IRC Standards		Proposed
		Mountainous terrain	Steep terrain	
	Superelevation	10% (1 in 10)	10% (1 in 10)	10%
13	Extra widening on Curve (m) (2 - lane)			
	Radius of curve up to 40 m	1.5	1.5	1.5
	41-60 m	1.2	1.2	1.2
	61-100 m	0.9	0.9	0.9
	101-300 m	0.6	0.6	0.6
	Above 300 m	Nil	Nil	Nil

2.5.7 Pavement Design

The flexible type of pavement has been adopted for widening of existing carriageway as well as for new construction of realigned carriageway. Separate design for widening/new carriageway and strengthening of existing carriageway has been carried out. As per the guide lines issued by MoRTH for preparation of draft detailed project report and cost estimates of NHIIP projects, the design period has been taken as end of year 2030 with construction period of 3 years. Details of Pavement Composition are given in **Table 2.23.**

Table 2.23: Adopted Pavement Composition

Design (km)	Pavement Layers (mm)					
	SDBC	BC	DBM	WMM	GSB	Total
Km 141.000 to km 145.825	25	-	50	250	150	475
km 145.825 to km 193.075	-	40	50	250	150	490
Km.193.075 to km 224.400	25	-	50	250	150	475
Km.224.400 to km 250.592	-	40	50	250	150	490

Design of Overlay: The existing pavement was evaluated with a view to work out the overlay requirement on the existing carriageway and to provide new crust in additional lane. Benkelman Beam deflection studies were carried out along both outer edges of the carriageway as per IRC 81-1997.

The deflections were measured, as per procedure detailed in IRC: 81-1997. Overlay design has been carried out based on statistical analysis of all measurement. The overlay thickness for the total project road is considered with average BM 50 mm as PCC, DBM 50 mm and

BC 40 mm, except from km.193.075 to 224.400 in which 25 mm SDBC with 50 mm DBM has been considered.

2.5.8 Improvement in Roadside Drainage

On the project road V Shaped drain of size 60x (40 to 60) mm depth is existing and functioning efficiently. In the project road Kerb and channel of 60 x 20 cm sized drain has been taken. Rectangular drains (covered) have been proposed in urban area details are given in **Table 2.24**:

Table 2.24: Covered Drains in Urban Area

S. No.	Package	Design Chainage		Length
		From		
1	Package 1 km 141.000 to km 188.450	145+825	146+850	1025
2		147+250	148+000	750
3		148+700	149+400	700
4		150+425	151+625	1200
5		152+625	152+800	175
6		153+675	155+000	1325
7		155+400	158+975	3575
8		160+800	161+225	425
9		162+200	162+400	200
10		163+150	163+450	300
11		167+425	167+775	350
12		168+500	168+850	350
13		173+825	176+300	2475
14		178+300	178+700	400
15		179+800	180+100	300
16		187+950	188+150	200
17	Package 2 km 188.450 to km 208.950	207+600	208+000	400
18	Package 3 km 208.950 to km 250.592	211+400	211+575	175
19		214+000	214+300	300
20		219+700	219+975	275
21		231+050	231+525	475
22		234+400	234+800	400
23		235+275	235+700	425
24		236+225	236+475	250
25		238+500	239+200	700
26		245+150	245+400	250
27		245+600	245+850	250
28		246+125	246+400	275
29		247+600	248+050	450
			Total	**18375**

2.5.9 Embankment Raise

In the project road, embankment is raised as per the site requirement. The summary of embankment height is given in **Table 2.25** and details are provided in **Annexure 2.5.**

Table 2.25: Summary of Embankment Height

S.No.	Embankment Height (m)		Length (m)
	From (m)	To (m)	
1	0	1	25
2	1.1	2	400
3	2.1	3	800
4	3.1	4	4800
5	4.1	5	3425
6	5.1	6	2700
7	6.1	7	2400
8	7.1	8	1675
9	8.1	9	1025
10	9.1	10	1500
11	10.1	11	1100
12	11.1	12	550

2.5.10 Junction Improvement

There are 77 nos. of junctions are existed on the project road. As per design junctions proposed are 75. Major junctions involved are intersection of NH, SH and MDR. Village and other roads intersections have been considered as minor junctions. Two junctions have been dropped out of 77 nos. due to realignment near Mandi. Summary of proposed junction is given **Table 2.26.**

Table 2.26: Summary of Proposed Junctions Improvement

S.N.	Type of Junction	Numbers
1	Minor	64
2	Major	4
3	+ Junction	3
4	T-Junction	3
5	Y-Junction	62

2.5.11 Cross Drainage Structures

Culverts

After careful examination of existing cross drainage structure, site conditions, hydraulic calculations and alignment (plan and profile) of the project road, improvement proposals have been prepared. Out of 487 culverts 8 culverts are retained with minor repair, 297

culverts are considered for reconstruction, 163 culverts are to be widened, 19 culverts are to be abandoned on account of realignment and 10 new culverts have been added. Details of the Improvement proposal are given in **Table 2.27.**

Bridges

On the basis of the site condition, hydraulic calculation and alignment (plan and profile) of the project it has been recommended that all the Bridges (1 Major & 7 Minor Bridges), are to be constructed as new due to realignment less width of carriage way having no space for by pass during construction. The details of each bridge (dropped / reconstructed) with reasons is given in **Table 2.28.**

Table 2.27: Details of Summary – Replaced, Rehabilitated, Repaired and New

S.N.	Types of structure	Existing Structures	Proposed						Proposed Structures	Remarks
			Retained/ Repair/ Rehabilitation	Replaced	Widen	Reconstruction	Abandoned	New + Replaced		
1	Slab Culverts	33	0	0	0	0	4	0	4	6 Nos of Slab Culverts are replaced by Box culverts
2	Pipe Culverts	345	8	0	148	283	9	6	454	6 Nos of Pipe Culverts are Proposed due to change of alignment
3	Box Culverts	0	0	0	15	14	0	4	33	4 Nos of Box Culverts are Newly Proposed due to change of alignment
4	Stone Scupper	107	0	0	0	0	6	0	6	101 Nos.Stone Scupper are replaced by Pipes Culverts
5	Causeway	2	0	0	0	0	0	0	0	Both Causeway are replace by Pipe Culverts
	Total	487	8	0	163	297	19	10	497	

Table 2.28: Details of Proposed Bridges

Detail of Cross-Drainage Work												
S. No.	Types of structure	Existing Chainage	Design Chainage	Exis-ting Struc-tures	Proposed					New Con-struction	Proposed Structures	Remarks
					Retained/ Repair/ Rehabili-tation	Re-placed	Widen	Recon-struction	Abandoned			
1	**Minor bridge**	184+364	180+619	1	0	0	0	1	-	-	1	Change of Alignment
2	**Minor bridge**	185+717	181+800	1	0	0	0	1	-	-	1	Change of Alignment
3	**Major bridge**	195+463	189+755	1	0	0	0	1	-	-	1	Change of Allignment
4	**Minor bridge**	230+288	220+283	1	0	0	0	1	-	-	1	Change of Alignment
5	**Minor bridge**	235+318	224+703	1	0	0	0	1	-	-	1	Change of Alignment
6	**Minor bridge**	238+933	228+016	1	0	0	0	1	-	-	1	Change of Alignment
7	**Minor bridge**	240+486	229+381	1	0	0	0	1	-	-	1	Change of Alignment
	Total			7	0	0	0	7	0	0	7	

2.6 SLOPE PROTECTION MEASURES

Various slope protection measures are adopted to protect the slopes at CD structures and high embankment locations.

2.6.1 Stone Pitching

Stone pitching is the conventional erosion control for bridge abutments and is preferred solution to reduce erosion. Availability of stones is posing a great challenge from an environmental and commercial standpoint. 14625 m length in LHS and 8175 m length in RHS is proposed for stone pitching to protect the slopes. km wise details of stone pitching is provided in **Annexure 2.6.**

2.6.2 Retaining walls

A retaining wall is a structure designed and constructed to resist the lateral pressure of soil, when there is a desired change in ground elevation that exceeds the angle of repose of the soil. Retaining walls are relatively rigid walls used for supporting the soil mass laterally so that the soil can be retained at different levels on the two sides. A total of 20850 m long retaining wall is proposed at various locations. Abstract of retaining wall is given in **Table 2.29**.

Table 2.29: Abstract of Provision of Retaining Walls

S.No.	Section Height	Package 1 km 141.000 to km 188.450	Package 2 km 188.450 to km 208.950	Package 3 km 208.950 to km 250.592	Total Length of Retaining wall
1	3.5m	1325	525	1250	**3100 m**
2	4.0m	1275	225	1050	**2550m**
3	4.5m	975	175	625	**1775m**
4	5.0m	775	375	675	**1825m**
5	6.0m	1775	325	900	**3000m**
6	7.0m	1550	425	625.00	**2600m**
7	8.0m	1225	125	475.00	**1825m**
8	9.0m	475	100	250.00	**825m**
9	10.0m	950	375	275.00	**1600m**
10	11.0m	700	350	125.00	**1175m**
11	12.0m	400	75	100.00	**575m**
Total Length		11425	3075	6350	**20850m**

In addition to the above slope protection structures, bioengineering measures for slope protection work has been provided as the subproject is in mountainous terrain and substantial hill cutting is required. Therefore, slope stabilization measures like bioengineering are required and beneficial for the subproject.

2.6.3 Vetiver Grass and Geo Textiles

Vetiver is a special type of grass which can be grown in a wide variety of soil such as clayey, sandy, silty, gravely types or in other words from least erodible to highly erodible soils. This type of grass does not require any special maintenance.

A geo-textile is typically defined as any permeable textile material used to increase soil stability, provide erosion control or aid in drainage. More simply put, if it is made of fabric and buried in the ground it is probably a geo-textile. It is the combination of planer polymeric reinforcement (geogird) & steel wire mesh in order to build high MSE Walls to control the soil erosion or landslides on critical curt slope.

A total of 8350 m length at different locations is proposed to protect the slopes through use of Vertiver Grass and Geo Textiles**.** Vetiver grass is proposed for 18120 sq. meter area, Geo-textile Material is for 37280 sq. meter area and Geo-grid & steel are proposed for 4080 sq, meter area. Area wise details of Vetiver Grass and Geo Textiles are given in **Table 2.30** and km wise details are provided in **Table 2.31**.

Table 2.30: Details of Vetiver Grass and Geo Textiles

S.No.	Item	Height	Length	Area
1	Vetiver grass	5	2520	12600
2		8	690	5520
3	Geo-textile Material	8	4660	37280
4	Geo-gird & Steel	8.5	480	4080
		Total	8350 m	59480 sq. m

Table 2.31: **Chainagewise Details of Bioengineering Slope Protection**

S.No.	Package Number	Chainage		Length (M)
		From (m)	To (m)	
1	Package 1 km 141.000 to km 188.450	151900	152450	550
2		152800	153400	600
3		176650	176920	270
4		180200	180600	400
5		182200	183000	800
6		188350	189000	650
7		180670	181150	480

S.No.	Package Number	Chainage		Length (M)
		From (m)	To (m)	
8	Package 3 km 208.950 to km 250.592	210100	210600	500
9		211800	211900	100
10		213200	213800	600
11		218600	218700	100
12		233300	233500	200
13		242200	242500	300
14		246000	246300	300
15		247900	248100	200
16		210100	210600	500
17		211800	211900	100
18		213200	213800	600
19		218600	218700	100
20		233300	233500	200
21		242200	242500	300
22		246000	246300	300
23		247900	248100	200
	Total Length			**8350 m**

2.7 ROAD SAFETY MEASURES

There are two types of strategies in designing for the road safety work, are accident reduction and accident prevention. In the former, we generally use the previous accident data on existing roads to influence the designs of behavior of the road user. In the latter, we apply expertise for safe design including both geometric design and material design. In this project various type of safety considerations have been incorporated, are given below:

- Design standards for whole project uniformly applied essential from the view point of road user's safety and the smooth flow of traffic.
- Both horizontal and vertical geometry are given importance at all stages.
- The designs are consistent and the standards proposed for the different elements are compatible with one another and abrupt changes in the design speed were avoided.
- "Ruling" standards are followed and "Minimum" standards are followed for safety considerations only where serious restrictions encountered by technical or economic considerations.

2.7.1 Sign Boards

Providing and fixing of retro- reflectorised cautionary, mandatory and informatory sign as per IRC: 67 made of encapsulated lens type reflective sheeting vide clause 801.3, fixed over aluminum sheeting. There are various types of signboards at various locations; 1030 nos. speed limit boards near the locations of habitations, education institutions & hospitals, 80 nos. octagon sign boards (Stop Boards) near major/minor junctions & villages, 12 nos. over

head sign board for truss and vertical support, 8 nos. over head sign board for toll plaza, 15011 nos. delineators, 5729 cats eye at curves & 4403 on road edges. Summary of the sign boards proposed for this project are given **Table 2.32**.

Table 2.32: **Summary of the Road Signboards**

		Unit	Pkg-1	Pkg-2	Pkg-3	Total
1	***90 cm equilateral triangle***					
	School	***Nos***	46	2	6	**54**
	On Junction	***Nos***	94	16	26	**136**
	Left/right turn	***Nos***	1230	642	1418	**3290**
	Steep Ascent/steep descent	***Nos***	88	90	92	**270**
2	***60 cm equilateral triangle***	***Nos***	26	30	2	**58**
3	***60 cm circular***					
	Speed Limit for Speed lesser than 20 Kmph	***Nos***	252	314	464	**1030**
4	***80 mm x 60 mm rectangular***					
	Petrol Pumps	***Nos***	0	0	2	**2**
	Hospital	***Nos***	2	0	4	**6**
	Bus Shelters	***Nos***	48	6	26	**80**
5	***90 cm high octagon (STOP)***					
	on Major X junction	***Nos***	4	0	0	**4**
	on Major Y Junction	***Nos***	6	0	3	**9**
	on Major T Junction	***Nos***	0	0	0	
	at Village	***Nos***	48	6	26	**80**
6	***Direction and Place Identification signs***					
	150 Cm x 120 Cm Rectangular					
	Place Identification(For Villages)	***Nos***	24	3	13	**40**
	120 Cm x 75 Cm Rectangular					
	Direction (Major Junctions)	***Nos***	3	0	1	**4**
	90Cm x 60 Cm Rectangular					
	Direction (Minor Junctions)	***Nos***	44	8	12	**64**
	Slogan Boards 80Cm x 60 Cm Rectangular as per Requirement	***Nos***	42	20	42	**104**
6	**Providing and erecting overhead signs**					
	Truss and Vertical Support	***Nos***	3	0	1	**4**
	For Toll PlazaT (russ and Vertical Support)					
	For Over head sign board	***Nos***	4	0	4	**8**
	For cantilever sign board	***Nos***	4	0	4	**8**
	Toll rate & exempted vehicle (2 x 2)	***Nos***	4	0	4	**8**
	Aluminium alloy plate for over head sign	***Nos***	6	0	2	**8**
	For Toll Plaza (Aluminium alloy plate for over head sign)					
	For Vehicle wise toll rates board & Exempted Vehicle board (2 X 2)	***Nos***	4	0	4.00	**8**
	Over Head Sign Board	***Nos***	2	0	2.00	**4**
	Cantilever toll plaza boards	***Nos***	2	0	2.00	**4**

2.7.2 Road Markings and Delineators

Road marking (Lane/centre line/edge line/ transverse marking /Zebra Crossing and any other markings) shall be carried out with hot applied thermoplastic paints conforming to ASTM D36/BS-3262 (Part - I) and as per IRC Standard. As per the IRC guidelines 840 sq. m Zebra crossing (near the locations of junctions, bus bays, truck lay byes and villages), 956 sq.m. hazard making at culverts, and 31430 sq.m. edge line making are proposed for batter road safety. 15011 nos. delineators, 5729 cats eye at curves and 4403 on road edges are also proposed. Summary of road marking and delineators are given in **Table 2.33.**

Table 2.33: Summary of Road Marking and Delineators

		Unit	Pkg-1	Pkg-2	Pkg-3	Total
1	**Supplying and installation of delineators**	***Nos***	5530	2851	6630	**15011**
2	**Supply of Shevron sign of size 600x450 mm**	***Nos***	2460	1284	2836	**6580**
3	**Supply & Fixing of Cat's Eye**					
	In Curves					
	On centerline (12 m c/c)	***Nos***	2023	1215	2491	**5729**
	On Edges (24 m C/C both side)	***Nos***	1683	834	1886	**4403**
4	**"W" : Metal Beam Crash Barrier**	***Rmt***	33447	14500	22320	**70267**
5	**Providing and laying of hot applied thermoplastic compound**					
	For Centre Line (Total Straight Length)	**sqm**	747.70	349.60	633.87	**1731.2**
	For Centre Line (Total Curve Length)	**sqm**	805.75	272.5	767.75	**1846**
	For Centre Line (Firm line of Total Sharp Curve Length)					
	For Splayde Double Line	**sqm**	815.80	912.40	1454.20	**3182.4**
	For Hatched Marking in between the Two Splayde Double Line	**sqm**	407.90	456.20	727.10	**1591.2**
	Edge line	**sqm**	12787.50	6150.00	12492.60	**31430.1**
	Zebra Crossing					
	on Major X junction	**sqm**	42.00	0	0	**42**
	on Major Y Junction	**sqm**	63.00	0	31.50	**94.5**
	on Major T Junction	**sqm**	0	0	0	
	at Village	**sqm**	504.00	63.00	273.00	**840**
	Stop Lines					
	on Major X junction	**sqm**	2.80	0	0	**2.8**
	on Major Y Junction	**sqm**	4.20	0	2.10	**6.3**
	on Major T Junction	**sqm**	0	0	0	
	at Village	**sqm**	33.60	4.20	18.20	**56**
	For Bus Bays	**sqm**	496.80	62.10	269.10	**828**
	For Truck Lay Bye	**sqm**	81.82	81.82	0	**163.6**
6	**hazard marker**					
	For Culverts	***Nos***	270	218	468	**956**
7	**Bus Bays**	***Nos***	24	3	13	**40**
8	**Truck Lay Bye**	***Nos***	1	1	0	**2**

		Unit	Pkg-1	Pkg-2	Pkg-3	Total
9	**Toll Plaza**	***Nos***	1	0	1	**2**
10	**5th kilometre stone**	***Nos***	8	4	9	**21**
11	**Ordinary Kilometer stone**	***Nos***	35	16	33	**84**
12	**Hectometer stone**	***Nos***	170	82	166	**418**

2.7.3 W-Beam crash barrier

The W-Beam crash barrier will be provided as per IRC: 5 and IRC: SP: 73. W-Beam crash barrier ends the "tapered" details will be replaced with crash attenuators type ends. The spacing of posts for the crash barrier shall be kept between 1800 mm to 2000 mm. the deflection space behind the crash barrier rails of around 800mm to 1000mm shall be ensured for proper function. Crash barriers have been provided where the height of embankment is more than 3m for 30m length on either side of the approaches of the bridge. Total 22.800 Km length (14.625 km in LHS and 8.175 km in RHS) have been identified in the project section for provision of W-Beam Metal Crash Barrier.

2.8 ROAD SIDE AMENITIES

For the batter development of passenger services 40 nos. bus bays are proposed as per IRC: 80-1981. The shelter structure will be structurally safe and functional so as to protect the waiting passengers adequately from sun, rain and wind. Locations of the Bus Bays / Shelters are given in **Table 2.34.**

Table 2.34: Proposed Locations of Bus Bays & Bus Shelters

Package 1 from Km - 141+000 to Km 188+450		
S. No.	**Location**	**Name of Village**
1	146+425	Kot
2	151+177	Touni Devi
3	152+762	Bari Mandir
4	153+858	Jhanikar
5	154+418	Barara
6	155+147	Sapnehra
7	156+662	Panjot
8	157+882	Samirpur
9	158+985	Sangroh
10	160+846	Awah Devi
11	162+963	Cholthra
12	165+066	Kagaloo
13	166+610	Ropar
14	167+836	Jabrali
15	168+730	Rakoh
16	170+666	Morgalu
17	172+643	Tatoj
18	174+449	Sarkaghal
19	176+498	Jamsai
20	177+839	Parsada
21	179+999	Damshera

22	181+184	Parchoo
23	184+896	Hukal
24	188+286	Longni
Package 2 from Km 188+450 to Km 208+950		
S. No.	**Location**	**Name of Village**
1	190+062	Shivdwala
2	200+500	Baroti
3	207+000	Koti
Package 3 from Km 208+950 to Km 250+592		
S. No.	**Location**	**Name of Village**
1	220+214	Lagdhar
2	224+601	Roproo
3	228+043	Salater
4	232+988	Kotli
5	234+623	Saigaloo
6	235+675	Sai
7	236+545	Chaloh
8	237+407	Deonal
9	239+251	Sathol
10	240+163	Raprahal
11	241+841	Fatewahal
12	243+601	Depdjar
13	245+331	Talayar

2.8.1 Proposals for Truck Lay byes

Two-truck lay bye are proposed at Km 173/639 near Sarkaghat and at Km 193/062 near Dharampur. Truck Lay Bye shall be set out where sufficient suitable land shall be available.

2.8.2 Lighting

The lighting requirements will be provided as per IS-1944 (1&2) and IS-1944 (V & VI) for intersections, bus stops, truck laybye, urban area and areas of civic Importance. The Lighting requirements shall be as per IS: 1944(1 & 2)-1970.

2.8.3 Landscaping and Arboriculture

IRC: SP: 21-2009 "Manual on Landscaping" shall guide the plantation of rows of trees with staggered pitch on either side of the road. The choice of the trees shall also be made as per the same code.

2.8.4 Toll Plaza

To toll plaza are proposed and user facilities like dirking water facilities, toilets, first aid, emergency services etc. will be also provided at the location of toll plaza (existing km 119.230 and km 178.500).

Facilities to be provided in the Toll Plaza:

I. Para 10.3 of IRC Manual-IRC:73-2015 **'Land for Toll Plaza'**.

The provisions/Paras under section 10 of IRCManual-IRC:73-2015 are amended as follows:

i) Adequate land for Toll Plaza shall be acquired to permit the provision of toll lanes for the projected peak hour traffic of 10 years subject to a minimum number of 6 toll lanes for project highway including all other buildings and structures to be accommodated at the Toll Plaza location 149+700. Land has acquired as per the provision of then contract agreement.

ii) Para 10.4 Lay out and design of Toll Plaza:

a) Typical Layouts of 6-Lanes/8 lanes shall be designed and constructed for projected peak hour traffic of 10 years.

b) No stage construction of toll lanes shall be allowed. All toll lanes in both directions of traffic shall be ETC/FASTab lanes. Not less than 2 middle toll lanes shall be capable of being used as reversible lane to met the demand of tidal flow.

c) For purpose of design of Toll Plaza/determining number of Toll lanes capacity of individual toll lane (ETC/FASTag enabled) shall be taken as 400 vehicle/hour.

d) Traffic Islands at the Toll Plaza
Between each toll lane of the toll plaza, traffic islands are required for traffic distribution. These islands shall be minimum of 35 m length of (22.5 m on approach side) and of 0.6 m width. Further protective barriers of reinforced concrete and traffic impacts attenuators shall be proposed to placed at the front of each island to prevent out of control approaching vehicle crashing into island. They would be painted with reflective chevron markings.

e) Toll Booths
Toll booths on extreme left lanes may be provided of prefabricated materials or of masonry. The toll booths shall have adequate space for seating of toll collector, computer, cash box etc. It would have provision for light fan and air conditioning. Toll booth shall be placed at the centre of traffic island on extreme left lane. The toll booth shall have large glass window to provide the toll collector with good visibility of approaching vehicles. The bottom of the toll window shall be placed in such a height of 0.9 m above the ground level for providing convenience for the booth operation. The toll booths shall be economically designed and vandal proof. There shall be CCTV camera installed at each booth.

f) Transition
A transition of 1 in 10 may be provided from Two lane/Four lane/six lane section to the widened width at Toll Plaza on either side.

Booth canopy shall be provided with staircase and overhead corridor.
The provision of the canopy be replaced with staircase and overhead corridor as specified in drawings. The vertical clearance shall be prescribed in respective manuals.

The total number of toll booths and toll lane shall be such to ensure a service time of not more than 10 seconds per vehicle at peak flow regardless of methodology adopted for fee collection. Further if any time the queue of the vehicles in any lane becomes more than 100 metres from the toll booth, then the boom barrier of that

lane shall be lifted and the free flow of traffic with no tolling be allowed till the queue comes within 100m. So, for solving this purpose, a yellow lane at a distance of 100m from toll booth may marked in each toll lane. This provision shall be prominently displayed/informed in each toll lane. This provision shall be prominently displayed/informed for the toll users.

The toll lane requirement for the project be worked out based on traffic as provision of IRC guidelines with amended provisions as per the Para 1 above Accordingly, the land acquisition requirements be calculated and land of toll plaza be acquired.

g) Medical Aid Post: A medical aid post shall be provided at proposed toll plaza.
h) Traffic Aid Post: A traffic Aid post shall be provided at toll plaza (150+051)
i) Highway Petrol unit: A highway petrol unit shall be provided at Toll Plaza.
j) Emergency Medical services: An emergency medical services shall be provided at Toll Plaza.
k) Communication System: A Suitable communication system in accordance with the Manual of specification and standards shall be provided
l) Rest Areas:
m) Solar Plant: A capacity of about 50 KW of solar plant shall be provided for the lighting system.

It includes the Cafeteria, Rest house, Toilet block for Ladies and Gents, Drinking water facility, Parking, Walki-takie and First Aid Facility.

The above facility shall be provided duly functional with all furniture, furnishing of superior quality. The whole area shall be elaborately landscaped to provide pleasing environment along with access from main road and internal roads.

2.8.5 Rain Water Harvesting Storage

Rainwater harvesting storage units are proposed to conserve the rainwater along the road. The locations of proposed rainwater structures are given in **Table 2.35.**

Table 2.35: Proposed Water Harvesting Locations

Package 1 from Km 141+000 to Km 188+450		
Water Harvesting Location		
S.No.	**Location LHS**	**Location RHS**
1	153200	157400
2	155325	157600
3	155975	157900
4	156025	158000
5	156275	158025
6	156300	159500
7	156400	159530
8	156450	159570
9	156500	159600
10	158280	159610
11	158300	159620
12	158310	159650
13	158315	159675
14	158325	159690
15	160675	159700
16	160680	159710
17		159750
18		159910
19		159950
20		159975
21		160010
22		160210
23		160325
24		160340

25		160350
26		160360
27		160375
28		160430
29		163050

Package 2 from Km 188+450 to Km 208+950

Water Harvesting Location

S.No.	Location LHS	Location RHS
1	153200	157400
2	155325	157600
3	155975	157900
4	156025	158000
5	156275	158025
6	156300	159500
7	156400	159530
8	156450	159570
9	156500	159600
10	158280	159610
11	158300	159620
12	158310	159650
13	158315	159675
14	158325	**159690**
15	160675	159700
16	160680	159710
17		159750
18		159910
19		159950
20		159975
21		160010
22		160210
23		160325
24		160340
25		160350
26		160360
27		160375
28		160430
29		163050

Package 3 from Km 208+950 to Km 250+592

Water Harvesting Location

S.No.	Location LHS	Location RHS
1	153200	157400
2	155325	157600
3	155975	157900
4	156025	158000
5	156275	158025
6	156300	159500
7	156400	159530
8	156450	159570
9	156500	159600
10	158280	159610
11	158300	159620
12	158310	159650
13	158315	159675
14	158325	**159690**
15	160675	159700
16	160680	159710
17		159750
18		159910
19		159950
20		159975
21		160010
22		160210
23		160325
24		160340
25		160350
26		160360
27		160375
28		160430
29		163050

2.9 CONSTRUCTION MATERIALS REQUIREMENTS

2.9.1 Estimation of Construction Materials

The quantity and sources of construction materials are given in **Table 2.36**.

Borrow areas and quarries are locally available. These will be identified by the contractor based on material testing. Necessary regulatory permits/clearance will be obtained before opening borrow areas and quarries.

2.9.2 Borrow Areas

Extensive survey was conducted to locate the potential source of borrow earth required for the construction of embankment and sub-grade. Approx. 663441 cum earth will be required for embankment and it will be taken from identified borrow areas. Details of locations, required quantity, available quantity, and distanced of quarry from the site are given in **Table 2.37.**

2.9.3 Quarry

Five quarries have been identified for the stone materials. Details of these quarries are provided in **Table 2.38.**

2.9.4 Water Requirement

The water requirement has been assumed based on past project experiences and on the strict quality control basis. Domestic requirement of 80 liters per worker has been assumed. About 8 workers/km have been considered for this project. Details of the water requirement assessed for the project is presented in **Table 2.39.**

This requirement of water will be spread over the project road length. It will be assured that no public water sources will be used for construction purpose.

2.9.5 Fly Ash Utilization

As per Fly Ash Utilization Notification dated 25th January, 2016, use of fly ash is mandatory in highway up-gradation projects where the project is situated within 300 km radius from any coal based thermal power plant. In the present project Fly ash will be used in road construction on basis of its availability. There are 8 nos. of thermal power plants within the 300 km radius of project alignment, which are: - 1. Maqsoodpur Thermal Power Plant (182 km distance), 2. Guru Nanak Dev Thermal Plant, Bathinda (225 km distance), 3. Guru Hargobind Thermal Plant (220 km distance), 4. Jalkheri Rice Straw Thermal Power Plant (225 km distance), 5. Ropar Thermal Power Plant (80 km distance), 6. Rajpura Thermal power plant (130 km distance), 7. Talwandi Sabo Thermal power plant (240 km distance), and 8. Goindwal Sahib Thermal power plant (135 km).

Table 2.36: Quantity of Construction Materials for the Project Road

S. No.	Item Description	Pkg-1	Pkg-2	Pkg-3	Quantity	Unit	Aggregate	Sand	Stone	Cement (Tonn)	Bitumen (Tonn)	Steel (tonn)
1.	**Granular Sub Base**	76511	39826	77170	193506	cum	193506	0	0	0	0	0
2.	**Wet Mix Macadam**	81442	39471	79828	200740	cum	200740	0	0	0	0	0
3.	**Dry Lean Concrete**	158	0	158	316	cum	284	217	0	47	0	0
4.	**Pavement Quality Concrete**	316	0	316	632	cum	569	435	0	253	0	16
5.	**DBM**	23870	11521	23595	58986	cum	57888	0	0	0	5787	0
6.	**BC**	14980	5844	11932	32756	cum	31896	0	0	0	3859	0
7.	**Bituminious Macadam**	289	61	272	623	cum	604	0	0	0	73	0
8.	**Primer Coat**	337694	160590	330396	828681	sqm	0	0	0	0	580	0
9.	**Tack Coat**	689920	323100	675834	1688854	sqm	0	0	0	0	380	0
10.	**Stone for Pitching**	4080	1755	7845	13680	cum	0	0	13680	0	0	0
11.	**Stone for Masonary**	28861	29464	18636	76961	cum	0	0	76961		0	0
12.	**Sand for Filter Media**	2040	1111	3922	7073	cum	0	7073	0	0	0	0
13.	**Aggregate for Filter Media**	28068	8458	12017	48543	cum	48543	0	0	0	0	0
14.	**PCC 1:3:6 & M15**	23352	16578	21475	61405	cum	55265	30703	0	16579	0	0
15.	**RCC M20 & Above**	109816	35469	60421	205706	cum	185135	82282	0	61712	0	0
16.	**Steel for Structure & RW**	5654	2182	4148	11984	Tonn	0	0	0	0	0	11984

Borrow areas and quarries are locally available. These will be identified by the contractor based on material testing. Necessary regulatory permits/clearance will be obtained before opening borrow areas and quarries.

Table 2.37: Borrow Earth Area Locations

Pavement Layer	Material	Average Thickness in mm	Quantity in cum	Source 1 and its distance from project site
Embankment	Earth	480 mm	266022	Suitable Earth out of excavation of cutting of the highway Excavated shall be used. The present land use is barren land.
Sub-grade	Earth	125 mm	57326	Borrow area Bassi villaage 0.7 km from Ch.164.7 & Available private land in between work site. . The present land use is barren land.
Embankment	Earth	430 mm	114742	Suitable Earth out of excavation of cutting of the highway Excavated shall be used. . The present land use is barren land.
Sub-grade	Earth	125 mm	26224	Borrow area Dharmpur village 0.7 km from Ch.192 & Available private land in between work site. . The present land use is barren land.
Embankment	Earth	285 mm	154268	Suitable Earth out of excavation of cutting of the highway Excavated shall be used. . The present land use is barren land.
Sub-grade	Earth	100 mm	44859	Borrow Area Hazakara village 0.7 km from Ch.210.00 & Available private land in between work site. . The present land use is barren land.

Table 2.38: Locations and Description of Aggregate Quarries

S.No.	Location/Name of Quarry	Quantity required on the Project Road in cum	Remarks
1	10 Km LHS from Km 146.350 (Pung Khad)	149930	Suficient quantities is avaliable at Quarry
2	1 Km LHS from Km 178 (Sarkaghat Quarry)	149930	
3	6 Km LHS from Km 195 (Stone Quarry)	262378	
4	9.16 Km LHS from Km 258 (Stone Quarry)	187413	

Table 2.39: Requirement of Water for Proposed Construction Works

S. No.	Item Description	Water (KL)
1.	Re-use of Earth cutting	128408
2.	Subgrade & Earthen Shoulder	30818
3.	Granular Sub Base	11610
4.	Wet Mix Macadam	16059
5.	Dry Lean Concrete	35
6.	Pavement Quality Concrete	129
7.	Primer Coat	1409
8.	Stone for Masonary	23
9.	Sand for Filter Media	1
10.	PCC 1:3:6 & M15	5219
11.	RCC M20 & Above	30856
12.	Additional water for curing	36075
13.	Additional water for Drinking	29872
	Total =	**290514**

2.10 FACILITIES AT TOLL PLAZA

In the DPR, two toll plazas one at Km 150/051 and another at Km 244/751 are proposed. Toll plaza may have facilities of user fare display, digital traffic lights, overhead lane signs, toll collection cabins, automatic barriers, data loggers and computer systems, weighbridge, toll office, ambulance, accident help vehicles, toe vehicle, crane, rest room, sanitary facilities, drinking water, toilet, first aid/emergency services and parking facilities, etc.

2.11 MANPOWER REQUIREMENT

Manpower required in construction and operation phases for the proposed project is given below. During Construction phase local labor will be hired for un-skilled work and partially local and outside labor will be hired for semi-skilled and skilled work. Details of manpower requirement during construction and operation stage are given in **Table 2.40** and **Table 2.41,** respectively.

Table 2.40: Manpower Requirement during Construction Stage

S. No.	Designation	Nos.
1	Project Managers	3
2	Dept. Project Managers	3
3	Site Engineers	9
4	Mech. Engineers	3
5	Technicians	12
6	Supervisors	24
7	Workers (Skilled-80, Semi-skilled-80 & Un-skilled-160)	200
8	Medical Staff	6
	Total	**260**

Manpower requirement will depend on construction works at one point of time. It is estimated that about 70 to 80% workers will be from local area. Remaining skilled workers, operators, supervisors and engineers may be from outside area.

Table 2.41: Manpower Requirement During Operation Stage

S. No.	Designation	Nos.
1	Project Director	1
2	Adm. Managers	2
3	Financial Managers	2
4	Tech. Managers	2
5	Maintenance Managers	3
6	Accountant	2
7	Supervisors	8
8	Helpers	30
	Total	**50**

2.12 PROJECT IMPLEMENTATION SCHEDULE

The project road is estimated to be completed in 24 months from date of start of construction.

2.13 COST ESTIMATES FOR THE PROJECT

The total project cost is Rs 1112.17 Crore and per km cost is Rs 10.15 Crore.

CHAPTER 3

POLICY, LEGAL AND REGULATARY FRAMEWORK

This chapter presents the national and state level environmental legislations and regulations; and World Bank Policies relevant to the "Improvement and upgradation of Hamirpur Mandi Section (Km 141.000 to Km 265.00) of NH-70 in the state of Himachal Pradesh". The various environmental regulations applicable and regulatory consents and clearances required for the proposed up-gradation project are also been presented in this Chapter.

3.1 LEGAL FRAMEWORK

The Government of India has laid out various policy guidelines, acts and regulations pertaining to environment. The Environment (Protection) Act, 1986 provides umbrella legislation for the protection of environment. As per this Act, the responsibility to administer, the legislation has been jointly entrusted to the Ministry of Environment, Forest and Climate Change (MoEF&CC) at National level, whereas Himachal Pradesh Pollution Control Board (HPPCB) at State level in the present context to "Improvement and upgradation of Hamirpur Mandi Section (Km 141.000 to Km 265.00) of NH-70 in the state of Himachal Pradesh".

3.2 APPLICABLE NATIONAL AND STATE REGULATIONS

The key environmental and other regulations relevant to Improvement and upgradation of Hamirpur Mandi Section (Km 141.000 to Km 265.00) of NH-70 in the state of Himachal Pradesh is presented in **Table 3.1.**

Table 3.1: Environmental Regulations Relevant to the Project Road

S. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Regulatory Clearances Required	Authority
1	Environment (Protection) Act- 1986	To protect and improve overall environment	Yes	It is umbrella legislation. Various notifications, rules and schedules are promulgated under this act.	--	MoEF&CC, HPPCB
2	Environmental Impact Assessment Notification, 2006 &	Prior environmental clearance for designated activities for category A and B	Yes#	The project road is not covered under the preview of EIA Notification 2006 and subsequent amendments. Since,	No Prior Environmental Clearance	SEIAA/ DEIAA

S. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Regulatory Clearances Required	Authority
	subsequent activities	projects under the Environmental Impact Assessment Notification, 2006 & subsequent activities		only part of projects are above 1000m MSL, hence the provision of EIA notification does not arise. However, for opening of stone quarry, prior environmental clearance will be required from SEIAA/DEIAA.	for opening stone quarry	
3	Notification for use of Fly ash, 3rd November, 2009 and its amendment on 25th January 2016	"No agency, person or organization shall, within a radius of 300 Kilometres of a thermal power plant undertake construction or approve design for construction of roads or flyover embankments with top soils; the guidelines or specifications issued by the Indian Road Congress (IRC) as contained in IRC specification No. SP: 58 of 2001 as amended from time to time regarding use of fly ash	Yes	Thermal power plants with 300 km from project Highway are located at 1. Maqsoodpur Thermal Power Plant (182 km distance), 2. Guru Nanak Dev Thermal Plant, Bathinda (225 km distance), 3. Guru Hargobind Thermal Plant (220 km distance), 4. Jalkheri Rice Straw Thermal Power Plant (225 km distance), 5. Ropar Thermal Power Plant (80 km distance), 6. Rajpura Thermal power plant (130 km distance), 7. Talwandi Sabo Thermal power plant (240 km distance), and 8. Goindwal Sahib Thermal power plant (135 km).	Use of Fly ash in the Road as per design criteria	MORTH
4	Forest Conservation Act, 1980	To check deforestation by restricting conversion of forested areas into non- forested areas	Yes	The project is passing through forest areas. Diversion of 59.7059 ha forest land is required for project road construction. Same act also governs the cutting of trees on forest area.	Prior Forest Clearance for diversion of forest land for non-forest activities	Dept. of Forest, Govt. of Himachal Pradesh/ MoEF&CC
5	The Schedule Tribes and Other Traditional Forest	Recognition of Forest Rights of Schedule Tribes and Other Traditional Forest	No	This applicable only when schedule tribes and other traditional forest dwellers, have forest rights for forest	NOC	District Authority

S. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Regulatory Clearances Required	Authority
	Dwellers (Recognition of Forest Rights) Act 2006'	Dwellers along the project road		land to be diverted for the project road.		
6	Air (Prevention and Control of Pollution) Act, 1981	To control air pollution & controlling emission of air pollutants as per the prescribed standards. The NAAQ standards (CPCB) for Ambient Air Quality have been promulgated by the MoEF&CC for various land uses.	Yes	This act is applicable for construction phase to control stack/fugitive emissions and to manage ambient air quality at project site and ancillary activities like crusher plant, hot mix plant, concrete batch mix plant, WMM Plants, DG Set etc, for the road.	Consent To Establish (CTE) and Consent To Operate CTO) for hot mix plant, batching plant and WMM Plants, DG sets, etc.	HPPCB
7	The Wildlife Protection Act, 1972	To protect wildlife, if occurred along the project	No	This act is applicable for wildlife protection in the Wildlife Sanctuary, National Park, wildlife corridors, etc.	As there is no Wildlife Sanctuary, National Park, wildlife corridors, etc. within 10 km from the project road, no clearance is required.	NBWL, MOEF&CC
8	Himachal Pradesh Private Forest Act 1954/HP Land Preservation Act, 1978	To regulate trees cutting on non forest private land/Govern felling of trees on private land.	Yes	Trees felling will be required on the private land within the proposed ROW.	Tree cutting permission on private land.	CCF/DFO
9	Biodiversity Act 2002	Conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resource.	Yes	The road is passing through the forest areas at places.	No	National Biodiversity Authority (NBA)/ State Biodiversity Board (NBB)
10	Water Prevention and Control of	To control water pollution by controlling	Yes	Applicable for construction phase to manage to liquid	Consent To Establish (CTE) and	HPPCB

S. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Regulatory Clearances Required	Authority
	Pollution) Act1974	discharge of liquid pollutants as per prescribed standards		effluent discharges from camp, batch mix plant, etc.	Consent to Operate (CTO) for plants and camps	
11	Noise Pollution (Regulation and Control) Rule 2000	The standards for noise for day and night have been promulgated by the MoEF&CC for various land uses.	Yes	This act will be applicable for all construction equipment/ plant and machinery including vehicles deployed for construction of the proposed road to regulate ambient noise levels This act will be applicable to regulate noise nuisance during construction phase	None	HPPCB
12	Hazardous and Other Wastes (Management, & Trans-Boundary Movement) Rules, 2016 and amended thereof	Protection to the general public against improper handling and disposal of hazardous wastes	Yes	Rules will be applicable to used oil generated from construction equipment/ machinery during construction works. The rule includes storage, handling, transportation procedures and requirements for safe disposal of hazardous wastes	Hazardous Waste Authorization with CTE and CTO	HPPCB
13	Construction and Demolition Waste Management Rules, 2016	Safe disposal and management of construction and demolition wastes	Yes	Rules shall be applicable to generation of wastes resulting from demolition of bridge and culvert structures and scarifying of surface of existing road and from other activities.	Construction and Demolition Waste Management Plan should be prepared, prior to commencement of works	Local Municipal Corporation
14	Solid Waste Management Rules 2016	Collection and disposal of municipal solid waste	Yes	Applicable to all forms/types of solid waste generated at construction activities,	Solid Waste Management Plan should be prepared prior to	Local Municipal Corporation

S. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Regulatory Clearances Required	Authority
				camp site, plant sites, etc..	commencement of works	
15	Guidelines to Regulate and Control Ground Water Extraction in India, 2019	Regulate and control ground water extraction for various purpose.	Yes	NOC is required for infrastructure, mining projects, others requiring water withdrawal	NOC from CGWA	CGWA
16	HP Ground Water Act 2005	Regulate and control ground water extraction for various purpose	Yes	Permission is required for ground water withdrawal	NOC	HP Ground Water Management Authority
17	Mines and Minerals (Development and Regulation) Amendment Act, 2015	This act has been notified for safe and sound mining activity.	Yes	The construction of project road will require aggregate through mining from riverbeds and quarries	Permit and mining lease for stone quarry	Department of mining, State Government
18	Minor Mineral and concession Rules, 2015	For opening new borrow / quarry	Yes	Regulate use of minor minerals like stone, soil, river sand etc.	Permit and mining lease for stone quarry	District Collector
19	Ancient Monuments and Archaeological Sites and Remains Act, 1958	Protection of Archaeological Monuments sites and Remains	Yes	No notified Archaeological Monuments is located within 300m of the project highway. However for chance finds the provisions laid out in the act will be applicable.	Permission from ASI	Archaeological Survey of India
20	Explosive Act 1984	An Act to regulate the manufacture, possession, use, sale, [transport, import and export] of Explosives	Yes	If contractor open stone quarry and use explosive for quarrying	License for storage and handling of explosive.	Chief Controller of Explosives
21	The Building and Other Construction Workers (regulation of employment and conditions	To regulate the employment and conditions of construction workers and to provide for their safety, health and welfare measure and for other	Yes	To ensure safety and welfare measures for workers employed at construction sites. These regulations to be complied with during the construction	None. Safety and welfare measures for work force employed at construction sites are to	State Labour Department

S. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Regulatory Clearances Required	Authority
	of service) Act, 1996	matter incidental thereto		of proposed road works.	be regulated in conformity with this act.	
22	Bonded Labour System (Abolition) Act, 1976 along with Rules, 1976	An Act to provide for the abolition of bonded labour system with a view to preventing the economic and physical exploitation of the weaker sections of the people and for matters connected therewith or incidental thereto	Yes	Contractors shall employ numbers of Labours during Construction Phase. Contractor will ensure that there is no Bonded Labour by him or sub contractors.	Labour License	State Labour Department
23	Contract Labour (Regulation and Abolition) Act 1970 along with rules, 1971	The Object of the Contract Labour Regulation and Abolition) Act, 1970 is to prevent exploitation of contract labour and also to introduce better conditions of work	Yes	Contractors shall employ work-force during Construction Phase. The Act applies to the Principal Employer of an Establishment and the Contractor where in 20 or more workmen are employed or were employed even for one day during preceding 12 months as Contract Labour.	Labour License	State Labour Department
24	Employees Provident Funds and Miscellaneous Provisions Acts 1952 along with EPF Scheme Rules and Forms	It is a beneficent piece of social welfare legislation aimed at promoting and securing the well-being of the employees	Yes	Contractors shall be employing Workman more than 20 persons during Construction Phase	Compliance of regulations	State Labour Department
25	Employees State Insurance Act 1948 along with Rules and Regulations	Protect the interest of workers in contingencies such as sickness, maternity, temporary or permanent physical disablement, death due to employment injury resulting in loss of wages or	Yes	Contractor shall be applying large number of labours during construction which will include both Men and Women	Insurance	State Labour Department

S. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Regulatory Clearances Required	Authority
		earning capacity. Act also guarantees reasonably good medical care to workers and their immediate dependents.				
26	Equal Remuneration Act, 1976 along with allied Rules	An Act to provide for the payment of equal remuneration to men and women workers and for the prevention of discrimination, on the ground of sex, against women in the matter of employment and for matters, connected therewith or incidental thereto.	Yes	Contractor shall be applying large number of labours during construction which will include both Men and Women.	Compliance of regulations	State Labour Department
27	Inter State Migrant Workmen (Regulation of Employment and Conditions Service Act	To regulate the condition of service of inter- state labourers in Indian labour law. The Act's purpose is to protect workers whose services are requisitioned outside their native states in India. Whenever an employer faces shortage of skills among the locally available workers, the act creates provision to employ better skilled workers available outside the state	Yes	Contractor Shall be employing large number of workers during Construction from other States also.	Compliance of regulations	State Labour Department
28	Minimum Wages Act 1948 along with Central Rules 1950	To ensure that workman gets at least minimum wages as fixed by Govt. Minimum wages sets the lowest limit below	Yes	Contractor Shall be employing large number of workers during Construction	Compliance of regulations	State Labour Department

S. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Regulatory Clearances Required	Authority
		which wages cannot be allowed to sink.				
29	Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participations) Act , 1995 along with Rules,1996 and National Trust for Welfare of Persons with Disabilities Act,1999 with rules 2000.	It gives effect to the proclamation on the full participation and equality of the persons with disabilities in the Asian & Pacific Region and provides for their education, employment, creation of barrier free environment, social security, etc.	Yes	Contractor Shall be employing large number of workers during Construction.	Compliance of regulations	State Labour Department
30	Central Motor Vehicle Act 2019	The Act provides in detail the legislative provisions regarding licensing of drivers/ conductors, registration of motor vehicles, control of motor vehicles through permits, special provisions relating to state transport undertakings, traffic regulation, insurance, liability, offences and penalties.	Yes	These rules will be applicable to road users		Motor Vehicle Department
31	National Green Highway Policy 2015	To evolve a policy framework for planation along National Highway	Yes	Road side plantation will be carried out along the road		

Note: *The subproject is national highway and expansion of highway is proposed in the form of upgradation/ widening. Hill road elevation criteria is not applicable for the project road. As per EIA Notification, 2009 and amendment dated 22 Aug 2013, environmental clearance is required for expansion of National Highways greater than 100 km involving additional right of way or land acquisition greater than 40 m on existing alignments and 60 m on realignments and bypasses. In the subproject additional right of way or land*

acquisition is less than 20 m on existing alignments and 30 and 45 m ROW for new realignments and bypasses, respectively. Therefore, Environmental Clearance and Environmental Impact Assessment are not required for the subproject as per EIA Notification 2009.
Environment Impact Assessment (EIA) study is mandatory only for "Expansion of National Highways greater than 100 Km involving additional right of way or land acquisition greater than 40 meters on existing alignments and 60 meters on re-alignment or by-passes". National Highway project less than 100 Kms in length are exempted from the EIA Notification, 2006.

The PROW of the project is 12 meters in built up section and 15 meters in open section, hence Environmental Clearance is not mandatory. Land acquisition has taken only within PROW. Hence EC & EIA is not mandatory for the Project highway.
On dated December 1, 2009, the MoEF, had exempted all state highway expansion projects from the EIA notification, 2006. But projects located in hilly terrains (above average mean sea level of 1000meters) and ecologically sensitive areas were kept within its purview.

3.3 Applicable World Bank Safeguard Policies

The safeguard policies of the World Bank relevant to the Improvement and upgradation of Hamirpur Mandi Section (Km 141.000 to Km 265.00) of NH-70 in the state of Himachal Pradesh are given in **Table 3.2**.

Table 3.2: Relevant and Applicability of World Bank Safeguard Policies

S. No.	World Bank Safeguard Policy	Key Features	Policy Applicability to Sub Project	Policy Triggered Or Not
1.	OP/BP 4.01 Environmental Assessment	Overall governing policy intended to ensure Bank-financed projects are environmentally sound and sustainable	All potential impacts due to the improvement and up-gradation project road are to be assessed and necessary mitigation measures are to be incorporated accordingly.	Triggered
2.	OP/BP 4.36 Forests	Policy is intended to support sustainable and conservation-oriented forest management, harness potential of forests to reduce poverty in a sustainable manner, integrate forests into sustainable economic development, and protect vital local and global environmental	The proposed improvement and upgradation of the project road is passing through forest area and prior forest clearance is required for diversion of forest land for non-forest purpose.	Triggered

S. No.	World Bank Safeguard Policy	Key Features	Policy Applicability to Sub Project	Policy Triggered Or Not
		services and values of forests.		
3.	OP/BP 4.11 Physical Cultural Resources	Policy is intended to ensure that projects identify and inventory cultural resources that are potentially affected by the project. Projects should include mitigation measures, when there are adverse impacts on physical cultural resources.	Construction of road will be on existing road corridor and will avoid cultural property resources (CPR) and therefore does NOT warrant shifting or affect CPRs. However, there may be direct or indirect impact on nearby cultural properties along the road.	Triggered
4.	OP/BP 4.11 Involuntary Resettlement	Involuntary Resettlement Policy addresses direct economic and social impacts from project activities that may cause involuntary taking of land resulting in: (i) relocation or loss of shelter, (ii) loss of assets or access to assets, and/or (iii) loss of income sources or livelihoods	The proposed improvement and upgradation of the project road require land acquisition and Involuntary Resettlement.	Triggered
5.	OP 09 Paste Management	The objective of this policy is to reduce reliance on synthetic chemical pesticides, promote Integrated pest management (IPM) and Integrated Vector Management (IVM) Minimize the environmental and health hazards of pesticide use.	In the subproject tree plantation will be done by Forest Department. In roadsides plantation, synthetic chemical pesticides are not used. Usually, organic manure is used at the time of sapling plantation.	Not Triggered.

3.4 APPLICABLE INTERNATIONAL CONVENTIONS

Ramsar Convention on Wetlands of International Importance, 1971

The Ramsar Convention is an international treaty for the conservation and sustainable utilization of wetlands i.e. to stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific and recreational value.

According to the Ramsar list of Wetlands of International Importance, there are 25 designated wetlands in the country which are required to be protected. Activities undertaken in the proximity of these wetlands should follow the guidelines of the convention.

International Union for Conservation of Nature (IUCN)

The International Union for Conservation of Nature (IUCN) is a membership Union uniquely composed of both government and civil society organizations. IUCN has evolved into the world's largest and most diverse environmental network. IUCN is the global authority on the status of the natural world and the measures needed to safeguard it.

IUCN produces the IUCN Red List of Threatened Species and the IUCN Red List of Ecosystems. The IUCN Red List of Ecosystems is applicable at local, national, regional and global levels. IUCN' stated goal is to expand the global network of national parks and other protected areas and promote good management of such areas. In particular, it focuses on greater protection of the oceans and marine habitats.

3.5 PROVISIONS IN MORTH'S CODE

The provisions in MORTH's Code are as given in **Table 3.3.**

Table 3.3: Provisions in MORTH's Code

Section 111	Precautions for safeguarding the environment
Clause 201.2	Preservation of Property/Amenities during clearing and grubbing
Clause 301.3.2	Stripping and storing of topsoil for reuse during excavation for roadway and drains
Clause 302.4	Restriction on timings for blasting operations

Clause 304.3.6	Public safety near towns/villages where excavation is carried out
Clause 305.2.2.2	Locations of borrowing and relevant regulations
Clause 305.3.3	Stripping and storing of topsoil at borrow locations
Section 306	Soil erosion and sedimentation control
Clause 407.4.2	Provisions for turfing on median and islands
Section 517	Recycling of bituminous pavement and excavated material
Clause 701.2.1	Use of geo-textiles for control of soil erosion
Section 810	Use of Metal beam crash barriers for safety, relevant regulations and specifications
Clause 2501	Precautions during river training works

3.6 INDIAN ROAD CONGRESS (IRC) CODES APPLICABLE TO THE PROJECT Road

Key Indian Road Congress (IRC) Code of Practices applicable for the project road with respect to environment are given in **Table 3.4**:

Table3.4: Indian Road Congress Code of Practices for Project Road

Sl. No.	IRC Code Theme	Year	Purpose	Applicability
1.	Recommendations for Road Construction in Areas Affected by Water Logging, Flooding and/or Salts Infestation	IRC:34-2011	Construction in water logged areas	No
2.	Recommended Practice for Construction of Earth Embankments and Sub-Grade for Road Works (First Revision)	IRC:36-2010	Issues relating to Borrow pits	Yes
3.	Guidelines for Pedestrian Facilities	IRC: 103 - 1988	Safety of pedestrians	Yes
4.	Recommended Practice for Recycling of Bituminous Pavements	IRC:120-2015	For recycling of bituminous pavements	Yes
5.	Guidelines for Use of Construction and Demolition Waste in Road Sector	IRC:121-2017	Use of Construction and Demolition Waste in Road Sector	Yes

Sl. No.	IRC Code Theme	Year	Purpose	Applicability
6.	Guidelines on Landscaping and Tree Plantation	IRC:SP:21-2009	Landscaping and Tree Plantation along of the road	Yes
7.	Guidelines on Road Drainage	IRC: SP: 42-1994	Drainage	Yes
8.	Highway Safety Code	IRC: SP: 44-1994	Highways safety	Yes
9.	Guidelines for Use of Fly-ash in Road Embankments	IRC:SP:58-2001	Use of Fly-ash in Road Embankments	No
10.	Guidelines for Use of Geotextiles in Road Pavements and Associated Works	IRC:SP:59-2002	Use of Geotextiles in Road Pavements and Associated Works	Yes
11.	Guidelines for Soil and Granular Material Stabilization Using Cement Lime and Fly Ash	IRC:SP-89-2010	Soil and Granular Material Stabilization Using Cement Lime and Fly Ash	Yes
12.	Guidelines on Requirements for Environmental Clearance for Road Projects	IRC:SP-93-2017	Requirements for Environmental Clearance for Road Projects	Yes
13.	Use of Cold Mix Technology in Construction and Maintenance of Roads Using Bitumen Emulsion	IRC:SP-100-2014	Use of Cold Mix Technology in Construction and Maintenance of Roads Using Bitumen Emulsion	No
14.	Interim Guidelines for Warm Mix Asphalt	IRC:SP-101-2014	Warm Mix Asphalt	Yes
15.	Guidelines on Preparation and Implementation of Environment Management Plan	IRC:SP-108-2015	Preparation and Implementation of Environment Management Plan	Yes

3.7 ENVIRONMENTAL STANDARDS

Environmental standards applicable to the Improvement and upgradation of Hamirpur Mandi Section (Km 141.000 to Km 265.00) of NH-70 in the state of Himachal Pradesh are National Ambient Air Quality Standards, 2009 are as given below:

- National Ambient Air Quality Standards, 2009 (Given in **Table 3.5**)
- Ambient Noise Standards (Given in **Table 3.6**)
- Drinking Water Quality Standards-IS:10500:2012
- CPCB Standards for Surface Water Use
- Stack Gas Discharge Standards for Hot Mix Plant

3.8 WORLD BANK GUIDELINES FOR EHS GUIDELINES FOR TOLL ROADS

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the General EHS Guidelines document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at:

www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

World Bank Guidelines for Environmental, Health, and Safety Guidelines for Toll Roads are given in **Annexure 3.1** at the end of EIA report.

Table 3.5: National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO_2), $\mu g/m^3$	Annual*	50	20
	24 hours**	80	80
Nitrogen Dioxide (NO_2), $\mu g/m^3$	Annual*	40	30
	24 hours**	80	80
Particulate Matter (size less than 10 µm) or PM_{10} $\mu g/m^3$	Annual*	60	60
	24 hours**	100	100
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ $\mu g/m^3$	Annual*	40	40
	24 hours**	60	60
Ozone (O_3) $\mu g/m^3$	8 hours*	100	100
	1 hour**	180	180
Lead (Pb) $\mu g/m^3$	Annual*	0.50	0.50
	24 hours**	1.0	1.0
Carbon Monoxide (CO) mg/m^3	8 hours*	02	02
	1 hour**	04	04
Ammonia (NH_3) $\mu g/m^3$	Annual*	100	100
	24 hours**	400	400
Benzene (C_6H_6) $\mu g/m^3$	Annual*	5	5
Benzo(a)Pyrene (BaP)-particulate phase only, ng/m^3	Annual*	1	1
Arsenic(As), ng/m^3	Annual*	6	60
Nickel (Ni), ng/m^3	Annual*	20	20
* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.			
** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time; they may exceed the limits but not on two consecutive days of monitoring.			

Source: National Ambient Air Quality Standards, Central Pollution Control Board Notification in the Gazette of India, Extraordinary, New Delhi, 18th November, 2009

Table 3.6: National Ambient Noise Level Standards

Area Code	Category of Area	Limits in dB (A) Leq.	
		Daytime	Night time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence	50	40

Source: *Central Pollution Control Board, New Delhi.*

Note-1 Day time is reckoned in between 6 AM to 10 PM

Note-2 Night time is reckoned in between 10 PM to 6 AM

Note-3 Silence zone is defined as areas up to 100 meters around such as premises as hospitals, educational institutions and courts. The silence zones are to be declared by the Competent Authority

Note-4 Mixed categories of areas should be declared as one of the four above mentioned categories, by the Competent Authority and the corresponding standard shall apply.

CHAPTER 4

DESCRIPTION OF EXISTING ENVIRONMENT

4.1. GENERAL

The baseline environmental status in the study area is discussed with reference to physical, biological and socio-economic environment aspects of the project road. This chapter is based on environmental monitoring, field visits/observations and secondary data review. The study area corridor includes 10 km aerial distance on either side of the project road. Primary data was collected from the Right of Way and for 250 m on either side of the project road (Hamirpur-Mandi Section of NH-70). The study was conducted as per the MoEFCC EIA Guidance Manual (2010) for Highways and the World Bank Guidelines for environmental impacts assessment.

Standard methodologies for baseline data collection was followed for conducting the EIA study for the project. The data was collected from field studies, information from the Forest Department, and official websites of Himachal Pradesh Govt. and Central Govt. Departments.

Environment monitoring to collect baseline data for Soil, surface and ground water, ambient air quality and noise levels was conducted in the month of October 2019 by NABL & MoEF&CC recognized laboratory). The summary of data collection from various source covered in the present study is given in **Table 4.1.**

Table 4.1: Summary of the data collection from various source for the study

Aspect	Mode of Data Collection	Parameters Monitored	Source(s)
Meteorology	Secondary	Climate, Temperature, relative humidity, wind speed, direction, rainfall	Indian Meteorological Department,
Land Use	Primary and Secondary	Land use pattern	Forest Department (H.P.), National Remote Sensing Agency
Soils	Primary and Secondary	Physico-chemical parameters	Field studies and Literature from HP govt. websites
Geological	Primary	Geological characteristics of the study area	Geological Survey conducted for the Project
Water Quality	Primary	Physico-chemical and biological parameters as per IS 10500:2012	Field studies
Ambient Air Quality	Primary	Parameters depicted under NAAQS	Field studies
Noise Levels	Primary	Hourly noise levels as per Noise level standards by CPCB	Field studies

Study Area: 10 km area either side of from the project road has been considered as project influence zone in view of areas likely to be affected by the project activities directly and indirectly.

4.2. PHYSICAL ENVIRONMENT

4.2.1. Geomorphology and Topography of the Project Road

Hamirpur district is bounded by Beas River in the north, which separates it from Kangra district. In the east, Bakkar and Seer Khads separate it from Mandi district, and in the south it's bounded by Bilaspur district and on the west bounded by Una District. The Elevation of the project area varies from 450 meters MSL (near confluence of Mutard/Masoh Khad with River Beas) to 1235 meters MSL (Near Awah Devi). Geomorphologically the area can be divided into two categories:-

1. Moderately steep to low hill and intervening valley of Siwaliks;
2. Fluvial valley.

These can be further classified as:

I. Fluvial terrace;
II. Structural Valley;

Mandi

Mandi District lies between latitude 31° 13' 30'' to 32° 04' 22" N and longitude 76° 36' 08"to 70° 23' 26 E. Rock types in this district are Jutog, Chail, Shah & Tertiary group of rocks. The oldest rocks belong to Jutog groups whereas the youngest valley fills are of recent age comprising of clay, sand and gravel beds. The oldest rock exposed in the district belongs to the Sundru Formation of Vaikrata Group consisting of Biotite schist with Kyanite gneiss and migmatites. Karsog, Mandi and Chichot-Sundru granites of Paleozoic age intruded in it.

The project road falls in high altitude area of Himalayas in the districts of Hamirpur and Mandi in Himachal Pradesh. The project road passes through mountainous / hilly terrain.

The proposed road alignment falls in middle and western part of Himachal Pradesh where major part is covered by Swalika group rocks and remaining part is covered by Sirmour group rocks and Sakhala formation rocks. The rock formation of the project influence area is given in **Figure 4.1.**

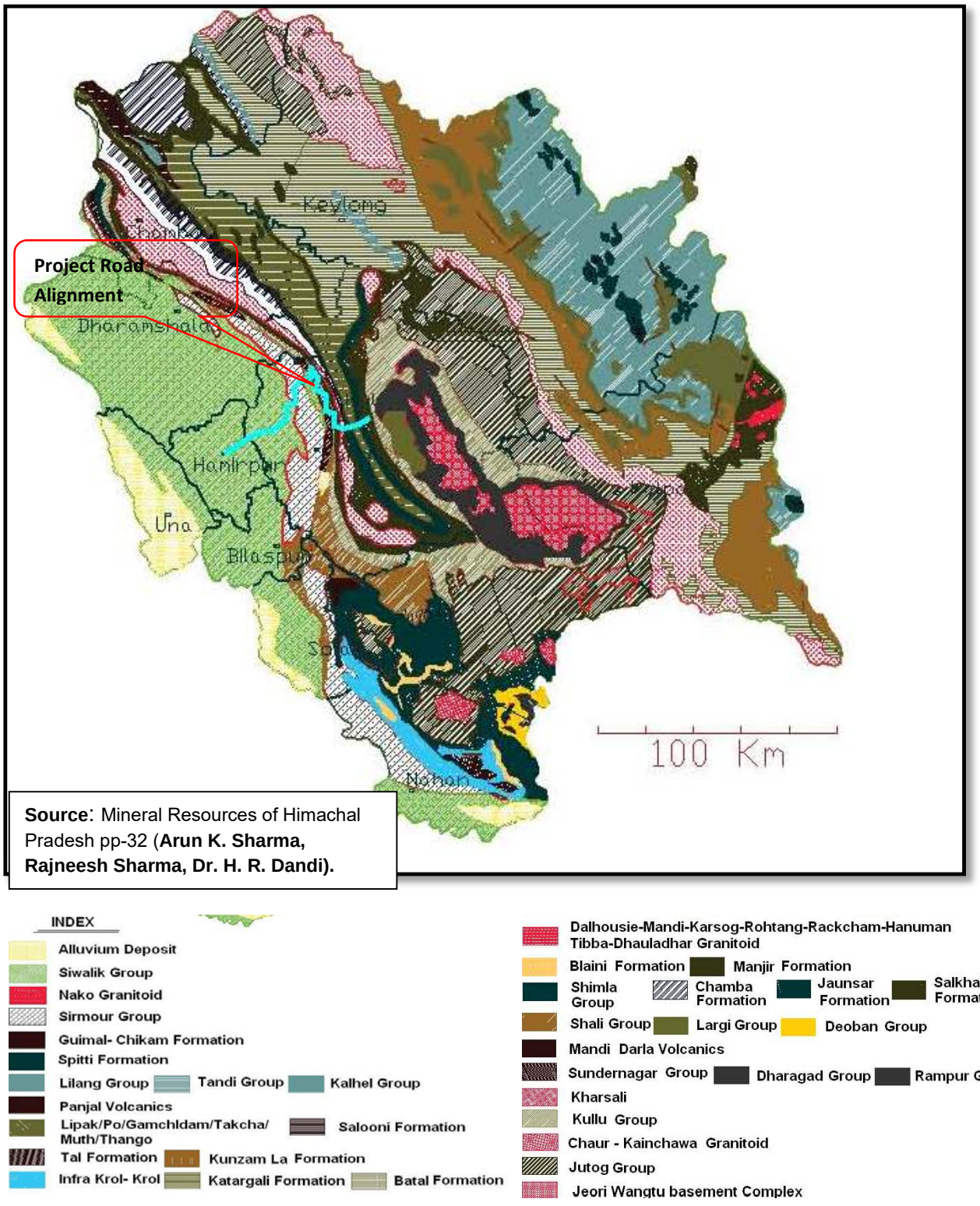


Figure 4.1: Rock Formation of the Project Influence Area

4.2.2. Soil

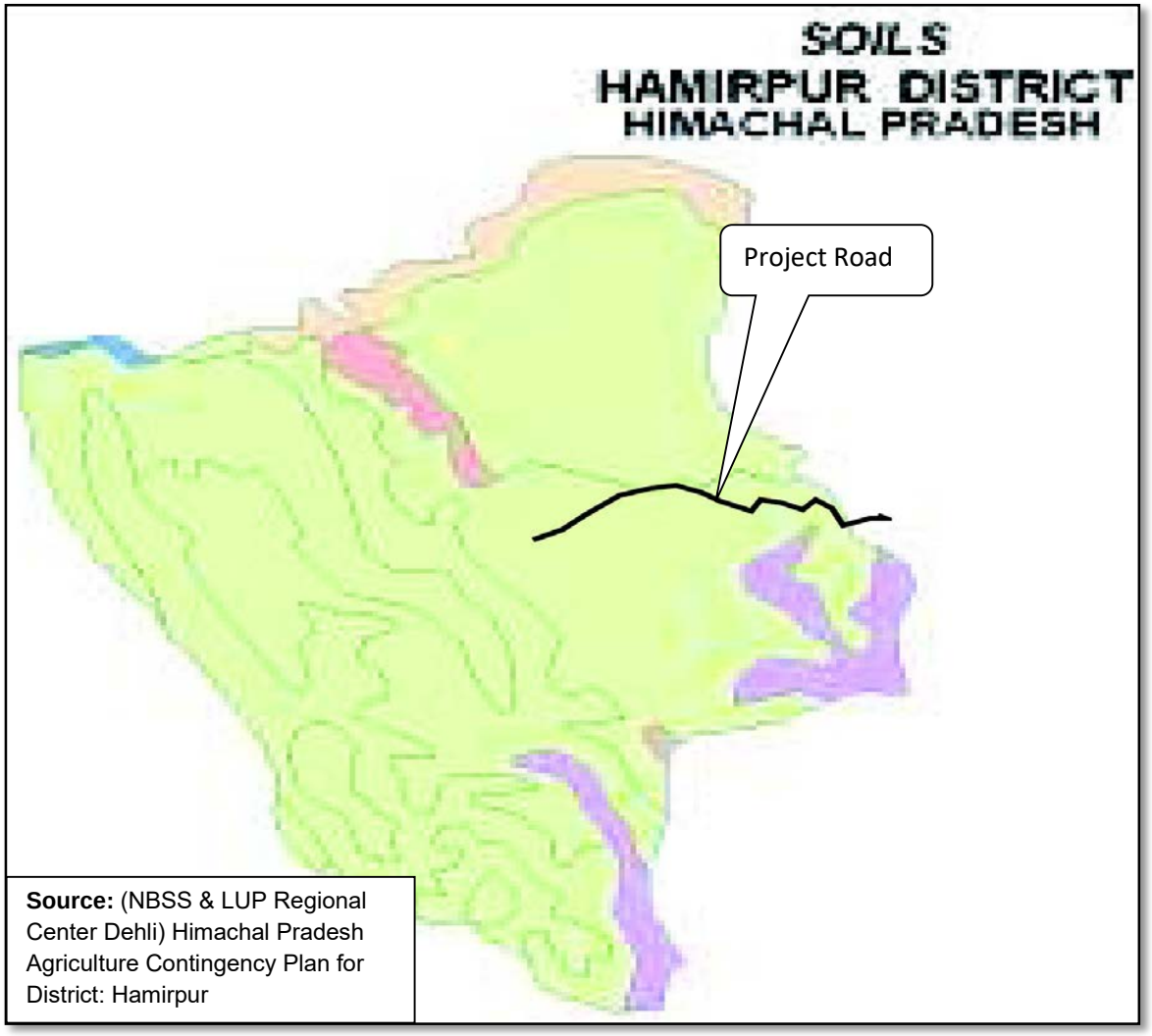
Soil Type and Distribution

In the project influenced area, predominant soil type is loamy, and various sub category under loamy soil are shallow to medium shallow loamy soils, deep loamy-skeletal soils, shallow loamy-skeletal soils, deep loamy soils, medium deep loamy, calcareous soils, shallow to medium deep loamy soils, medium deep to deep loamy soils, medium deep to deep loamy-skeletal and medium deep loamy soils etc. Along the proposed road alignment, predominant soil type is medium deep to deep loamy-skeletal soils. Distribution of soil in Hamirpur and Mandi district is given **Figure 4.2** and **4.3** respectively**.**

Soil Quality

For the baseline study along the proposed road alignment, seven representative soil-sampling locations were selected for studying soil characteristics. The locational details are given in **Table 4.2**.

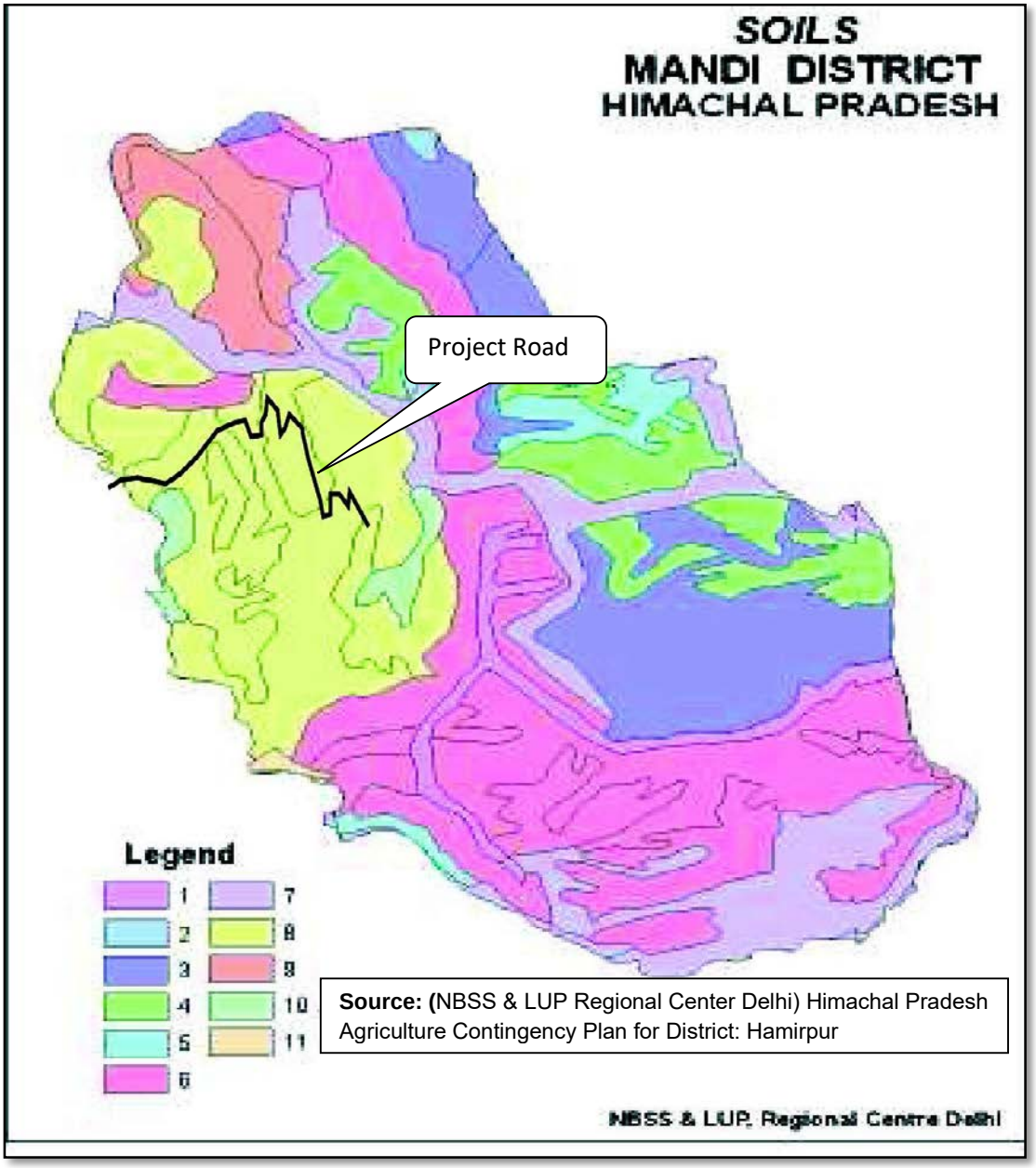
Sampling locations were spread over the study area, keeping in view the vegetative cover and different soil types, which would accord an overall idea of the soil characteristics within the study area. Soil sampling and analysis were conducted as per establish standard method and procedures prescribed in IS: 2720 and ASTM. The parameters indicative of physico-chemical and fertility characteristics were determined through the study. The physiochemical characteristics, as observed from the analytical test of the soil samples collected from the study area are presented in the **Table 4.3**. From the soil analysis, colour of soil samples was found radish brown. pH value was between 7.22 to 7.52, bulk density varied from 1.224 to 1.48 gm/cm^3, Nitrogen content varied from 48.2 to 60.2 mg/1000g, Potassium varied from 0.4 to 0.6 mg/kg, Phosphorus varied from 44 to 76 mg/1000g and Organic Carbon varied from 0.21 to 0.24 % by mass.



Legend

S.N.	Colour	Description	Area (ha)
1		Shallow to medium deep, loamy soils	1.9
2		Medium deep to deep loamy soils	37.9
3		Medium deep to deep, loamy-skeletal soils	64.9
4		Medium deep, loamy, calcareous soils	6.2

Figure 4.2: Distribution of Soil in Hamirpur



Legend Discription

New Soil Unit	Description	Area (ha)
1	Shallow to medium shallow, loamy soils	9480.6
2	Deep, loamy-skeletal soils	7763.1
3	Shallow, loamy-skeletal soils	85862.5
4	Deep, loamy soils	15484.5
5	Medium deep, loamy, calcareous soils	5470.6
6	Shallow to medium deep, loamy soils	72070.8
7	Medium deep to deep loamy soils	74941.1
8	Medium deep to deep, loamy-skeletal	70664.5
9	Deep, loamy soils	42841.09
10	Medium deep, loamy, calcareous soils	8538.7
11	Deep, loamy soils	1881.9

Figure 4.3: Soil Distribution in Mandi District

Table 4.2: Location Details of Soil Samples

Sample code	Location of Sample	Project Chainage	Coordinates
SQ1	Mandi	km 265	31°41'14.54"N, 76°56'7.05"E
SQ2	Kotli	km 247	31°44'53.46"N, 76°53'43.36"E
SQ3	Kulhar	km 222	31°47'47.04"N, 31°47'47.04"N
SQ4	Shiv Dawala	km 201	31°47'46.35"N, 76°45'31.31"E
SQ5	Rakoh	km 179	31°42'27.77"N, 76°44'14.29"E
SQ6	Tyoni Devi	km 159	31°42'46.66"N, 76°38'45.74"E
SQ7	Hamirpur	km 146	31°43'3.56"N, 76°33'4.10"E

4.2.3. Land *Use*

Land use is the human use of land. Land use involves the management and modification of natural environment or wilderness into built environment such as fields, pastures, and settlements.

The project road falls under middle to eastern part of Hamirpur and western to middle part of Mandi districts. The predominant land use categories along the project road are mainly agriculture, forest and habitation. The land use of the project districts is given in **Figure 4.4. & 4.5** respectively**.**

Land Use in the Corridor of Impact (COI)

At present, land to be acquired is used mainly for cultivation of wheat and soybean. Residential and commercial land uses are also existed in town / village along the project road. Forest land is also observed at places.

Land Use in the 10 km either side of road centerline

In the 10 km radius agriculture, forest, open area and habitations are predominant land use. The summary of land use are given in **Table 4.4** and details are provided in **Annexure 2.1.**

Table 4.3: Physico - Chemical properties of the soil samples

S.No.	Parameter	Test Method	Test Results									Units
			Mandi km 265	Kotli km 247	Kulhar km 222	Shiv dawala km 201	Rakoh km 179	Tyoni Devi km 159	Hamirpur km 146	Min.	Max.	
1	pH (1:5 suspension)	IS:2720 (Part-26)	7.52	7.22	7.44	7.4	7.28	7.44	7.34	7.22	7.52	-
2	Electrical Conductivity at 25◦C (1:5 suspension)	IS:2720 (Part-21)	121	86	92	56.2	110	98	106.8	56.2	121	µmhos/cm
3	Bulk Density	STP/SOIL	1.224	1.231	1.242	1.48	1.342	1.321	1.342	1.224	1.48	gm/cm³
4	Moisture	STP/SOIL	25	22	26	22	24	24	24	22	26	%
5	Texture	STP/SOIL	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	0	0	-
6	Sand	STP/SOIL	35	45	42	40	55	40	44	35	55	% by mass
7	Clay	STP/SOIL	20	30	36	25	25	30	20	20	36	% by mass
8	Silt	STP/SOIL	45	25	22	35	20	30	36	20	45	% by mass
9	Cation Exchange Capacity	STP/SOIL	2.15	2.12	2.11	2.32	1.66	2.22	2.32	1.66	2.32	mg/Kg
10	Nitrogen	STP/SOIL	48.2	53.4	52.4	52.4	56.4	52.4	60.2	48.2	60.2	mg/1000g
11	Potassium (as K)	STP/SOIL	0.4	0.4	0.5	0.6	0.6	0.6	0.5	0.4	0.6	mg/Kg
12	Phosphorus	STP/SOIL	52	64	55	44	76	72	68	44	76	mg/1000g
13	Calcium	STP/SOIL	2.2	2.4	2.4	2	1.8	2.6	2.4	1.8	2.6	mg/1000g
14	Magnesium	STP/SOIL	1.38	1.42	1.32	1.58	1.88	1.42	1.38	1.32	1.88	mg/1000g
15	Organic Carbon	STP/SOIL	0.24	0.22	0.22	0.22	0.21	0.21	0.24	0.21	0.24	% by mass

Source: Sampling and Analysis taken by Environment Pollution Analysis Lab, Bhiwadi 2019

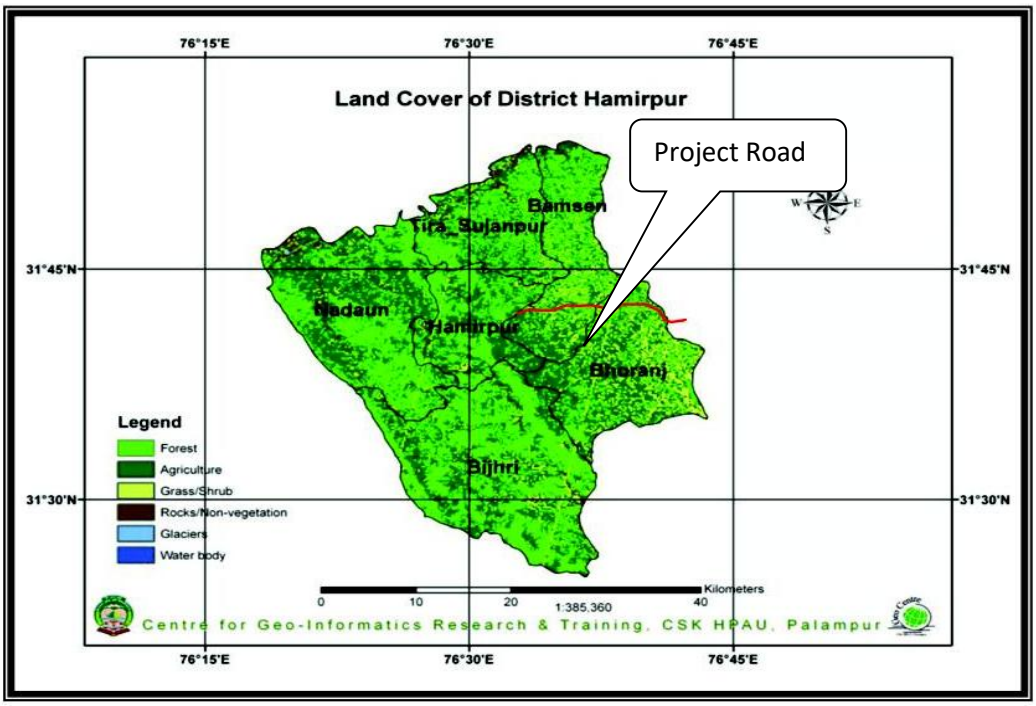


Figure 4.4: Land use of Hamirpur District

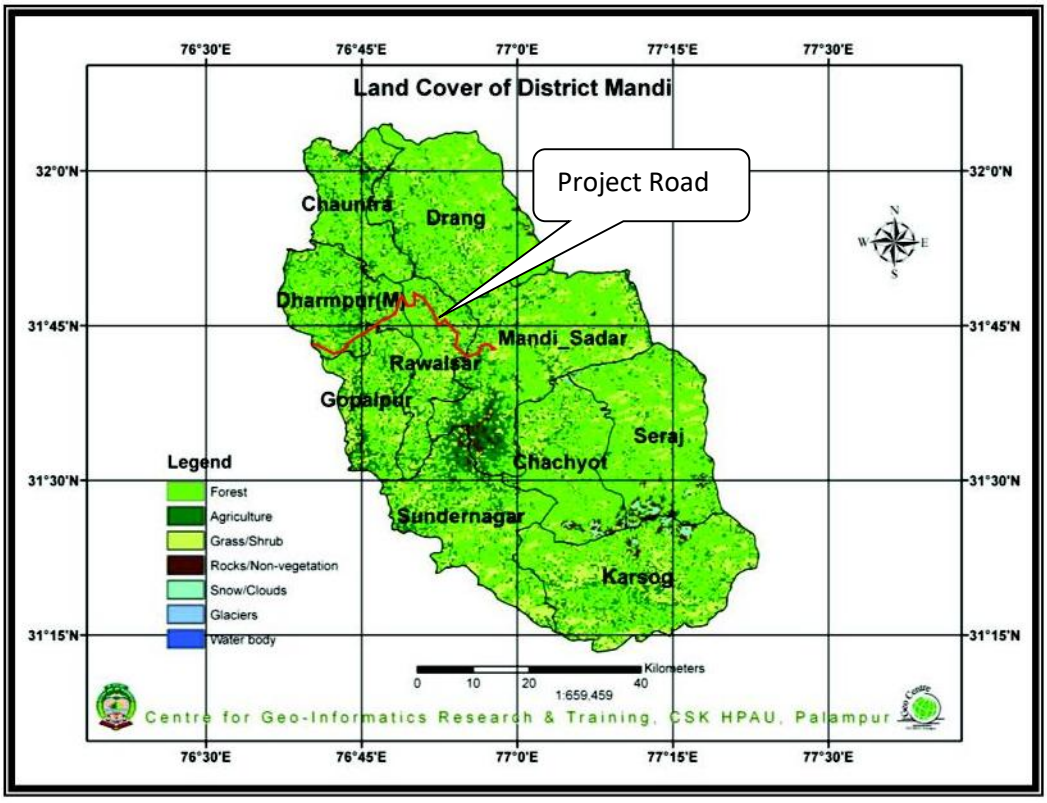


Figure 4.5: Land use of Mandi District

Table 4.4: Land Use Pattern Along the Project Road

S.No.	Land Use	Percentage
1	Forests	24.21
2	Not available for cultivation	24.82
3	Permanent pastures and other grazing lands	32.89
4	Land under misc. tree crops and groves	1.43
5	Culturable wasteland	3.03
6	Fallow lands other than current fallows	0.33
7	Current fallows	1.41
8	Net area sown	11.90
	Total	**100**

4.2.4. Climate

The project influence area is come under sub-tropical (Hamirpur) and slightly warm temperature zone (Mandi District).

Temperature in Hamirpur District

The climate of the project region is typical sub-tropical, characterized by prolonged summer, mild winter and moderately heavy rainfall during monsoon season. About 90% rainfall received from southwest monsoon. June is hottest month while January month is coldest month. During last 10 years time duration maximum 36°C monthly mean highest temperature was recorded during June month while 6.5°C monthly mean minimum temperature was recorded during January month. Highest relative humidity 70% to 80% is observed during monsoon season while lowest 40%relative humidity is observed during peak summer month of April and May. The summary of last 10-year temperature data is given in **Table 4.5.**

Table 4.5.: Summary of last 10-Year (2009 to 2018) Temperature Data

Item	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Avg. Temperature (°C)	11.7	14.3	18.9	24	28.8	30.3	26.9	25.9	25.5	22.3	17.4	13.6
Monthly Mean Min. Temp (°C)	6.4	8.7	13	17.5	22.4	24.6	23.2	22.5	21.2	16.5	10.8	7.7
Monthly Mean Max. Temp (°C)	17.1	20	24.8	30.6	35.3	36	30.7	29.4	29.9	28.1	24	19.5
Source: climate-data.org												

During the year of 2009 to 2013, maximum monthly mean temperature was observed 39ºC in June 2009 and June 2012 while minimum 4ºC was observed in January 2011 and January 2012.

Temperature of Mandi

The climate of Mandi district is sub-tropical in the valleys and tends to be temperate near the hilltops. In the higher region, the climate remains cold throughout the year. In winter snow often comes down to 1300 m amsl. Normally, it starts melting from the end of March from places lying below 3300 m. In summer, the whole Balh valley and other low altitudes are quite hot.

The winter starts from the middle of November and continues till the middle of March. Thereafter, the mercury continues to rise till the onset of the monsoon, which starts from the last week of June or early July and continues till the middle of September. During October and November, the nights are pleasant, whereas the days are a little bit hot. Average minimum and maximum temperature in the district vary from 66° C to 358° C. During winters snow fall often occurs down to elevation of 1300m amsl. The summary of last 10-year Temperature data are given in **Table 4.6.**

Table 4.6: Summary of Last 10-year (2009 to 2018) Temperature Data

Item	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Avg. Temperature (°C)	11.8	14.5	19	24.1	28.8	30.1	27	26.1	25.5	22.3	17.4	13.5
Monthly Mean Minimum Temperature (°C)	6.6	8.9	13.2	17.7	22.4	24.5	23.3	22.7	21.2	16.6	11	7.8
Monthly Mean Maximum Temperature (°C)	17.1	20.1	24.9	30.6	35.3	35.8	30.8	29.6	29.9	28	23.8	19.3
Source: climate-data.org												

Rainfall

Normal rainfall in Hamirpur district is 851 mm while in Mandi district it is 1240 mm. About 90 percent of the rainfall occurs during the southwest monsoon, lasting from about June to September. The average annual rainy days are 55 days. The relative humidity ranges from 40 % to 90% in this area. Last 5 year from 2013 to 2017 rainfall data of Hamirpur and Mandi district are given in **Figure 4.6 and 4.7,** respectively.

In the Hamirpur district max. 547 mm rainfall was observed during August, 2017 while minimum 0 mm rainfall was observed during October & November months of 2017. In Mandi district max. 467 mm rainfall was observed in July 2017 and minimum 0 mm rainfall was observed in October month of 2017.

Rainfall trends of Himachal Pradesh as per state level climate change trends in India (*Meteorological Monograph No. ESSO/IMD/EMRC/02/2013)* :

- Himachal Pradesh have shown highest decline trends (non-significant) in monsoon season rainfall.
- Post monsoon rainfall has decreased over Himachal Pradesh.
- The decreasing trends in rainfall are significant for Himachal Pradesh (-0.69 mm/year)

State	Monthly rainfall trends in mm per year											
	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Himachal Pradesh	**-0.69***	+0.44	+0.05	+0.07	+0.21	+0.48	**-1.72***	-1.04	-0.24	-0.10	+0.01	-0.03

Wind rose

A wind rose diagram is a graphic tool used to give a concise view of how wind speed and direction are typically distributed at a particular location. Wind rose diagram of the project influence area is given in **Figure 4.8.**

The wind rose diagram shows duration and predominant direction of wind. The predominant direction of wind is North-East (NE) to South-West (SW). As per wind direction, it is suggested to propose realignment should in North-East (NE) direction from proposed alignment and hot mix plant establishment given preference in south-west (SW) direction.

Customized Rainfall Information System (CRIS)

Hydromet Division

India Meteorological Department
Ministry Of Earth Sciences
New Delhi-110 003

Choose the States/UTs: HIMACHAL PRADES ▼ Select District: HAMIRPUR ▼ GO

District : HAMIRPUR

Note : (1) The District Rainfall in millimeters (R/F) shown below are the arithmatic averages of Rainfall of Stations under the District.
(2) % Dep. are the Departures of rainfall from the long period averages of rainfall for the District.
(3) Blank Spaces show non-availability of Data

YEAR	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEPT		OCT		NOV		DEC	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2013	45.1	-38	121.4	98	80.3	36	9.7	-64	13.9	-67	295.0	106	441.4	15	280.8	-28	73.4	-54	24.4	-41	12.8	-8	29.8	-4
2014	42.1	-42	91.7	49	107.4	82	37.3	38	55.5	30	71.4	-50	349.0	-9	374.4	-4	95.1	-40	24.0	-42	0.1	-99	55.5	79
2015	79.0	8	106.9	74	153.4	160	72.5	168	28.4	-33	143.0		368.1	-4	396.0	1	83.2	-48	15.5	-62	8.4	-40	28.0	-10
2016	11.2	-85	25.7	-58	67.6	14	7.2	-73	87.9	106	165.0	15	275.8	-28	469.1	20	86.6	-46	0.2	-99	0.0	-100	2.5	-92
2017	148.0	103	12.4	-80	40.1	-32	42.1	55	52.1	22	137.3	-4	302.5	-21	547.0	40	87.6	-45	0.0	-100	0.0	-100	60.2	94

Figure 4.6: Rainfall for Last 5 year from 2013 to 2017 of Hamirpur district

Customized Rainfall Information System (CRIS)

Hydromet Division

India Meteorological Department
Ministry Of Earth Sciences
New Delhi-110 003

Bac

Choose the States/UTs HIMACHAL PRADES ▼ Select District. MANDI ▼ GO

District : MANDI

Note : (1) The District Rainfall in millimeters (R/F) shown below are the arithmatic averages of Rainfall of Stations under the District.
(2) % Dep. are the Departures of rainfall from the long period averages of rainfall for the District.
(3) Blank Spaces show non-availability of Data

YEAR	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEPT		OCT		NOV		DEC	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2013	62.4	-12	142.5	111	71.5	-12	29.0	-40	18.7	-71	381.9	139	393.5	-4	321.4	-13	97.8	-36	14.1	-59	17.6	15	23.2	-25
2014	64.1	-10	113.2	68	105.9	30	62.1	29	102.9	60	124.7	-22	396.9	-3	374.6	1	152.1	0	27.5	-20	2.3	-85	94.4	206
2015	87.5	23	130.2	93	154.4	89	100.1	107	38.8	-40	113.4	-29	407.5	-1	340.9	-8	73.0	-52	29.6	-14	9.7	-37	39.4	27
2016	13.5	-81	42.8	-37	93.1	14	24.7	-49	165.1	157	208.2	30	314.6	-23	415.1	12	108.6	-29	10.9	-68	0.0	-100	0.0	-99
2017	135.3	90	32.2	-52	41.1	-50	61.2	27	111.1	73	162.6	2	467.8	14	430.7	16	134.7	-11	0.0	-100	1.4	-91	52.0	68

Figure 4.7: Rainfall for Last 5 year from 2013 to 2017 of Mandi District

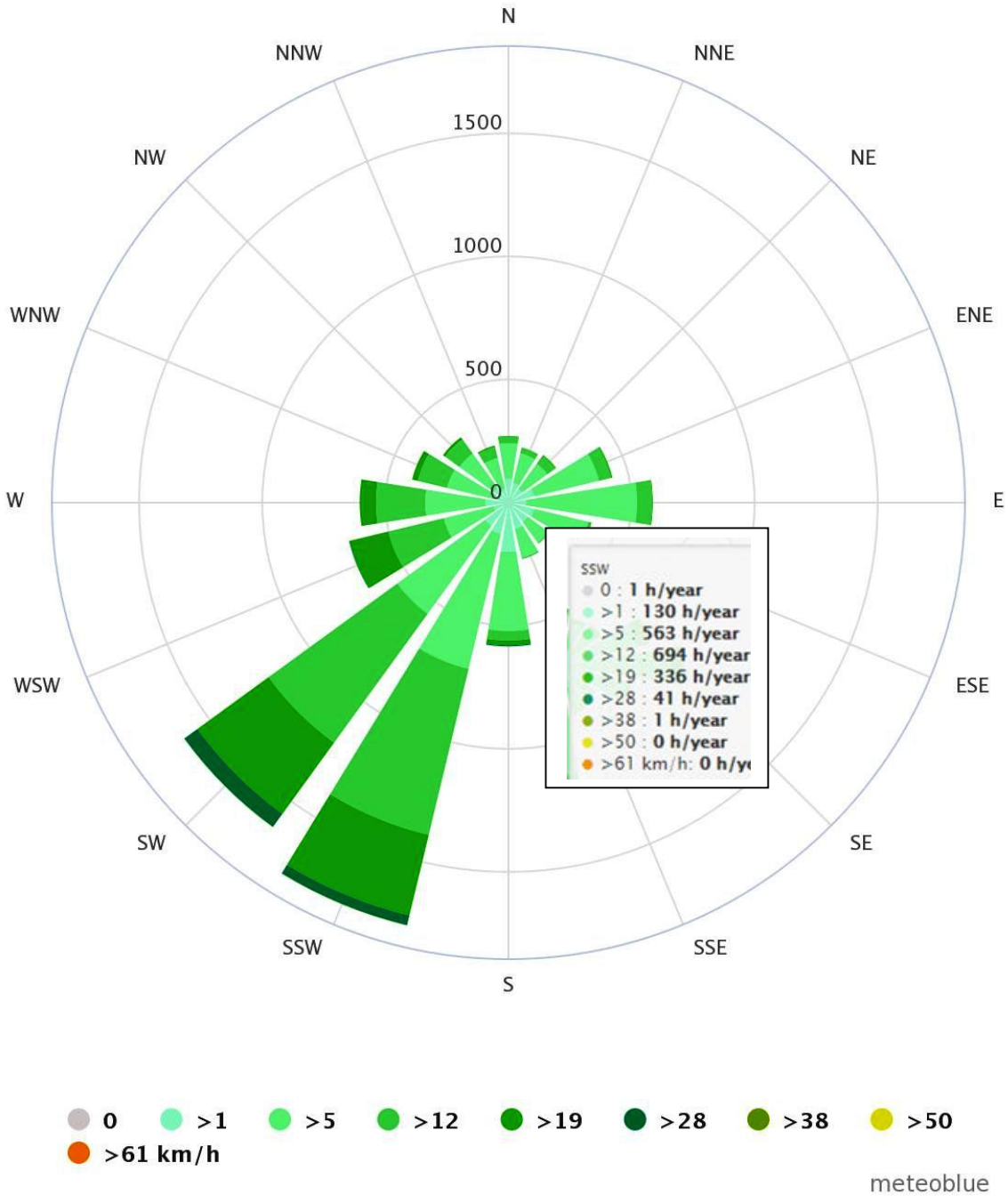


Figure 4.8: Wind Rose of Study Area

4.2.5. Natural Hazards and Vulnerability

Seismicity

Himachal State is located in the Himalayan Mountains. Various thrust like himalayan frontal thrust, the main boundary thrust, the Krol thrust, the Giri thrust, Jutogh thrust, Nahan thrusts etc. exist in this region. Due to its location, it weathers dozens of mild earthquakes every year. Chamba, Kullu, Kangra, Una, Hamirpur, Mandi, and Bilaspur Districts are situated in Seismic Zone-V and the remaining districts namely Lahual and Spiti, Kinnaur, Shimla, Solan and Sirmaur lie in Zone IV. The Seismic zone map of Himaqchal Pradesh is given in **Figure 4.9.** The proposed road alignment falls under seismic Zone-V, therefore the proposed CD structures and bridges must be resistant to very high damage risk zone.

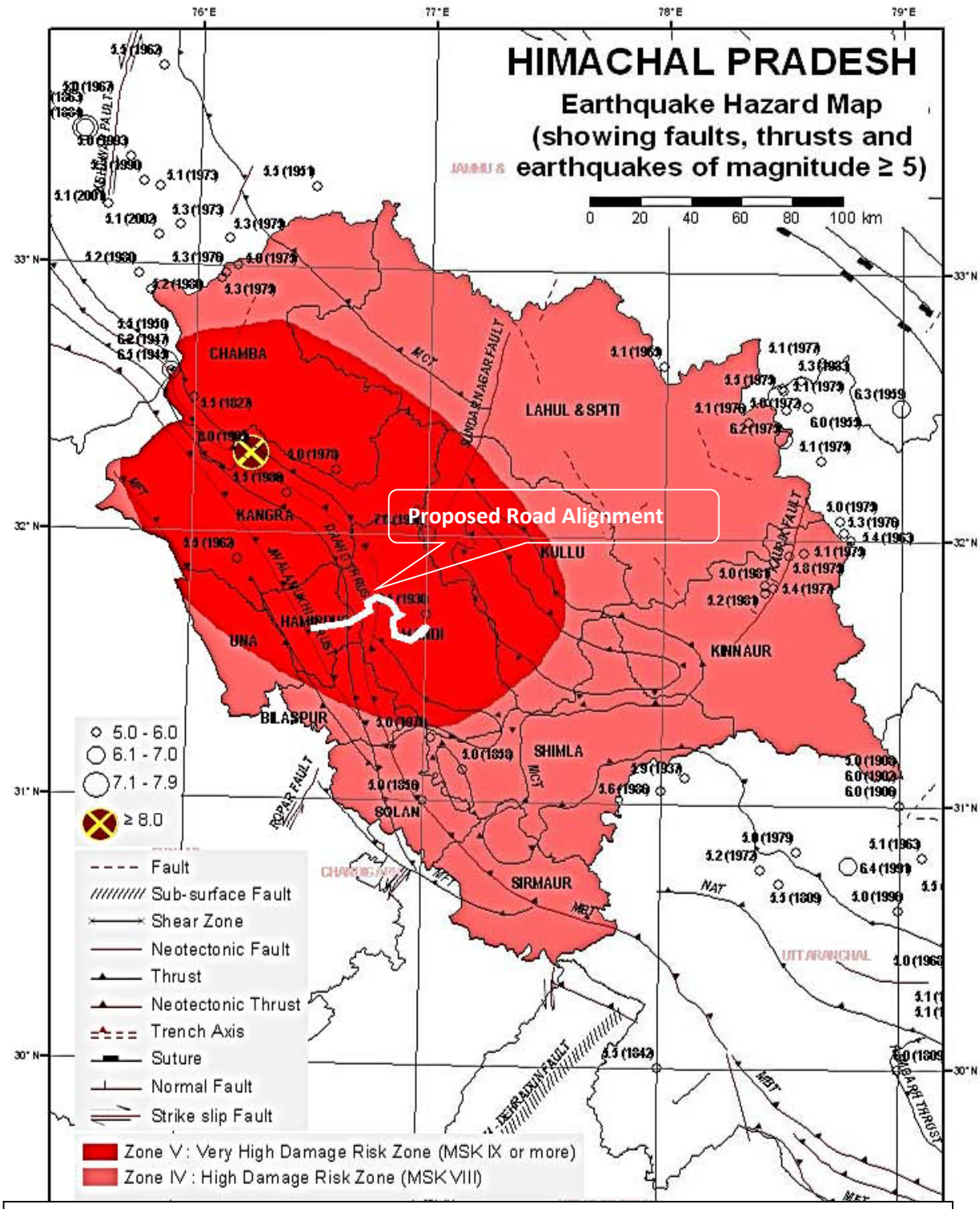
4.2.6 Water Environment

Water is not only important physical resource for domestic, agricultural, industrial and infrastructure construction context but also it is densely encoded with social, spiritual and environmental meaningsThe water resources in the project area have been studied and presented below:

A. Ground Water Resources in the Project area

Hamirpur district forms a part of Changer Belt, which is an water scarcity area of Himachal Pradesh and experiences almost severe drought conditions occasionally. The water requirement of general public is being met from traditional water sources like springs, percolation wells, step wells and streams. Khatris/traditional water harvesting structures are very common in the northern part of the district in and around Sujanpur-Sachui-Patlandar-Ahwa Devi areas. Khatris are constructed in conglomeratic terrain, in which seepage water along with rainwater is collected in the under-ground storage for domestic purpose during lean period. Traditional methods of water harvesting like roof top rainwater and collection of rain water in tanks called Talavs are still in practice. Along the project stretch percolation wells and Khatris/traditional water harvesting structures are observed but majority of settlements are supplied dirking water supply.

In hilly areas of Hamirpur district, springs are the main source of ground water. In the local language, these are known by various names like Bowris, Chasmas, Magars etc. The spring water thus collected in artificially constructed tank structure is ultimately used for drinking and other domestic purposes in old days.



Source: BMTPC : Vulnerable Atlus-2nd Edition, Peer Group, MoH&UPA Map is based on digital data of SOI, GOI: Seismic Zone of India Map IS 1893: 2002: Seism tectonic Altus of India, GSI,

Figure 4.9: The Seismic zone map of Himachal Pradesh

Valley areas of Hamirpur district are comparatively densely populated. This reflects the demand for more water for domestic and agriculture purpose. Such areas are primarily served by various lift water supply schemes by State agencies. Most of these schemes are established on major rivers, tributaries or streams/nallas having sufficient perennial discharge.

In the Mandi district, high hill ranges occupy more than 90 % of the area of the district. During the past years, the traditional ground water sources have served the settlements. Ground water development on moderate scale is seen in the valley areas particularly in Balh valley. Water demands in settlements along the project road is fulfill from public water supply and traditional Bowris & water percolations wells.

B. Drainage Pattern of the study area

The flow of water through well-defined channels is known as ‘drainage’ and the network of such channels is called a ‘drainage system’. The drainage pattern of an area is the outcome of the geological time period, nature and structure of rocks, topography, slope, amount of water flowing and the periodicity of the flow.

C. Drainage System of Hamirpur District

The general drainage pattern of the rivers/ streams in the district is dendritic pattern. All rivers/streams of Hamirpur district are forming part of two major rive system catchments *i.e.* Beas river catchment and Satluj River catchment. The northern half part of the district forms the catchment area of Beas river and southern half part form the catchment of Satluj river. In the Hamirpur district mainly 3 nos. river/tributaries “Khad” are existed which areMan Khad, Kunah khad and Gasoti Khad. Drainage map of Hamirpur district is given in **Figure 4.10.**

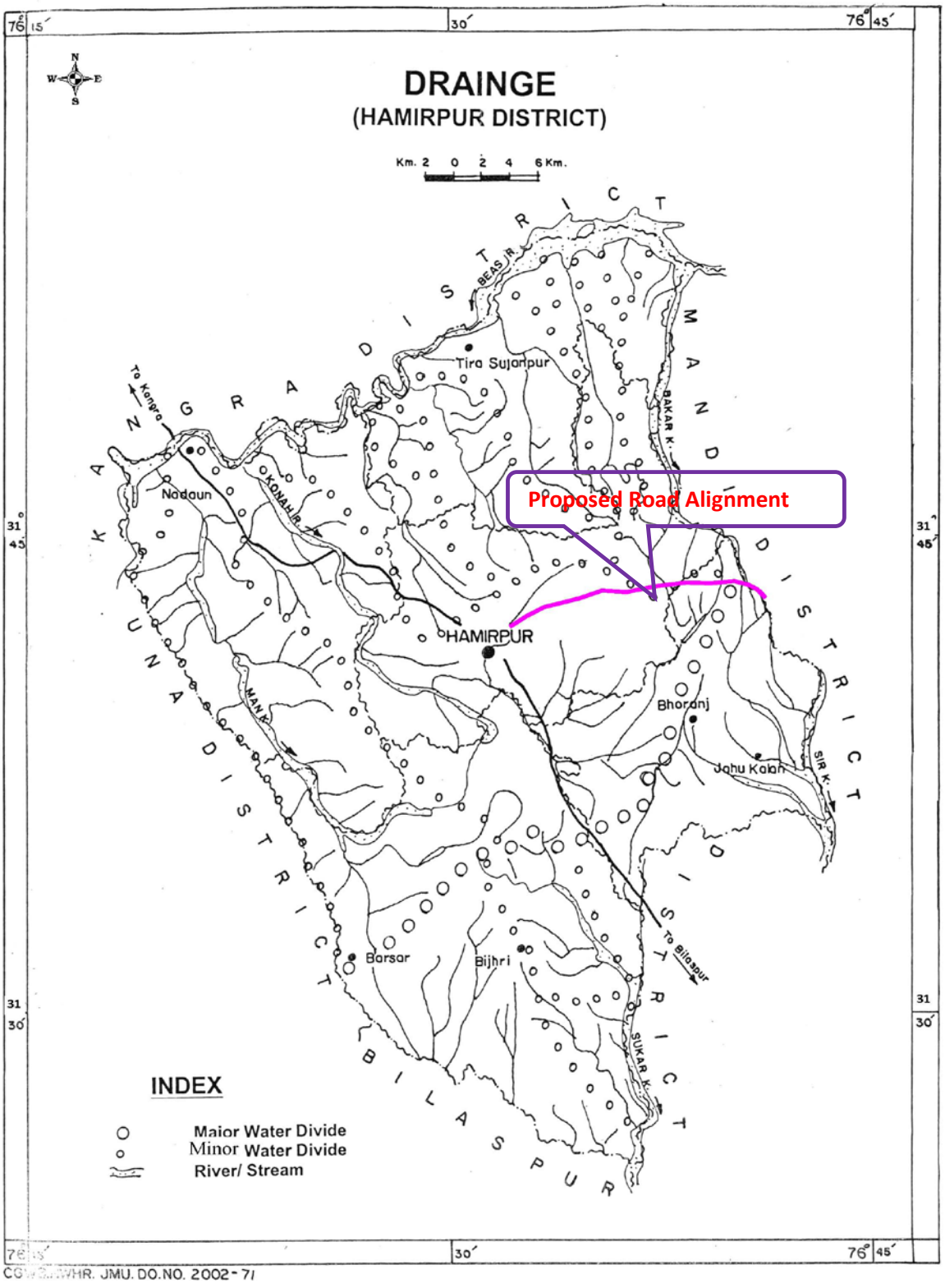


Figure 4.10: Drainage Map of Hamirpur District

D. Drainage System of Mandi District

Mandi district presents an intricate mosaic of mountain ranges, hills and valleys. It is primarily a hilly district with altitudes ranging from 550 m near Sandhol where the Beas River leaves the district, to about 3960 m amsl near Kullu border. There is a general increase in elevation from west to east and from south to north. Master slope is southwesterly. The south western part consists of Siwalik ranges having scarped slopes. There are few small intermontane valleys; prominent among them is the Balh valley, located in the lesser Himalayan ranges, having an average altitude of about 790 m msl and have a general slope towards NNE. The valley floor is undulating and is marked by low hillocks and terraces fringing the hills and intervening low alluvial plain.

The Beas and Satluj rivers form the major drainage system in the district. The river Beas and its tributaries, drain about 70% of the district area in the northern part, whereas the area in the south is drained by the river Satluj. Suketi Khad and its tributaries, chiefly drain Balh valley. The Suketi Khad maintains a perennial flow, because of effluent seepage from groundwater. There are three important lakes in the district, namely *Rewalsar*, *Prasher* and *Kamrunag*. Drainage Map of Mandi is given in **Figure 4.11.**

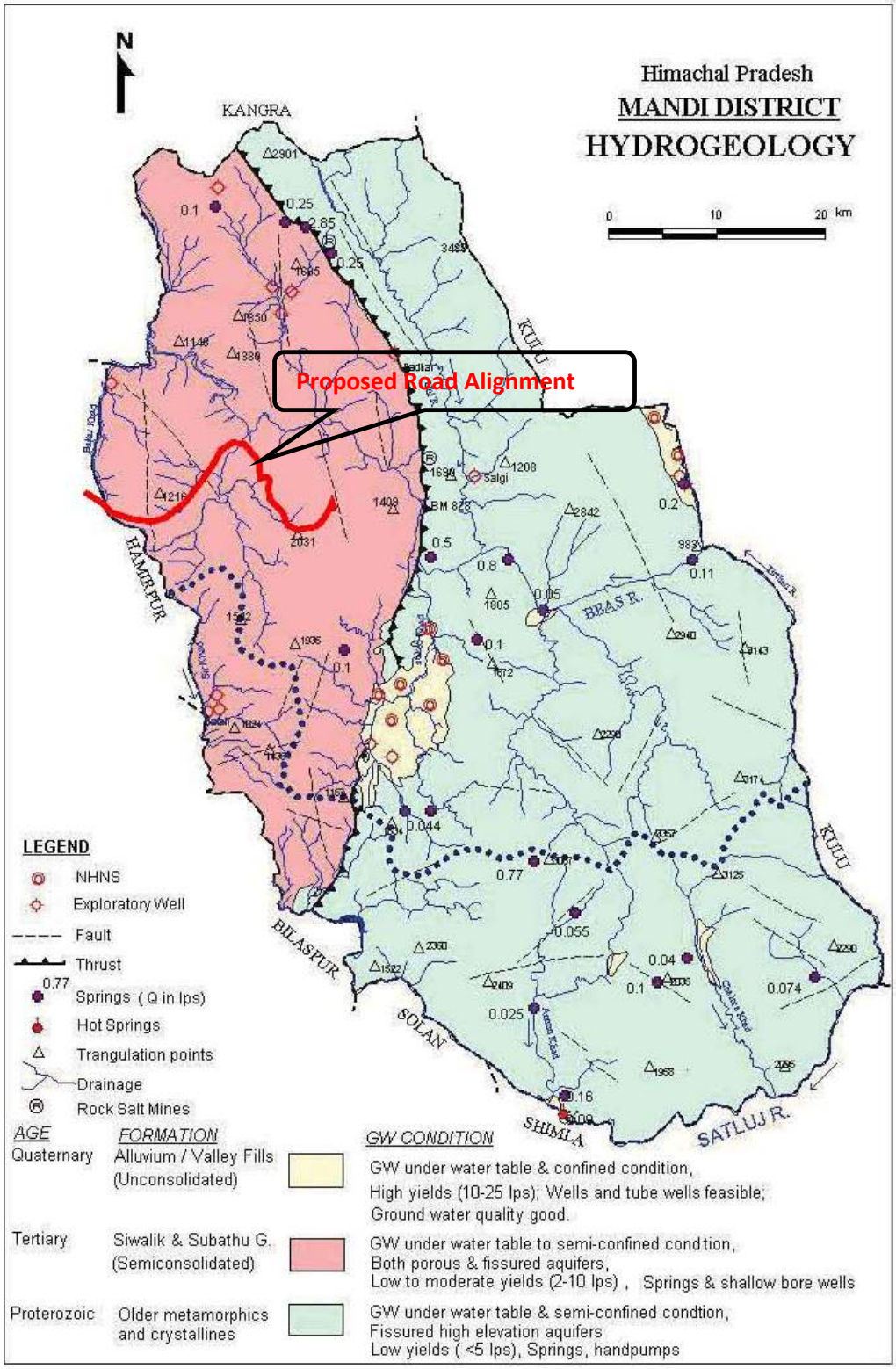


Figure 4.11: Drainage Map of Mandi District

i. Surface Water Bodies

Along the project road, 25 nos Bowris, 21 nos. Khatris (rain water percolation wells), 8 nos. small rivers/Khads and 44 nos of natural springs. Details of water bodies are given in **Annexure 4.2.**

ii. Water Quality in the Study Area

To understand baseline conditions of water quality, 4 nos. surface water sample and 7 nos. ground water samples were collected and analysed. The sampling locations were selected after the field investigations and review of all the water bodies/ resources along the project stretch. Baseline information on the quality of surface and ground water sources along the alignment of proposed road is required before predictions can be made of the future quality.

Water Quality Analysis

The collected ground and surface water samples from the various locations along the project highway, were tested as per IS 10500:2012 and CPCB water quality standards and results are shown in **Table 4.7** and **Table 4.8**, respectively.

In the ground water samples, pH was observed in the range of 6.34 to 7.76, total hardness as $CaCO_3$ in the range of 15.0 to 40.8 mg/l, Chloride in the range of 10.2 to 96.2 mg/l, TDS in the range of 106.0 to 394.0 mg/l, Sulphate in the range of 2.2 to 26.4 mg/l, Fluoride in the range of 0.14 to 0.26 mg/l and Alkalinity in the range of 22.1 to 66.2 mg/l. All physio-chemical parameters were found within prescribed limits of IS 10500:2012..

In the surface water quality pH was observed in the range of 6.52 to 7.23, Total hardness as $CaCO_3$ in the range of 56.4 to 126.4 mg/l, Chloride in the range of 24.8 to 42.1 mg/l, TDS in the range of 186.0 to 226.0 mg/l, Sulphate in the range of 12.4 to 26.4 mg/l, Fluoride in the range of 0.15 to 0.26 mg/l, Alkalinity in the range of 42.8 to 96.4 mg/l, DO in the range of 6.4 to 12.4 mg/l, COD in the range of 10.2 to 196.8 mg/l, BOD in the range of 4.1 to 22.0 mg/l and Total Coliform in the range of 6 to 14 MPN/100 ml.

Table 4.7: Analysis Result of Ground Water Samples

S.N.	Parameters	Results							Drinking Water Specifications (As per IS-10500)2012	
		Sample-1 (Hamirpur)	Sample-2 (Tauni Devi)	Sample-3 (Rakoh)	Sample-4 (Shiv Dawala)	Sample-5 (Mandi)	Sample-6 (Kotli)	Sample-7 (Ludhiana)	Desirable Limits	Permissible Limits in the absence of better alternate source
1	Colour, Hazen units (Hz)	<5	<5	<5	<5	<5	<5	<5	5 max	15 max.
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity, NTU	<1	<1	<1	<1	<1	<1	<1	1 max	5 max.
5	pH	6.34	6.94	7.76	7.76	7.38	7.04	7.43	6.5-8.5	No relaxation
6	Total Hardness,(as CaCO3)mg/l	40.8	24.8	28.4	22.8	32.4	15	20.4	200 max.	600 max.
7	Iron, (as Fe),mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.30 max.	No relaxation
8	Chloride, (as Cl),mg/l	96.2	24.2	18.4	24.9	52.6	10.2	19.9	250 max.	1000 max.
9	Residual Free Chlorine, mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.20 max.	1 max.
10	Calcium Hardness, (as Ca), mg/l	9.7	5.9	6.8	5.4	7.7	3.6	4.8	75 max.	200 max.
11	Magnesium Hardness, (as Mg),mg/l	3.9	2.1	2.5	2.24	2.5	1.4	2.53	30 max.	100 max.
12	Total Dissolved Soilds, mg/l	394	256	222	186	226	106	126	500 max.	2000 max.
13	Sulphate, (as SO_4), mg/l	26.4	10	12.4	11.8	16.4	2.2	6.4	200 max.	400 max.
14	Fluoride, (as F), mg/l	0.26	0.24	0.24	0.26	0.16	0.14	0.18	1.0 max.	1.5 max.
15	Total Alkalinity, (as $CaCO_3$), mg/l	66.2	36.4	33.8	36.4	42.1	22.1	26	200 max.	600 max.

S.N.	Parameters	Results							Drinking Water Specifications (As per IS-10500)2012	
		Sample-1 (Hamirpur)	Sample-2 (Tauni Devi)	Sample-3 (Rakoh)	Sample-4 (Shiv Dawala)	Sample-5 (Mandi)	Sample-6 (Kotli)	Sample-7 (Ludhiana)	Desirable Limits	Permissible Limits in the absence of better alternate source
16	Chromium Total, (as Cr), mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05 max.	No relaxation
17	Hexa Chromium, (as Cr+6), mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05 max.	No relaxation
18	Nitrate, (as NO3), mg/l	4.6	4	4.6	5	3.6	2.1	3.4	45 max.	No relaxation
19	Zinc, (as Zn), mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	5 max.	15 max.
20	Phenolic Compounds, (as C6H5OH), mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001 max.	0.002 max.
21	Copper, (as Cu), mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05 max.	1.50 max.
22	Manganese, (as Mn), mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.10 max.	0.30 max.
23	Arsenic, (as As), mg/l	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05 max.	No relaxation
24	Aluminium, (as Al), mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.03 max.	0.20 max.
25	Cyanide, (as CN), mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05 max.	No relaxation
26	Lead, (as Pb), mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01 max.	No relaxation
27	Cadmium, (as Cd), mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003 max.	No relaxation
28	Ammonia (as NH3), mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.5 max.	No relaxation
29	Barium (as B), mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.7 max.	No relaxation
30	Mineral Oil, mg/l	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.5 max.	No relaxation
1	Coil form organisms, MPN/100ml	<1	<1	<1	<1	<1	<1	<1	Less than 1	No relaxation

S.N.	Parameters	Results							Drinking Water Specifications (As per IS-10500)2012	
		Sample-1 (Hamirpur)	Sample-2 (Tauni Devi)	Sample-3 (Rakoh)	Sample-4 (Shiv Dawala)	Sample-5 (Mandi)	Sample-6 (Kotli)	Sample-7 (Ludhiana)	Desirable Limits	Permissible Limits in the absence of better alternate source
2	E.Coil, per 100ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	No relaxation

Table 4.8: Analysis Result of Surface Water Samples

S.No.	Parametrs	Units	Results			
			Sample-1 (Ludhiana)	Sample-2 (Mandi)	Sample-3 (Shiv Dawala)	Sample-4 (Hamirpur)
1	Colour	Hz	<5	<5	<5	<5
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity	NTU	<1	<1	<1	<1
5	pH	-	6.56	6.52	7.23	6.82
6	Total Hardness (as $CaCO_3$	mg/l	126.4	96.4	116.4	56.4
7	Iron, (as Fe)	mg/l	<0.5	<0.5	<0.5	<0.5
8	Chloride, (as Cl)	mg/l	38.4	36.4	42.1	24.8
9	Residual Free Chlorine (RFC)	mg/l	N.D.	N.D.	N.D.	N.D.
10	Calcium Hardness, (as Ca)	mg/l	9.2	23.1	27.9	13.5
11	Magnesium Hardness, (as Mg)	mg/l	3.5	9.3	10.8	5.7
12	Total Dissolved Solids(TDS)	mg/l	186	216	226	198
13	Sulphate, (as SO4)	mg/l	18.2	12.4	26.4	12.4
14	Fluoride (as F)	mg/l	0.2	0.26	0.24	0.15
15	Total Alkalinity, (as $CaCO_3$)	mg/l	96.4	66.4	88.4	42.8
16	Chromium Total, (as Cr)	mg/l	<0.05	<0.05	<0.05	<0.05
17	Hexa Chromium, (as Cr+6)	mg/l	<0.05	<0.05	<0.05	<0.05
18	Nitrate, (as NO_3)	mg/l	6.2	2.4	3.6	5.6
19	Zinc, (as Zn)	mg/l	<0.1	<0.1	<0.1	<0.1
20	Phenolic Compounds, (as C_6H_5OH)	mg/l	<0.001	<0.001	<0.001	<0.001
21	Cooper, (as Cu)	mg/l	<0.05	<0.05	<0.05	<0.05

S.No.	Parametrs	Units	Results			
			Sample-1 (Ludhiana)	Sample-2 (Mandi)	Sample-3 (Shiv Dawala)	Sample-4 (Hamirpur)
22	Manganese, (as Mn)	mg/l	<0.1	<0.1	<0.1	<0.1
23	Arsenic, (as As)	mg/l	<0.03	<0.03	<0.03	<0.03
24	Aluminium, (as Al)	mg/l	<0.03	<0.03	<0.03	<0.03
25	Cyanide, (as CN)	mg/l	<0.05	<0.05	<0.05	<0.05
26	Lead, (as Pb)	mg/l	<0.1	<0.1	<0.1	<0.1
27	Cadmium, (as Cd)	mg/l	<0.01	<0.01	<0.01	<0.01
28	Dissolved Oxygen	mg/l	6.4	6.4	12.4	8.3
29	Oil & Grease	mg/l	<1	<1	<2	<2
30	Chemical Oxygen Demand, (COD)	mg/l	46.2	196.8	22.8	10.2
31	Biological Oxygen Demand, (BOD)	mg/l	4.1	22	<1	<0.5
32	Total Suspended Solids, (TSS)	mg/l	8	12	6	6
33	Total Coil form	MPN/100 ml	6	10	14	<1

4.2.7 Ambient Air Quality

Ambient air quality refers to the condition or quality of air surrounding environment. The study area represents mostly rural/residential as well as urban. The sources of air pollution in the region are mainly vehicular traffic; dust arising from unpaved road and domestic fuel burning etc. The prime objective of the baseline air quality study is to establish the existing ambient air quality along the project road and it will also be useful for assessing the conformity to standards of the ambient air quality specified by CPCB due to the construction and operation of the project road. The ambient air quality monitoring has been carried out as per new notification, issued on 16th November 2009. The copies of signed analysis and monitoring reports for ambient air, water, soil and noise by NABL approved laboratory are enclosed as **Annexure 4.1.**

Selection of Sampling Locations

The sampling of the ambient air quality has been established through a scientifically designed ambient air quality monitoring network and is based on the following considerations:

- Meteorological conditions on synoptic scale;
- Topography of the study area; and
- Representatives of likely impact areas along the project road.

Details of the AAQM locations are given in **Table 4.9.**

Table 4.9: Description of Ambient Air Quality Monitoring Locations

Station Code	Station Name	Chainage	Coordinates	Distance from central line of the project (m)	Location Description
AQ1	Hamirpur	Km 141	31˚42’15”N, 76˚31’34”E	10	Residential area
AQ2	Tyoni Devi	Km 152	31˚42’50”N, 76˚35’55”E	12	Rural
AQ3	Rakoh Bus Stop	Km 172	31˚40’34”N, 76˚35’15”E	12	Commercial
AQ4	Shiv Dawala	Km 194	31˚52’43”N, 76˚44’45”E	10	Industrial
AQ5	Kulhar	Km 215	31˚48’54”N, 76˚45’29”E	12	Rural
AQ6	Kotli	Km 242.570	31˚47’57”N, 76˚52’58”E	12	Commercial
AQ7	Mandi	Km 264	31˚41’26”N, 76˚46’12”E	10	Commercial

Frequency and Parameters for Sampling

Ambient air quality monitoring has been carried out with a frequency of twice a week at each site during October 2019. The baseline data of ambient air quality is monitored for Particulate Matter (PM_{10}), Particulate Matter ($PM_{2.5}$), Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_x), Carbon monoxides (CO), etc.

Sampling and Analytical Techniques

Respirable Dust Sampler (RDS-DX) along with gaseous sampling impingers were used sampling of PM_{10}, NO_2 and SO_2, and Fine Particulate Sampler (FPS) was used for sampling of $PM_{2.5}$. SO_2 was collected by drawing air through absorbing solution of TCM (EPA Modified West & Geake Method) and NO_2 was collected by drawing air through the mixture of absorbing solution of Sodium Arsenite (Na-Arsenite Modified Jacob & Hochheiser Method). The measurement for both SO_2 and NO_2 was done calorimetric.

Monitored values are compared with National Ambient Air Quality Standards prescribed by Central Pollution Control Board (CPCB). Results of ambient air quality are within the limits, are presented in **Table 4.10.** On the basis of tabulated results, following observations can be made:

Particulate Matter (PM_{10})

The average concentration of PM_{10} was found in the range 44 to 61.2 µg/m^3 and all values were lower than the prescribed limits of CPCB (100 µg/m^3).

Particulate Matter ($PM_{2.5}$)

$PM_{2.5}$ value was observed in the range of 17.7 to 33.25 µg/m^3. Maximum 33.2 µg/m^3 value was recorded at Rakoh bus stop due to traffic conjunction and market activities. All values of $PM_{2.5}$ were lower than the prescribed limits of CPCB (60 µg/m^3).

Sulphur Dioxide (SO_2)

SO_2 value was observed in the range of BDL to 9.45 µg/m^3.

Nitrogen Dioxide (NO_2)

The NO_2 concentration of ambient air quality was found in the range of 8.95 to 15.4 µg/m^3.

Carbon Monoxide (CO):

The Carbon Monoxide (CO) concentration of ambient air quality was found in the range of 0.22 to 0.44 µg/m^3.

Monitored ambient quality values for all parameter were within the National Ambient Air Quality Standards (NAQQM).

Table 4.10: Ambient Air Quality Monitoring Results

S.No.	Parameters	Ambient Air Quality Monitoring Result							NAAQS Limit
		Location 1	Location 2	Location 3	Location 4	Location 5	Location 6	Location 7	
1	Particular Matter PM_{10} (µg/m³	60.3	54.05	61.2	52.9	46	44	48	100
2	Particular Matter (PM_{25}) (µg/m³)	30.25	24.2	33.25	25.45	18.2	17.7	21.6	60
3	Sulphur Dioxide (SO_2) (µg/m³)	7.9	9.45	9.15	8.8	6.5	BDL	7.9	80
4	Nitrogen Dioxide (NO_2) (µg/m³)	15.25	13.8	15.4	14.55	12	8.95	12.7	80
5	Ozone(O_3) (µg/m³)	16.1	11.45	18.75	11	9.7	6.4	12.2	180
6	Carbon Monoxide (CO) (µg/m³)	0.44	0.33	0.39	0.275	0.22	0.295	0.38	4
7	Benzene (C6H6) (µg/m³)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5
8	Benzopyrene (BaP) (ug/m³)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1
9	Lead (Pb) (µg/m³)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1
10	Arsenic (As) (µg/m³)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6
11	Nickle (Ni) (µg/m³)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	20
12	Ammonia (NH3) (µg/m³)	8.45	9.9	6.8	7.5	7.1	11.7	12.25	400

4.2.8 Noise Measurement

A preliminary reconnaissance survey was undertaken to identify the major noise generating sources along the project road. To assess the noise level in the study corridor ambient noise monitoring was carried out considering all categories like commercial, residential and silence zone has been carried out. Total 7 nos. locations along the project highway were selected for measurement of present status of noise level. Locations and measured noise level results are given in **Table 4.11.** “SLM 100” instrument was used to ascertain noise status at monitoring sites along the project road. During the night time, noise level was observed within the prescribed limits of CPCB, However, during the day time it was observed slightly high at some locations.

Table 4.11: Ambient Noise Level Results at Various Locations

Locations	Landuse / Location	Day Time Equivalent Noise Level (Leq)	Night Time Equivalent Noise Level (Leq)
Hamirpur $31^0 42'58"$ N, $76^0 35'20''$ E	Commercial	59.8	38.2
Tauni Devi $31^0 42'50"$ N, $76^0 35'55''$ E	Commercial	61.9	38.3
Rakoh $31^0 40'34"$ N, $76^0 42'15''$ E	Residential cum Commercial	58.2	37.7
Shiv Dawala $31^0 52'43"$ N, $76^0 44'45''$ E	Residential cum Commercial	53.2	40.8
Mandi $31^0 41'19"$ N, $76^0 56'15''$ E	Residential	57.3	40.4
Kotli $31^0 47'57"$ N, $76^0 52'58''$ E	Commercial	54.0	42.2
Ludhiana $31^0 48'54"$ N, $76^0 45'29''$ E	Residential cum Commercial	50.3	39.7

Source: Sampling and Analysis taken by Environment Pollution Analysis Lab, Bhiwadi in 2019

Noise Level std. as per "The Noise Pollution (Regulation and Control) Rules, 2000"			
Category	**Night Time**	**Day Time**	
Industrial	70	75	
Commercial	55	65	
Residential	45	55	
Silence Zone	40	*50*	

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Forest

In the Himachal Pradesh Approx. 27% of total geographical area is under forest cover of the total state area. Hamirpur district having approx. 28% area of forest cover while Mandi is having approx. 45% forest cover. District wise forest cover is provided in **Table 4.12.**

Table 4.12: District wise forest cover of Project District

DISTRICT WISE FOREST COVER OF HIMACHAL PRADESH : As Per FSI Report 2017 (Area in Km2)						
District	**Geographical Area**	**Very Dense Forest**	**Mod. Desne Forest**	**Open Forest**	**Total**	**% Forest Cover**
Hamirpur	1118	39	86	188	313	27.99642
Mandi	3950	368	722	671	1761	44.58228
Source: **Himachal Pradesh Forest Department**						

Along the proposed road, demarcated forest areas as Reserved Forest (RF) patches are observed at various locations which are given in **Annexure 4.3**. In addition to reserved forest areas, in revenue records, forestlands are recorded in various category, which are given below:

- Jungal Mehfuja Mehduda,
- Jungale Mehfuja,
- Jungale Mehfuja Gair Mehduda,
- Jungale Mehfuja Gair Mehduda, G.M. Tank, G.M. Sadak, G.M. Guard Khana,
- Jungale Mehfuja Gair Mehduda, Jungale Mehfuja Mehduda,
- Jungale Mehfuja Gair Mehduda, Varsha Ashralay,
- Forest Department, G.M. Nursery

Source: Revenue Dept. of Himachal Pradesh

Reserved Forests have diverse ecosystems on land, because they hold the diverse terrestrial species of flora.

4.3.2 Wildlife

As per Protected Area Network of Forest Department in Himachal Pradesh 5 nos. National Parks, 26 nos. Wildlife Sanctuaries and 3 nos. Conservation Reserves are existed. None of them is falling within 10 km radius of the project road. There is no notified breeding or nesting bird site/ecological sensitive area/Ramsar convention site or Area notified under Wild Protection Act-1972 along the project road. Nearest protected area is Nagru wildlife Sanctuary which is approx. 20 km away from the project road.

4.3.3 Trees along the project road

Along the project road various type of tree species are found *viz.* Mapple/Mander (*Acer caesium*), Safed parcha (*Artemisia martima*), Kemal/Rausat (*Artemisia martima*),

Kemal/Rausat (*Berberis aristata*), Piyakh (*Alnus nepalensis*), Thangi (*Corylus jacquemontii*), Kashna (*Buddleja crispa*), Nilonji (*Viburnum cotinifolium*), Kilonj (*Viburnum erubecens*), Bhashndeyi (*Coriaria nepalensis*), Sarla (*Hippophae salicifolia*), Alan (*Lyonia ovalifolia*), Barh (*Rhododendron arboreum*), Kathi (*Indigofera heterantha*), Banz (*Quercus leucotrichophora*) Khair, (*Senegalia catechu*), Naspati (*Pyrus*), Pipal, (*Ficus religiosa*), Shisham (*Dalbergia sissoo*), Aam (*Mangifera indica*), Simbal (*Bombex malabaricum*), Akhrot (*Juglans regia*), Bargad (*Ficus benghalensis*), Cheed (*Pinus*), Jamun (*Syzygium cumini*), Khajur (*Phoenix dactylifera*), Tun (*Cedrela toana*), Acacia and albizia, etc.

4.3.4 Domestic and Wild Animals

A. Domestic Animals: Domestic animals observed i in the area are cow, buffalo, sheep, goat and ponies, etc.

B. Wild Animal

Inquiry from village people near forest areas during baseline data collection regarding wild animals reveals that *Rhesus macaque*, *Indian hare*, *fruit bat*, etc. are often seen in the area. As per discussions with Forest Range officers and DFOs of Mandi and Hamirpur districts it was noted that wild animals lik Jackal, Jungle cat, Samber, deer and Leopard are also seen in the project study area.

Distribution of monkeys is throughout the project road. Public consultations revealed that monkeys are found often near habitation areas in search of food.

The ecological status of the wild animals was categorized following IUCN Red Data Book and Wildlife Protection Act (WPA) 1972.Most of the species are of least concern except the *Panthera pardus* (Leopard), which is of vulnerable category and placed in Schedule I of the Wildlife (Protection) Act 1972. Lizards and snakes have also been reported for the project area.

Leopards are seen occasionally near the dense forest areas. Common wildlife in the project influence area is given in **Table 4.13**.

Table 4.13: Common Wildlife of Project Influence Area

S. No	Common Name of Mammals:	Scientific name	WPA 1975	IUCN Red List Status
1	Field mouse	*Apodemus sylvaticus*		LC
2	Jackal	*Canis aureus*	II	LC
3	Wild dog	*Cuonalpinus*	II	DD
4	Indian Palm Squirrel	*Funambulus palmarum*	IV	LC
5	Indian Grey Mongoose	*Herpestes edwardsii*	II	LC
6	Indian hare	*Lepus nigricollis*		LC
7	Rhesus macaque	*Macaca mulatta*		LC

S. No	Common Name of Mammals:	Scientific name	WPA 1975	IUCN Red List Status
8	Fruits Bat	*Pteropus conspicillatus*		LC
9	Rat	*Rattus rattus*	V	DD
10	Wild pig	*Sus scrofa*	III	LC
	Leopard	*Panthera pardus*	I	VU

LC=Least Concern, VU=Vulnerable, DD= Data Deficient, NT=near threatened,

4.3.5 Reptiles & Amphibians

The efforts were made to observe reptiles in and around the area along the road alignment. No sighting of reptiles was happened during course of field visits. Local Forest Dept. and local community were consulted and reported common reptiles in the project influence area are given in T**able 4.14:**

Table 4.14: Common Reptiles Species

S. No	Common Name	Scientific name	WPA 1975	IUCN Red List Status
1	Skipping frog	*Bufo stomaticus*	IV	LC
2	Krait	*Bungarus caeruleus*	IV	NA
3	Banded krait	*Bungarus multicinctus*		NA
4	Kashmir Rock Agama	*Laudakia tuberculata*		NA
5	Bronze Grass Skink	*Eutropis macularia*		NA
6	Garden lizard	*Calotes versicolor*		NA
7	House lizard	*Hemidactylus frenatus*		LC
8	India bull frog	*Hoplobatrachus tigerinus*		DD
9	Cobra	*Naja naja*	II	LC
10	Rat snakes	*Ptyas mucosus*		NA

LC: Least Concern, NA: Not Assessed, DD: Data deficient

4.3.6 Birds:

Various type of species of birds were sighted during course of filed study and information birds was also collected from various Forest Dept. The list of common avifauna and their status are given in **Table 4.15.**

Table 4.15: Common Avifauna found in Project Area

Sl.No	Scientific name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List
1.	*Columba livia*	Little grebe	IV	Least Concern
2.	*Podiceps euficollis*	Little cormorant	IV	Least Concern
3.	*Phalacrocorax niger*	Grey heron Purple heron	IV	Least Concern
4.	*Ardea purpurea*	Indian Pond-Heron	IV	Least Concern
5.	*Ardeola grayii*	Little Egret Large egret	IV	Least Concern
6.	*Ardea alba*	Painted stork	IV	Least Concern
7.	*Mycteria Leucocephala*	Spotbill	IV	Least Concern
8.	*Anas poecilorhyach*	Shikra	IV	Least Concern
9.	*Gallus qallus*	Jungle bush quall Grey quall	IV	Least Concern
10.	*Coturnix coturnix*	Common Pariah Kit	IV	Least Concern
11.	*Pavo cristatus*	Common Coot	IV	Least Concern
12.	*Vanellus indicus*	Common sandpiper	IV	Least Concern
13.	*Tringa hypoleucos*	Greenshank	IV	Least Concern
14.	*Tringa ochropus*	Indian river tern	IV	Least Concern
15.	*Sterna aurantia*	Spotted dove Alakndrine parakeet	IV	Least Concern
16.	*Psittacula supatria*	Common Teal	IV	Least Concern
17.	*Anas crecca*	Roser Parakeet	IV	Least Concern
18.	*Psittacula krameri*	Indian cuckoo	IV	Least Concern
19.	*Athene brama*	Jungle owlet	IV	Least Concern
20.	*Glaucidium radiatum*	House swift	IV	Least Concern
21.	*Merops orientalis*	Indian rooller	IV	Least Concern
22.	*Picus squamatus*	Himalayan scaly belliedgreen woodpecker Indian pitta	IV	Least Concern

Sl.No	Scientific name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List
23.	*Pitta brachyuran*	Crested Lark	IV	Least Concern
24.	*Galerida cristats*	Skylark	IV	Least Concern
25.	*Alauda gulgule*	Black headed oriol	IV	Least Concern
26.	*Sturnus contra*	Small minivet	IV	Least Concern
27.	*Pericrocotus cinnamomeus*	Black bulbulPied myna	IV	Least Concern
28.	*Hypsipates madacascariensis*	Jungle Babbler	IV	Least Concern
29.	*Turdoides striatus*	Common babbler	IV	Least Concern
30.	*Turdoides caudatus*	Grey headed flycather	IV	Least Concern
31.	*Culicicapa cevlonensis*	Red-backed shrike	IV	Least Concern
32.	*Lanius collurio*	Common Tailorbird	IV	Least Concern
33.	*Orthotomus sutorius*	Indian Robin	IV	Least Concern
34.	*Saxicoloides fulicata*	Blue rock thrush	IV	Least Concern
35.	*Anthus trivialis*	Yellow wagtall	IV	Least Concern
36.	*Motacilla flava*	Common Babbler	IV	Least Concern
37.	*Dicrurus macrocercus*	Western Koel	IV	Least Concern

4.3.7 Rare or Endangered Species

On the review of available information, there is no rare or endangered species of flora and fauna prescribed by IUCN or WPC, 1972 are found along the project road, except *Panthera pardus* (Leopard) which is Schedule I species as per The Wildlife (Protection) Act, 1972 and Vulnerable as per IUCN Red list.

4.4 SOCIO-ECONOMIC AND HEALTH ENVIRONMENT

4.4.1 Demographic Features

Hamirpur district having 4 nos. Tehsils namely Tira Sujanpur (NP), Nadaun (NP), Hamirpur (M Cl) and Bhota (NP). This district has a total number of 1,725 villages comprising 205 (Tira Sujanpur), 371 (Nadaun), 111(Galore), 378 (Hamirpur), 249 (Barsar), 132 (Dhatwal) and 279 (Bhoranj). The biggest tehsil in terms of villages is Hamirpur having 378 villages. Bhoranj tehsil, Dhatwal and Galore sub-tehsils are entirely rural while other tehsils have one town each.

Hamirpur district having 1725 villages among the 12 districts of the state. This district occupies: 8th rank among the districts in terms of population, 1st position in terms of sex ratio 1,095 females against 1,000 males, 8th position in terms of its working force, 10th positions in terms of decadal population growth, 1st position in population density and 7th rank among the districts of the state in terms of literate population. The economy of Hamirpur district is mainly depends on agriculture. All the in-habited villages of this district enjoy the facility of electricity and potable drinking water. Hamirpur district is also known for its attractive tourist destinations like Hamirpur, Tira Sujanpur, Nadaun and Temple of Deothsidh Baba Balak Nath. This district is also known for its colourful Holi Festival.

Mandi district is divided into seven sub-divisions of Mandi, Chachyot, Jogindarnagar, Padhar, Sarkaghat, Sundarnagar and Karsog, and 17 tahsils/sub-tahsils. Further this district is divided into ten community development blocks for the developmental purposes. All departments of the state Govt. such as public works department, agriculture, horticulture, irrigation & public health, forests, education, animal husbandry and fisheries etc. have district level officers. Sub-Divisional Magistrate is the head of subdivision while Block Development Officer is the head of Community Development Block. At the tahsil/sub-tahsil level, the Tahsildar/ Naibtahsildar and other officers look after their respective jurisdiction for developmental and regulatory functions.

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Mandi district occupies second largest district in terms of population, 3th rank in terms of sex-ratio in the state, 7th rank in terms of literacy among all the district of state (The literacy rate of the district is 81.5 per cent in comparison to state average of 82.8 per cent). Mandi tahsil has the highest rural population while Sandhol sub-tahsil has lowest rural population in the district.

Lad Bharol tahsil has the highest sex-ratio while Bali Chowki sub-tahsil has the lowest sex-ratio in the district.

4.4.2 Villages/Settlements Along The Project Road

The project requires acquisition of approx. 45 ha of private land and the acquisition is being done as per the provisions of "The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013" and National Highway Act 1956. Other than private land, 50.5164 ha govt. land will be required for this project. Village wise details of affected private land is given in **Table 4.16.**

Table 4.16: Details of village wise affected Private Land

S.No.	Package No.	Village	Area In Hect.
1.	**Package-I** (from Existing km 141 to km 184.758)	Droghan	2.3862
2.		Thana	0.5221
3.		Darkoti	0.3382
4.		Tapre	0.2459
5.		chahad	0.42
6.		Chaatrail	0.2669
7.		Bari	0.8851
8.		Jhanikar	0.8046
9.		Barada	0.4097
10.		Saphneda	0.5408
11.		Panjot	0.4895
12.		Lalyyar	0.1943
13.		Tikkari	0.0862
14.		Gughedi	0.0796
15.		Samirpur	0.5307
16.		Sangroh Kalan	1.6168
17.		Bagwada	0.9725
18.		Saron	0.8043
19.		Kothi	0.9885
20.		Ropad	0.54
21.		Dodar	0.1734
22.		Panyarwin	0.0927
23.		Kalot	0.2626
24.		Rakoh	0.4878

S.No.	Package No.	Village	Area In Hect.
25.		Bhalwan	0.3061
26.		Tathih	0.2481
27.		Laka	0.0592
28.		Sarkaghat	0.0303
29.		Jamsai	0.0086
30.		Chowk	0.0961
31.		Sarouri	0.0031
32.		Alyana	0.0351
33.		Gadyara	0.047
34.		Parsada Hawani	0.0059
35.		Damshehra	0.1454
36.		Karnohal	0.0059
37.		Parchhu	0.0386
Sub Total of Pkg-1			**15.1678 ha**
38.	Package-II (from Existing km 184.758 to km 217.014)	Hukkal	0.749
39.		Khelag	0.7734
40.		Tryamla	0.1982
41.		Longni	0.5328
42.		Riyur	0.0886
43.		Kalwahan	1.7841
44.		Bhatour	0.5399
45.		Kumharda	2.715
46.		Sihan	0.8643
47.		Paihad	0.0309
48.		Riyur	0.8102
49.		Banal	3.0506
50.		Dharampur	0.0072
51.		Hawani	1.9223
52.		Thana	1.2504
53.		Lungran	0.1171
54.		Banerdhi	2.2998
55.		Jhareda	0.5302

S.No.	Package No.	Village	Area In Hect.
Sub-Total of Pkg-II			**18.2640 ha**
56.	Package-III (from Existing km 217.014 to km 265.550)	Banog/1	0.0488
57.		Satahan/18	0.0914
58.		Dhawali Badehar/19	0.1007
59.		Lagadhar/16	0.0834
60.		Saploh/21	0.7358
61.		Surwari Uparli/22	0.3847
62.		Sain/21	0.2158
63.		Kushmal/24	0.171
64.		Dhaniyara/25	0.0807
65.		Balahar/26	0.453
66.		Fagla/77	0.5805
67.		Kotli/74	0.4118
68.		Kasan/17	0.1221
69.		Nalsan/71	0.1699
70.		Sai/52	0.3887
71.		Chaloh8/68	0.3464
72.		Satohal/64	0.4893
73.		Bohin/61	0.0056
74.		Paprahal/59	0.0442
75.		Chela/60	0.4844
76.		Fatewahan/358	0.4586
77.		Manthala/357	0.3322
78.		Maswadi/356	0.2947
79.		Ghera/354	0.1103
80.		Talyahad/360	0.87
81.		Madwahan/364	1.7162
82.		Sanyaradh/363	1.0354
83.		Chadyara/346	0.5613
84.		Maloun	0.3387
85.		Ludhiyana	0.4249
Sub-Total Pkg-III			**11.5505 ha**

S.No.	Package No.	Village	Area In Hect.
Total of Pkg-I, II &III			44.9823= Approx. 45 ha
Source: *As per LA Plan (3D), 2020*			

4.4.3 Type of Affected Plots

In the private affected plots, 1577 are barren land plots with structures, 277 are barren land plots without structures, 84 are agriculture land plots with structures and remaining 2065 are agriculture land plots without structures. Package wise details of impacted plots are given in **Table 4.17.**

Table 4.17: Details of Affected Plots

S.No	Package Details	Affected Private Plots				Govt. Plots details	Package Wise Total Plots
		Barren Plots with Structure	Barren Land	Agricultural Land	Agricultural plots with Structures		
1	Pkg-I	177	645	744	43	597	2206
2	Pkg-II	9	290	740	12	352	1403
3	Pkg-III	91	592	581	29	700	1993
Sub Total		277	1527	2065	84	1649	5602

Source: 3 D Notification, 2020

4.4.4 Impacts on Structures

As per the Census survey, a total of 1487 structures are getting affected due to project activities with 1366 private structures (including 25 cattle sheds), and 121 CPRS. Out of 1366 affected private structure owners, 1215 are Titleholders and 151 are non-title holders. A total of 4799 people is getting affected due to structure demolition and this figure does not include the family members of 63 households who were not available during census survey. A total of 121 CPRs will be affected which include 24 religious structures like, Peepal tree temples, cemetery and temples, are 97 Government structure like school, colleges, police chouki, hospital, govt. offices, hand pump, bus stop etc. People were consulted relocation and reconstruction of the CPRs. The 12 schools getting affected are mostly losing the boundary wall, entrance gates and toilets of the schools with not much impact on the main building. Package wise details of impacted structures is given in **Table 4.18.**

Table 4.18: Impact of the Project on Affected Structures

S.No.	Impact Category	Properties	Likely Impact			
			Total Impacted structures (including all packages)	Impacted in Pkg-1	Impacted in Pkg-2	Impacted in Pkg-3
A	**Private Structure**	Residential (including 25 cattle sheds)	533	332	97	105
		Commercial	410	281	28	100
		Residential+ Commercial	423	294	28	101
		Total (A)	**1366**	907	153	306
B	**Common Property Resources**					
B1	**Religious**	Temple	19	12	1	6
		Samsan Ghat (burial spots)	3	2	1	0
		Peepal Tree Temple (Shrine)	2	2	0	0
		Sub Total (B.1)	**24**	**16**	**2**	**6**
B2	**Government**	School	12	9	1	2
		Inter College	3	3	0	0
		Police Chouki	1	1	0	0
		Govt. Offices	18	13	2	3
		Govt Hospital	1	1	0	0
		Bus Shelter	19	13	2	4
		Public Toilet	2	1	0	1
		Pond/Bawadi	6	6	0	0
		Hand Pump	32	31	1	0
		Water Supply Tank	2	2	0	0
		Road Circle	1	1	0	0
		Sub Total (B.2)	**97**	**81**	**6**	**10**
		Total (B.1+B.2)	**121**	**97**	**8**	**16**

Source: Census Survey, October 2019

4.4.5 Extent of Impact on Properties

In the Pkg-I, II and III total 586 structure are partially while 780 are full impacted. In the impacted structures fully impacted structures are more than partially impacted because in the hill region house are constructed on slopes so that majority of the partially impacted structures are unsafe and ultimately these structures will be demolished. Details of Extent of Impact on properties are given in **Table 4.19.**

Table 4.19: Type and Details of Partially Affected Properties

No. of Pkg.	Residential		Commercial		Resi. Cum Com.		Sub Total
	Partially Impacted	Fully Impacted	Partially Impacted	Fully Impacted	Partially Impacted	Fully Impacted	
Pkg-I	144	188	135	146	126	168	907
Pkg-II	31	66	5	23	8	20	153
Pkg-III	52	53	45	55	40	61	306
Total							**1366**

4.4.6 Status of Ownership of Impacted Structures

Status of ownership of impacted structures is given in **Table 4.20.** It is found that out of all a total of 472 TH and 128 NTH are losing their livelihood due to loss of structure.

Table 4.20: Status of Ownership (Excluding 121 CPR)

Name of the Location (District) LHS	Status		
	Titleholder	Encroacher	Total
Pkg-I	768	139	907
Pkg-II	147	6	153
Pkg-III	300	6	306
Total	1215	151	1366
Source; *Census Survey, Oct., 2019*			

4.4.7 Socio Economic Profile of Project Affected Households

Census and Socio Economic Survey was conducted for only those households who are losing their structure due to proposed road widening and strengthening. As per the survey of affected structures, a total of 1366 households will be affected due to the proposed project, out of which information for 63 households could not be collected as they were not available during the survey. As per the Census survey, 1303 affected households consists of 4799 persons (family members of affected households) with an average family size of 4 members approx. Out of the 4799 PAPs, 51.8233% are male and 48.1767% are female. The socio-economic profile of the affected structures households is analyzed and presented in the following sections.

Out of 1303 project affected households 870 are in Package-I (from Existing km 141 to km 184.758), 147 are in Package –II (from Existing km 184.758 to km 217.014) and remaining 246 are in Package-III (from Existing km 217.014 to km 265.550).

In the 1303 surveyed families, majority belongs to Hindu population (>99%) followed by Muslim population of <1%. It is also found that majority of the families are joint families i.e, 63 % and remaining 37% are nuclear. Out of 1303 PAFs surveyed, 1096 belongs to General Category, 19 to Other Backward Castes (OBC), 179 to SC and only 9 belongs to ST.

The social development of a region is signified by many indices. One of which is literacy status of the population. The literacy rate (read, write and understand) in the affected households is around 95.78%. As per the information collected during the census survey, it is found that maximum of 36.91% are educated upto higher secondary level and 4.37% have completed graduate and postgraduate respectively. The details are provided in **Table 4.21.**

Table 4.21: Socio-Cultural Characteristics of the Affected Households

Item	Description	Project Affected Household					Project Affected Person				
		No. of Affected Household (Whole Length)	% of total (Whole Length)	Pkg-1 (from Existing km 141 to km 184.758)	Pkg-2 (from Existing km 184.758 to km 217.014)	Pkg-3 (from Existing km 217.014 to km 265.550)	Number of Affected person	% of total	Pkg-1	Pkg-2	Pkg-3
Population	Male	-	-	-	-	-	2487	51.82	1720	261	506
	Female	-	-	-	-	-	2312	48.18	1635	237	440
	Total	**-**	**-**	**-**	**-**	**-**	**4799**	**100**	**3355**	**498**	**946**
Religious Group	Hindu	1299	99.69	867	146	246	4752	99.02	3340	494	946
	Muslim	4	0.31	3	1	0	47	0.98	15	5	0
	Total	**1303**	**100**	**870**	**147**	**286**	**4799**	**100**	**3355**	**498**	**946**
Social Group	General	1096	84.11	712	127	257	4010	83.56	2803	416	790
	OBC	19	1.46	14	1	4	96	2.0	67	10	19
	SC	179	13.74	138	18	23	650	13.54	454	67	128
	ST	9	0.69	6	1	2	43	0.90	31	5	9
	Total	**1303**	**100**	**870**	**147**	**286**	**4799**	**100**	**3355**	**498**	**946**
Type of Family	Nuclear	482	37	322	54	106	NA	NA	NA	NA	NA
	Joint	821	63	548	93	180	NA	NA	NA	NA	NA
	Total	**1303**	**100**	**870**	**147**	**286**					
Education level of HH	Illiterate	253	5.27	37	6	12	252	5.28	177	27	50
	Primary Schooling	433	9.02	158	27	52	430	9.02	303	45	85
	Upper Primary Schooling	858	17.88	221	37	73	852	17.87	600	89	170
	High School	1950	40.63	321	54	105	1938	40.64	1363	202	383
	Graduate	809	16.86	90	15	30	804	16.86	566	84	159
	Post Graduate	403	8.40	38	6	12	400	8.39	281	42	79

Item	Description	Project Affected Household					Project Affected Person				
		No. of Affected Household (Whole Length)	**% of total (Whole Length)**	**Pkg-1 (from Existing km 141 to km 184.758)**	**Pkg-2 (from Existing km 184.758 to km 217.014)**	**Pkg-3 (from Existing km 217.014 to km 265.550)**	**Number of Affected person**	**% of total**	**Pkg-1**	**Pkg-2**	**Pkg-3**
	Technical	93	1.94	5	2	2	93	1.95	65	9	20
	Total	**4799**	**100**	870	147	286	**4799**	**100**	**3355**	**498**	**946**
Note: Total impacted household are 1366 and out 1366, 63 household were not available at site so that they could not be included in this Census survey and only 1303 house hold are included in this survey.											
Source: *Census Survey, October 2019*											

4.4.8 Economic Profile

The occupation pattern shows that primarily structure owners are engaged in Business sector comprising of 37.22% of the total available PAHs (1303 nos.). This is followed by 5.14% are cultivator, 8.60% are agriculture labour, 9.21% are Daily Wage Earner, 22.64% are Salaried persons, and 17.19% are engaged in other professions.

Details of the occupation of the project affected families whose structure will be impacted, are given in **Table 4.22.** The level of household income among the HHs within the RoW illustrate that an overwhelming majority of 40.22 %, have an income level between 10000-15000 per month followed by 15% of HHs earning 5000-10000 per month, 29.99 % of HHs earning 15000-20000 per month and 10.02 % of HHs earning more than 20000 per month. The proposed improvement will considerably reduce the travel time between the Hamirpur-Mandi. This will facilitate growth of more economic activities, access to better economic prospect outside the area and hence increase of income opportunities.

Table 4.22: Occupational Pattern and Income Profile of Affected Households

Item	Description	Number of HHs	% of total
Occupation of HHs	Cultivator-1:	67	5.14
	Agricultural Labour	112	8.60
	Daily Wage Earner	120	9.21
	Salaried	295	22.64
	Business	485	37.22
	Other	224	17.19
	Total	**1303**	**100**
Family Monthly Income	>5000	65	4.99
	5001-10000	196	15.04
	10001-15000	521	39.98
	15001-20000	391	30.01
	<20000	130	9.98
	Total	**1303**	**100**
Source: Census Survey, October 2019			

4.4.9 Vulnerable Group

Vulnerable families constitute that percentage of the population which is denied the opportunity to fully explore and utilize its abilities and thus enjoy a quality of life. These people are left behind in today's advancing economy and need special attention and care. Thus, below poverty line (BPL), women headed household (WHH), schedule caste (SC), schedule tribes (ST), Divyang (disabled) are considered in vulnerable groups.

As regards vulnerability among PAFs, out of 1303 PAH's, 426 belongs to vulnerable category which include 173 women headed households, 179 families Scheduled Castes, 9 Scheduled Tribes and 65 families belonging below the line of poverty (BPL). The details of the vulnerable category are given in **Table 4.23.**

Table 4.23: Vulnerable Category Along the Road

Type of vulnerable groups	**Number for Total Length**	**% of Total impacted Families**	**Number for Pkg-I** (from Existing km 141 to km 184.758)	**Number for Pkg-II(**from Existing km 184.758 to km 217.014)	**Number for Pkg-III**(from Existing km 217.014 to km 265.550)
Woman Household	173	40.61	144	13	16
SC	179	41.02	138	18	23
ST	9	2.11	6	1	2
BPL	65	15.26	30	20	15
Total	**426**	**100.00**	**318**	**52**	**56**
Source; Census Survey, October 2019					

4.4.10 Conclusion

The census survey analysis of the project affected persons reveals their dependency on the project corridor. This dependency is either in the form of place for residence, for livelihood generation or for transportation. Affected people shall be consulted at every stage of the project planning and implementation. Their worries and suggestions shall be taken into account and the negative impacts shall be mitigated. The social impact management measures shall be implemented during the various stages of the project viz. Pre-construction Stage, Construction Stage and Operational Stage. During the Census surveys and public meetings, it was observed that majority of owners of commercial and residential structures in congested market areas have demands for realignments or bypasses. As per the available space, land availability and geometry various realignments have been proposed to reduce the impacts upon houses and live hood. Project Affected households have given views to take minimum land for this road projects, and demands of cash compensation for of impacted structures and acquired land.

4.5 ARCHAEOLOGICAL AND CULTURAL SITES

There is no archaeological, historical or cultural important monuments on either side of the project road within 10 km of project influence area (PIA).

4.6 AGRICULTURE

The agricultural sector of the Himachal Pradesh Economy contributes over 45% to the net state domestic product and nearly the entire population of the state depends directly upon agriculture.

Hamirpur-Mandi Road section is located in the hilly terrains. Wheat, paddy maize, tabaco, vegetable, oilseed, etc, cultivated in the area along the project road.

4.7 INDUSTRIAL DEVELOPMENT

There is no large or medium scale industry along the project road.

CHAPTER 5

POTENTIAL ENVIRONMENTAL IMPACTS

5.1 BACKGROUND

This chapter assesses the nature, type and magnitude of the potential impacts likely on the various relevant physical, biological and cultural environmental components along the Hamirpur-Mandi Section of NH 70. The anticipated impacts due the project could be visualized as follows **(Figure 5.1).** The impacts of the activities proposed as part of the project can occurduring:

- Planning and Design Stage;
- Construction Stage and
- Operation Stage.

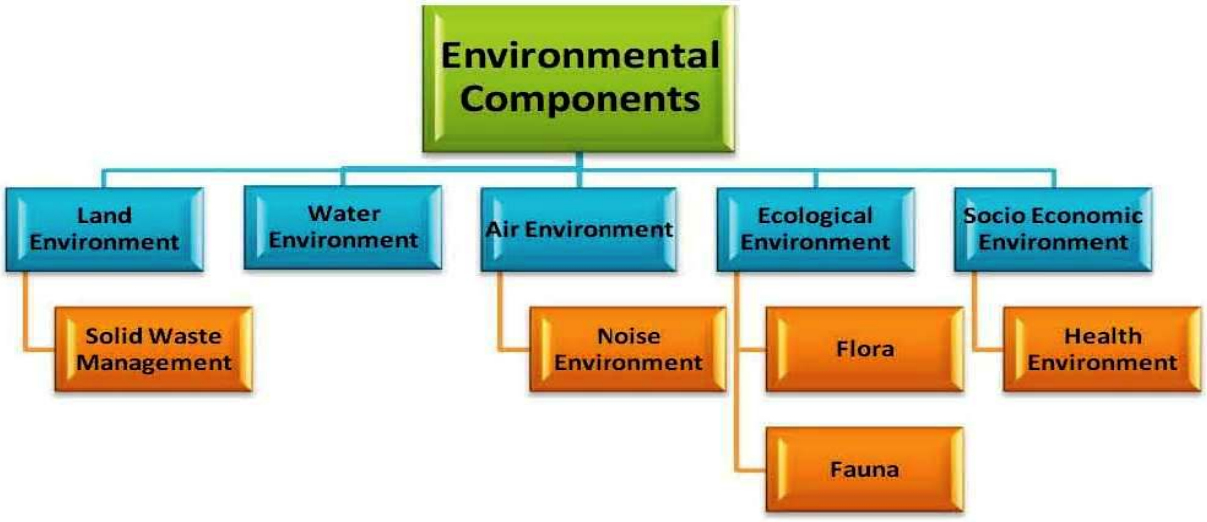


Figure 5.1: Components for Environmental Impact Evaluation

The planning of the proposed project intervention points towards the impacts in the pre-construction, the construction stages and the operation stages. The subsequent sections deal with the prediction of impacts due to the project on the physical, biological and socio & cultural environment **Tables 5.1** and **5.2** below presents the general environmental impacts expected due to the proposed up-gradation of the project road. Environmental impacts have been assessed based on the information collected from the project activities as per DPR, screening & scoping of environmental attributes, and baseline data collected during the EIA study. The quantum of anticipated impacts on physical, biological and socio-economic environment has been discussed in details in subsequent paragraphs.

Table 5.1 : Anticipated Impacts on Physical & Biological Environment

Project Activity	Planning and Design Phase	Pre-construction Phase		Construction Phase					Road Operation
Environmental component Affected		**Removal of Old Structures**	**Removal of trees and vegetation**	**Earth works including and borrow area**	**Laying of pavement**	**Vehicle & Equipment operation & maintenance**	**Asphalt & crusher plants**	**Sanitation & Waste (labour campus)**	**Vehicle operation**
Air		Dust generation during dismantling	Reduced buffering of air pollution, Hotter, drier microclimate along the road	Dust generation	Asphalt odour and emissions	Dust, Pollution	Soot, Odour, gaseous Dust, Pollution	Odour / Smoke from Cooking of food	dust, véhiculer emissions
Land	Impact on productive land if land acquisition required	Generation of debris	Erosion and loss of top soil	Erosion and loss of top soil	Land contamination due to improper disposal of bitumen waste/ solid wastes	Contamination by fuel and lubricants and compaction	Contamination and compaction of soil at camp& Plants	Contamination from Wastes and sewage	--
Water	Impact on Water Sources	Siltation due to loose earth	Siltation due to loose earth	Alteration of drainage, Break in continuity of ditches Siltation, Stagnant water pools in quarries and borrow area.	Reduction of ground water recharge area	Contamination by fuel and lubricants	Contamination by asphalt leakage or fuel	Contamination from wastes and untreated sewage disposal	Spill Contamination by fuel, lubricants and washing of vehicles
Noise		Noise Pollution	High Noise due to machinery	Noise Pollution	Noise pollution	Noise pollution	Noise Pollution	--	Noise from traffic movement

Project Activity	Planning and De-sign Phase	Pre-construction Phase		Construction Phase					Road Operation
Flora	Tree cutting		Loss of Biomass and vegetation cover due to Removal of vegetation	Lowered pro-ductivity loss of ground for vegetation	--		Lower pro-ductivity Use as fuel wood	Felling trees for fuel	Compensatory plantation and road side plantation

Table 5.2: Anticipated Impact on Social and Cultural Environment

Project Activity	Planning and Design Phase	Pre Construction Phase			Construction Phase					Operation	
										Direct	Indirect Induced development
Env. Component Affected	Design decisions & Implementation policies	Land acquisition	Removal of Structures	Removal of trees & vegetation	Earth works including quarrying	Laying of Pavement	Vehicle & machine operation & maintenance	Asphalt & crusher plants	Labour Camps	Vehicle operation	-
Agricultural land	-	Change in land prices	Change in land economic value	Loss of standing crops	Loss of productive land	-	-	Dust on agricultural land reduce n productivity	-	-	Conversion of Agricultural Land
Buildings and built structures in ROW	-	-	Loss of structures, Debris generation, Noise and Air pollution	-	Dust Deposition on structures	-	Noise, vibration may cause damage to structures near to road	Dust accumulation on building and structure	-	Vibration and noise	Change in building use and characteristics
People and Community	mpact on nea by community structure,	-	Impact on people and loss of livelihood	Loss of shade & community tree.	Health hazard to people	Odour and dust	Noise and Air pollution and discomfort	Air and noise pollution and discomfort	Community clashes with migrant labour	Risk of accident due to increase in speed on smooth carriageway	Induced pollution and increase in accident rate
Cultural Assets	-	Impact on access to cultural structure	Displacement loss of structure from RoW	--.	--	-	--	Dust accumulation	-	Damage from vibration & air pollution	-
Utilities and Amenities	-	-	Interruption in supply	-	-	-	Damage to utility and amenities	Dust accumulation on water bodies	Pressure on existing amenities		-

Project Activity	Planning and Design Phase	Pre Construction Phase			Construction Phase					Operation	
										Direct	Indirect Induced development
Labour's Health & Safety	-	-	-	-	Stagnation of water and disease	Asphalt odour and dust	Accident and injuries to labour/public	Impact on health due to inhale of dust	Health hazard from raw sewage disposal /wastes	Road safety issues	-

5.2 ENVIRONMENTAL ISSUES, TO BE CONSIDERED FOR PROJECT ROAD

The main environmental issues, which are important for the upgradation of the project road, to be considered are:

- Cutting of hills and filling of cutting debris valley side and in road construction.

Disposal for surplus hill cutting debris in environmentally sound manner.

- Cutting of trees for the road construction.
- Diversion of forest area for road upgradation,
- Channelization of rain-water from road and Longitudinal & cross drainage
- Likely impact due movement/crossing of road by wildlife Soil erosion /landslidesfrom unstabilized slopes during monsoon season as a result of cutting of hilly especially.
- Stabilization of slopes.
- Impact on existing rainwater structures
- Temporary Health and safety issues during construction of the project road.

Traffic management in hilly area during road construction.
In the project road, avoidance has been taken as the principal means to minimize project impacts, to reduce cost and to avoid delays. Therefore, most of the construction works in this project will be confined to the existing right of way.

During various surveys, consultations and site investigations; a number of environmental issues were identified. Thought process for analyzing various alternatives and effective measures for avoidance and impact mitigation were considered. Positive and negative impact matrix for the project road are given in **Table 5.3.**

Positive and negative impact matrix for the project road are given in **Table 5.4**.

Table 5.3 : Positive and Negative Impact Matrix for project road

S. No.	Aspect	Positive	Negative
1	Land	Paved road with stabilized slopes and embankments	Change in Topography due to construction, Land Aacquisition (LA) accounts for private as well as agriculture land
2	Geology	NA	Drastic Change in Geology due to hill cutting-filling and road widening
3	Soil	with slope stabilization techniques and plantation soil erosion will be controlled	Soil erosion during Construction of road Disposal of surplus earth cuttings/debris
4	Quarries	Cut material will be used mostly, hence saving in material from quarry	No new quarries opened. Indirect impact by obtaining rocks, soil and aggregate materials for road construction.
5	Slope Stability	Slopes will be stabilized by Engineering and Bio-engineering measures	NA
6	Surface water	NA	Surface water sources may be impacted during construction phase if avoidance majors not followed
7	Ground water	NA	Ground water recharge as water harvesting structures is proposed
8	Drainage	Drainage will be improved due to better drainage provisions in project road i.e. 345 Culverts, drains and sub-surface drainage	NA

S. No.	Aspect	Positive	Negative
9	Air Quality	Air quality will be improved due to better road conditions and plantation program	Negative impact due to better road conditions will draw more traffic in the future and temporary impacts due to dust and pollution during construction phase
10	Noise levels	Noise levels will be decreased due to better road conditions and plantation program along the road	Negative impact due to better road conditions will draw more traffic in the future and temporary impacts due to movement of heavy vehicle and machinery during construction phase
11	Flora	Roadside avenue plantation 29600 Nos., Compensatory afforestation 88800 Nos. and plantation for slope stabilization will improve the vegetation cover	Cutting of 29600 no. Roadside trees.
12	Fauna	Appropriately designed Cross drainage structures with sufficuient height as culverts will work as animal crossing pathway.	Impacts during construction stage. Loss of habitation for Avifauna, reptiles etc.
13	Road safety	Abundant Traffic safety measures as Road studs, signages, markings, crash barriers, traffic calming measures etc. will improve road safety	Traffic calming measures will reduce the speed and increase the travel time
14	Socio-economic condition	Positive Impacts on condition of Living of people, better connectivity, employment etc.	NA
15	Transport	Transport will be improved due to better road conditions	NA

S. No.	Aspect	Positive	Negative
16	Industry	Better road conditions and transport will attract more industries in the area	NA
17	Tourism	Better road conditions and transport will attract more tourists in the area	NA

Table 5.4: Summary of Potential Impacts due to Project Road

Sr. No	Parameters	Impact
Negative Impacts		
1	Land Acquisition	45 ha of private land.
2	Construction Water Requirement	260642 KL for civil construction purpose-29872 KL for Drinking and Domestic purpose
3	(i)Natural Spring	40
	(ii)Bowari and Water percolation Tank	5
4	Religious Structures	4 (Partially impacted)
5	Educational Institutions	5 (Partially impacted)
6	Material Requirements	
(i)	Aggregate	775299.65 cum
(ii)	Sand	189225 cum
7	Debris Disposal	11,263 cum
8	Tree cutting	29600
9	Utility Shifting	
i	Electric Pole	332
ii	Telephone Pole	352
iii	Optical fiber Cable	87
iv	Hand Pump	80

Sr. No	Parameters	Impact
v	Over Head Transmission	107
vi	Transformer	27
vii	Water Tap	9
Positive Impact		
10	Enhancement and Landscaping	At bus bays, junction and sensitive receptors
iii	Green belt development	Along the project stretch
11	Cross drainage structure	6 major bridges, 34 minor bridges and 269 culverts.
	New Culverts	6 nos. pipe culverts and 4 nos. box culverts
	Reconstruction	283 nos. pipe culvert, 14 nos. box culverts, 6nos. minor bridge one major bridge.
12	Road safety Measures	
i.	Truck lay Bye	2
ii. i	Bus Shelter	40
iii.	**Signage's**	
iv.	Speed Limit Sign for Speed lesser than 20 Km/h	1030 nos.60 cm circular speed limit lesser than 20 km/h
v.	School Signs	46 nos. 90 com equilateral triangle sign boards at 27 nos. locations.
vi.	Delineators'	15011
vii.	Zebra Crossing	At 4 junctions and at 40 villages
viii.	Stop Lines	At 4 junctions and at 40 villages
ix.	5th kilometre stone	**21**
x.	Ordinary Kilometer stone	**84**
xi.	Hectometer stone	**418**
xiv	Road boundary stone	1046
13	Avenue and Compensatory Plantation	Approx 88800

5.3 LAND ENVIRONMENT

5.3.1 Impact on Topography

Construction Stage

The existing and proposed road alignments are passing through hilly terrain where horizontal and vertical curves are are proposed for improvement and for it cutting of hill side and filling in valley side are required. Approx. 2917129 cum material from hard rock and approx 513170 cum material from marshy soil will be excavated.

During construction stage changes in the local topography will take place due to construction of embankment for improvement of deficient geometry. Construction of cross drainage structures over streams and slope protection works, etc. Maximum Construction material has to be obtained from cutting material obtained from road construction and it will be utilised in embankment construction, however some of best quality aggregates required for bituminous layers shall be taken from nearby Crushers. Hence the project provision considered with minimum impact on topography during construction stage.

Operation Stage

The topography during operation stage having no such impact except material required for maintenance purpose.

There will be some positive impacts as follows:

- More drainage structures will ease/improve the hydrology of the area, and reducing of soil erosion, smooth flow of rain water, avoid road damage due to over flow of rain water which was occurring in present road due to lack of cross drainage structure.
- Vertical geometries improvement leads to better sight distance, safer transportation, and improvement in riding quality will reduce travel time as well as less carbon emission.

Junction design/improvement for better and efficient traffic movement, which enhances safety of road user

5.3.2 Impact on Geology

Construction Stage

Impact on the geological resources will occur from the extraction of materials (granular sub base and aggregates for base courses and bridges). Approx. 2917129 cum material from hard rock and approx 513170 cum material from marshy soil will be excavated. 10.926 km realignment and 11.138 km curve improvement are proposed where slope cutting is required which may be

lead to change the local geology on micro level. The quantity of material required will be used from the cut material obtained. The cutting of hills will impact the geology of the project area. The quantity of material required will be used from the cut material obtained. The cutting of hills will impact the geology of the project area.

Operation Stage

During the operation stage, there will be no anticipated impact on Geology of the area.

5.3.3 Seismicity

(a) Impacts

During Construction

The project will need hill cutting to adjust the carriageway. The project lies in seismic zone IV (IS 1893:2002). Road construction in this area will have impacts on its earthquake susceptibility of the project area.

During Operation

The embankment and structures may be subjected to seismic effect as it lies in the seismic zone IV.

5.3.4 Land Use Impacts

(a) Impacts

Pre - Construction and Construction Stage

There will be major change of land use in terms of hill cutting and construction of road and structures within the proposed corridor of impact. The predominant land use is road side forest. About 59.7059 Ha of forest land will be required to divert which is falling in patches in project stretch. This forest diversion comprised minimum area along the road which also includes existing row of project road except black top. Apart from that, minimum land acquisition is also required to improve the road configuration and geometry.

Operation Stage

In operation stage no impact on land use changes in RoW of project road. However, there may be induced land use changes close to RoW near urban areas.

5.3.5 Impacts on Soil

Design and Construction Phase

A. Loss of Productive Soils

The productivity of the acquired land may lead to destroy in absence of proper mitigation measures. The impacts on soil due to the project will be in form of topsoil erosion. Strengthening

and widening of the existing road will not cause significant soil erosion. Soil pollution would take place to a negligible extent due to spillage of construction material i.e. oil, fuel, grease and asphalt, around the construction yards. Care should be taken to minimise spillages of construction materials.

Loss of productive soil may be taken place at the locations of workers' camps, stockyards, storage godowns etc, during the construction stage in condition. The EMP can ensure that there will be minimum loss soil productivity and minimum soil pollution.

The loss of productive topsoil due to road construction, is a direct adverse long-term impact. Since a major portion of the proposed alignment do not utilize agriculture land, there will be minimum permanent loss of agriculture soil. In addition to this, there will be temporary impact on productive soil at diversions, and labour camp due to leasing of land for construction period. Hence, the impact on soil during construction phase has to be controlled by strictly implementing the EMP suggested for the project.

During the operation phase of the proposed project, no impact on the productive top soil is envisaged.

B. Soil Erosion

The soil in the study area are sandy clay loam. Therefore, the potential of soil erosion is moderate to high particularly in the hilly terrain in the project stretch.

Pre Construction

The soil erosion may take place due to following:

- Site preparation may involve demolition of structures, tree removal, temporary rerouting of utilities. This brings risks of erosion to the exposed ground or stored topsoil.
- Setting up of workers camp along the project road may lead to loss of productive soils and impact the soil productivity especially at micro level.

During Construction

The soil erosion may take place along the project stretch during cutting of hill slopes to accommodate the proposed road configuration and locations of cross drainage structures due to rains.

During Operation

Due to provision of roadside drainage throughout the project stretch and sufficient amount of cross drainage and sub-surface drainage structures, minimal soil erosion is anticipated during operation stage.

C. Contamination of Soil

Pre-Construction Stage

Contamination of soil in the pre-construction stage may be considered as a short-term residual negative impact. Soil contamination may take place due to solid waste contamination from the labor camps set up during pre-construction stage. This impact is significant at locations of construction camps; stockyards, hot mix plants etc. as these will come up in this stage.

Construction Stage

Contamination of soil during construction stage is primarily due to construction and allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Pollution of soil can also occur at hot-mix plants from leakage or spillage of asphalt or bitumen. Refuse and solid waste from labor camps can also contaminate the soil. Contamination of soil during construction might be a major long-term residual negative impact. Unwarranted disposal of construction spoil and debris will add to soil contamination. This contamination is likely to be carried over to water bodies in case of dumping being done near water body locations.

Operation Stage

During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment, should they occur. These impacts can be long term and irreversible depending upon the extent of spill. However, monitoring of soil quality will be done during construction and operation phase.

D. Compaction of Soil

Pre-Construction Stage

Compaction of soil will occur in the pre-construction phase due to the movement of the construction equipment and machinery and during the setting up of construction camps.

Construction Stage

Movement of vehicles during road construction is the major cause of soil compaction. This impact is direct and will be maximum in the RoW. It is necessary to ensure that there is no adverse impact of soil compaction in areas other than the RoW, where vegetation can grow and rain infiltration will take place.

Operation Stage

During the operation period compaction will be restricted to the carriageway of project road.

5.3.6 Quarries

(a) Impacts

In addition to the cut material re-use in the construction of the road, the quarries used for obtaining rocks, soil and aggregate materials for road construction can cause direct and indirect adverse impacts on the environment. Although the cut operations shall generate ample rock and soil material, it is likely that material from quarries could be needed depending on the appropriateness of the material quality. Quarrying and crushing can have a critical impact especially on the air quality of the area especially in the area downwind to the quarry.

Pre Construction Stage

Existing quarries that are identified by the design team have been recommended for this project and no new quarries have been proposed. The cut material is to be obtained from hill cutting is proposed to be used in different pavement layers and retaining structures based on their suitability after required processing of the same at proposed mobile crushers. Remaining amount of material needed for the construction of the bituminous layers and cross drainage structures will be procured from the existing quarries. As these quarries are already in operation with the requisite environmental clearances and redevelopment plans, no major impacts, which arise in making new quarries operational, are likely.

Construction Stage

A major source of dust during the construction stage is from stone crushing operations from the crusher and the vibrating screen. The dust, in addition to being an eyesore, reduces visibility thereby increasing safety concern. Dust is generated due to procurement and transport of raw materials from quarries to the road construction area. These impacts will persist till the activity ceases.

5.3.7 Cutting of Hills and Generation of Debris/ Wastes from Excavation of Road

During the construction phase, muck/debris will be generated during excavation of road, cutting of ordinary rock and cutting of ordinary rock through blasting. Details debris generation and quantity are given below:

- 513170 cum soil will be generated from excavation process (172564.80 cum from pkg-1, 121313.68 cum from Pkg-2 & 219291.23 cum from pkg-3),
- 1197396 cum waste will be generated from ordinary rock without blasting (402651.20 cum from pkg-1, 283065.24 cum from Pkg-2 & 511679.54 cum from pkg-3), and
- 13205 cum waste will be generated from ordinary rock through blasting. (5435 cum from pkg-1, 3214 cum from Pkg-2 & 4556 cum from pkg-3).

Unplanned disposal of debris/muck and road excavated wastes from the project road will result in adverse environmental impacts on drainage, water bodies, vegetation, etc.

Slope Stability

The widening towards the hill ward side will create new areas of instability; as a result driving would be extremely unsafe with land slide, land slip, mud flow, rock fall etc as major issues especially during the monsoon season. The traffic vibrations also lead to land slips and all other stability issues.

Apart from the unstable areas identified in the baseline section a number of new areas will be developed. This cannot be predicted but will depend on the geological conditions and the vegetation cover, slope angle, and the height of the hill slope.

5.4 WATER ENVIRONMENT

The water environment, which comprises *i.e.* ground water and surface water, may be impacted quantitatively and qualitatively. Anticipated environmental impacts on water resources are expected only in construction phase. These impacts are described below as:

5.4.1 Ground Water

Design and Construction Phase

The project road lies on hilly terrain where ground water use for domestic and other purposes is negligible. Therefore, anticipated environmental impact from proposed road construction is not considerable.

Operation Phase

No environmental impact is ground water resources during operation phase.

5.4.2 Surface Water Bodies

Design and Construction Stage

There are 25 nos. Bowris, 21 nos. rain water percolation well " Khatris", 8 nos. small river/Khad and 44 nos. natural spring crossing**.** Water for domestic & drinking purposes, agriculture and for other purposes is full filled from Bowris & Khatris, natural springs, Nalas, and rivers. During reconstruction/construction of major & minor bridges and culverts over flowing surface water bodies may increase the load of soil sediments, large suspended particles and oil & grease. Degradation of water quality is also possible due to accidental discharges of fuel oil & other waste from drainage/sewage discharge from workers' camps vehicle parking and from fuel storage areas.

Operation Phase

No environmental impact is surface water resources during operation phase.

5.4.3 Drainage Pattern

Construction Phase

The project highway crosses many natural drains and rivers. There may not be permanent change in the drainage pattern except for some temporal changes as such; the surface water flow pattern may be affected insignificantly due to construction work for road widening. There are 8 nos. small river/Khad and 44 nos. natural spring crossing and these water bodies play vital role in maintaining local drainage system. Hence, through adoption of mitigation and control measures 2-laning of the project road is likely to have no significant impact on existing drainage system along the road as culverts and bridges are available at places to drainage system.

Operation Phase

No environmental impact is drainage during operation phase.

5.4.4 Degradation of Water Quality

The water quality of the roadside water sources can be degraded mainly in three ways; a) by addition of pollutants like debris, sewage generation, from construction works, b) Accidental spillage, c) encroaching of water bodies. Of these, addition of pollutants due to construction works will cease on completion of construction activities. However, depending upon the magnitude ground water contamination, the impact may last for significant duration.

Construction Stage

The proposed alignment plan crosses 8 nos. small river/Khad and 44 nos. natural spring and majority of terrain is rolling/hilly so there is possibility of contamination of surface water due to washout of lubricants, grease, fuel oil and washing solvents from temporary construction site and vehicle maintenance sites. Degradation of water quality is also possible due to accidental spoils into watercourses from workers' camps and vehicle parking and/or fuel and lubricant storage tank.

Operation Stage

During the operation stage, there is very low probability of degradation of water quality during normal operations.

5.5 AIR ENVIRONMENT

Present ambient air quality of the surrounding areas along project stretch is good due to mountainous region, in the absence of major source of pollution and low density of human settlement except city area *i.e* Hamirpur, Tyoni Devi, Avah Devi, Dharmpur, Kotli and Mandi. During the construction phase ambient air quality mey be effected for short duration due to generation of emissions of particulate matter from slope cutting, crushing, grinding, mixing and transportation of materials, and gaseous emission from fuel combustion in motor vehicle,

construction equipment and fugitive & stack emissions from crushing, mixing plants and DG sets.

Impacts during construction Phase

Dust Emissions

Preconstruction and Construction Phase

During the construction phase, dust emissions from road under construction in populated and unpopulated areas will be emitted and deposited on the leaves of trees and other vegetation which may affect the growth of the trees and other vegetation. Certain amount of dust and gaseous emissions will be generated during the construction phase from excavation machine and road construction machines. Pollutants of primary concern include particulate matters i.e. PM_{10} and $PM_{2.5}$. However, suspended dust particles matter may be coarse and will be settled within a short distance of construction area. Therefore, impact will be temporary and restricted within the closed vicinity of the construction activities only.

Gaseous emissions include carbon monoxide (CO), unburned hydrocarbons, Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), volatile organic compounds (VOCs) etc. from the hot mix plant/ DG set/ vehicles involved in transportation of materials during road construction.

Generation of dust and particulates

- Site clearance, use of heavy vehicles and machineries, etc.
- Slope cutting for widening of the road.
- Stone crushing operations in the crushers.
- Procurement and transport of raw materials and quarries to construction sites; It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself
- Earthworks;
- Handling and storage of aggregates at the asphalt plants;
- Concrete batching plants and;
- Asphalt mixing plants due to mixing of aggregates with bitumen.

Generation of dust is a critical issue and is likely to have adverse impact on health of workers in quarries, borrow areas and stone crushing units. This is a direct adverse impact, which will last almost throughout the construction stage along the project road.

In addition to air pollution due to activities mentioned above, there will be dust generation due to transport and construction materials storage at the site.

Impacts during Operation Stage

No dust generation is envisaged during the operation stage as project road shall be paved and there will be slope turfing/plantation through Bio-engineering techniques used.

Generation of Exhaust Gases

Pre Construction & Construction Stages

Generation of exhaust gases is likely due to movement of heavy machinery for clearance of the ROW for construction. High levels of SO_2, HC, NO_2 and VOCs are likely from hot mix plant operations. Toxic gases are released through the heating process during bitumen production. Although the impact will be much localized, it can spread downwind direction depending upon the wind speeds.

Ambient air quality monitoring should be carried out during construction phase. If monitored parameters are above the prescribed limit, suitable control measures must be taken out.

The health effects of inhaling particulate matter and gaseous have been widely studied in humans and are given in **Table 5.5**. Because of the size of the particles, they can penetrate the deepest part of the lung.

Table 5.5: Emissions and their Impacts on Human Health and Vegetation (Prediction of Impact on Ambient Air Quality)

Emission of pollutant	Impacts	
	Upon Humans	**Upon vegetations**
Hydrocarbons	Prolonged exposure to hydrocarbons contributes to asthma, liver disease, lung disease, and cancer. Inhaling formaldehyde can cause irritation. It is a major contributor to eye and respiratory irritation, which is caused by photochemical smog.	Ethylene causes injury to the leaves of sensitive plants. Effects are epinasty, chlorosis, curling, and abscission and growth retardation.
CO	Reduces the ability of hemoglobin to carry oxygen to the body tissues. Under acute conditions, it may result in death.	Carbon monoxide does not poison plants since it is rapidly oxidised to form Carbon Dioxide which is used for photosynthesis
NO_2	Nitrogen dioxide damages the cell membranes in the lung tissues and constriction of the lung passages. Edema or a filling of the intercellular spaces with fluid. Eye and nasal irritation and pulmonary discomfort are also common between concentrations between 15 to 25 ppm.	Nitrogen dioxide causes growth retardation and leaf bleaching in plants
Volatile Organic Compounds	Eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system, cancer, allergic skin reaction, dyspnea, fatigue, and dizziness.	The effects are uncontrolled water loss from leaves; leaf wet ability, chlorophyll content, fluorescence, seed production, and photosynthetic efficiency.
CO_2	Asphyxiation, caused by the release of carbon dioxide in a confined or unventilated area. Kidney damage or coma.	Elevated atmospheric carbon dioxide and reduces plant growth.
Ozone	Ozone causes an irritant action in the respiratory tract, cough chest pain, eye irritation, headaches and asthma attacks. Chronic effects include losses in immune system functions, accelerated aging and increased susceptibility to other infections.	Ozone concentrations cause flecks on the upper surfaces, premature aging and suppressed growth, leaf bleaching, necrosis.

Emission of pollutant	Impacts	
	Upon Humans	**Upon vegetations**
SO_2	The health problems related to the mucous membrane and respiratory tract are due to sulfate aerosols. Chronic effects of SO_2 include increased probabilities of bronchitis, "colds" of long duration and suppression of immune system.	SOx produce injury on leaves and plants which is characterized by the killing of marginal or intervention areas of the leaf.
Fugitive Dust	Irritation to the eyes, nose and throat. Respiratory distress, including coughing, difficulty in breathing and chest tightness. Increased severity of bronchitis, asthma and emphysema. Heart attacks and aggravated heart disease. Premature death in individuals with serious lung or heart disease.	Reduced photosynthesis due to reduced light penetration through the leaves. This can cause reduced growth rates and plant vigour. Increased incidence of plant pests and diseases. Dust deposits can act as a medium for the growth of fungal diseases.

Operation Stage

The impacts on air quality will, at any given time depend upon traffic volume/rate of vehicular emission within a given stretch and prevailing meteorological conditions. Excess discharge of exhaust gases can occur due to

(i) Inadequate vehicle maintenance.

(ii) use of adulterated fuel in vehicles

However, both the above reason for deterioration of ambient air quality are not above the preview of project authority. Upgraded/widened road will facilitate smooth flow of traffic and reduce travel time, therefore, fuel combustion will be less and subsequently vehicular emissions will be reduced.

5.5 NOISE ENVIRONMENT

During the construction phase of the road, the major sources of noise pollution are vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself and operation of construction equipment along the project road and at the plants . Mixing, casting and material movement are primary noise generating activities in the yard and will be uniformly distributed over the entire construction period. Construction activities are anticipated to produce noise levels in the range of 80 - 95 dB (A). The construction equipment will have high noise levels, which can affect the personnel operating the machines.

The significance of impact of increased traffic on noise pollution is generally estimated by comparing with the project conditions with Central Pollution Control Board (CPCB) prescribe Noise Quality Standards. The impacts on noise environment differs significantly during construction and operation phase.

Some salient features related to potential noise impact of road development include:

- The road noise impact is severe where road passes though populated areas.
- The range of noise level should be understood in relation to the habitation type also, for example, road noise in industrial areas is not likely to be problematic but at sensitive location like schools and hospitals, its impact may be significant.
- Mitigation of noise in urban areas is rather difficult, especially at the road intersections.
- There are 20 schools, 2 nos. collage, one NIT, 3 nos. hospitals, one hostel, 35 nos. temples and one Shamshanghat as per social survey along the road.

5.5.1 Design and Construction Phase

Noise levels during the pre construction stage are mostly expected to be indicative of prevalent baseline levels apart from localized noise levels at locations where pre construction stage activities are taking place such as establishment of workers camps, stockyards. These increased noise levels will prevail only for a short duration during the pre-construction stage. Moreover, as these activities are not likely to be placed near settlement the increased noise impact is bound to be negligible.

During construction, the major sources for noise pollution will be movement of vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. Crushing plants, asphalt production plants, movement of heavy vehicles, loading, transportation and unloading of construction materials produce significant noise during construction stage. The construction equipment with high noise levels, the noise generated during excavation, loading and transportation of material near the borrow areas will affect the construction personnel and other humans in the area.

The typical noise levels associated with the various construction activities and the various construction equipments are presented in **Table 5.6.**

Table 5.6: Typical Noise Levels of Principal Construction Equipment

Equipment	Noise levels
Tractor-scraper	93 dB
Rock drill	87 dB
Un-muffled concrete breaker	85 dB
Large rotary diesel compressor	80 dB
$1^{1/2}$ tonne dumper truck Diesel	75 dB
concrete mixer	75 dB

Source: The Noise Pollution (Regulation and Control) Rules, 2000

Though the noise levels presented for the various construction activities far exceed the permissible standards, it is important to note that the construction noise is generally intermittent and depends on the type of operation, location and function of the equipment.

During the construction phase, the noise level is bound to increase by the use of construction machines and generators. The increased level is expected to be between 10 - 20 %. However, these noise levels will be temporary in nature mostly during daytime only.

For an approximate estimation of dispersion of noise in the ambient air, a standard mathematical model for sound wave propagation is used. Sound pressure level generated by noise sources decreases with increasing distance from the source due to wave divergence. An additional decrease in sound pressure level from the source is expected due to atmospheric effect or its interaction with objects in the transmission path.

Operation Stage

The Noise levels in the project influence area during operation phase are expected to increase slightly as the project road traffic will significantly increase with road users. Though, the noise generated by vehicles will be decreased due to improved road (Roughness) & vehicle conditions.

Operation Stage Noise Modeling

The prediction of noise levels has been made for the horizon years 2010, 2020 and 2030 using the FHWA Transport Noise Model. The Highway Noise Model presented below is based upon calculating the hourly Leq for all category-wise vehicles separately and then adding these logarithmically to obtain the overall hourly Leq as follows:

Leq (hi) = Loei + 10log[Ni/(SiT)] + 10log[(15/D)*(1+ □1)]3 + □s

Where,

Leq (hi) Equivalent noise level at the hour (hi) for vehicle type (i)

Loei Reference means energy level for (ith) vehicle type

Ni Number of vehicles of (ith) class passing in time (T) one Hour (1 hour)

Si Average Speed of vehicles of (ith) class (kmph)

T Time duration corresponding to Ni, one hour

D Perpendicular distance in (m) from centreline of the traffic lane to observer

- Factor relating to absorption characteristics of the ground cover between roadway and observer (to be conservative, this is taken as O in actual modelling, but considered qualitatively in the final analysis)
- S: Shielding factor for barrier (to be conservative, this is taken as O in actual modelling, but considered qualitatively in the final analysis).

The combined effect of all the vehicle categories can be determined at the receptor by adding the individual values using the following equation.

Leq(h,total) = log10 □□10 Leq(hi/10)

Reference Noise Levels

The vehicular noise emission levels significantly vary with vehicle speed. It is therefore necessary that speed dependency of noise emissions for various categories of vehicles is taken into account while using the model for noise prediction due to the roadway. In this work the speed-noise relations presented by National Environmental Engineering Research Institute (NEERI) in their report on Environmental and Social Assessment Delhi - NOIDA Bridge Project has been adopted given in **Table 5.7**.

Table 5.7: Speed-Noise Relationships for Various Motor Vehicles

Speed (kmph)	Cars (db(A)	Trucks & Buses (db(A)	2/3 Wheelers (db(A)
30	56.0	73.0	58.0
40	59.0	76.0	61.0
50	63.0	80.0	66.0
60	68.0	81.0	68.0
70	68.0	81.5	70.0
80	70.0	82.0	72.0
90	72.0	83.0	74.0
100	74.0	83.5	76.0

Traffic Volumes and Speed

The projected hourly data category wise has been used. Different operative speeds have been used for various horizon years in the design life to get a realistic picture of the noise levels. Predicted noise level at noise monitoring are given in **Table 5.8.**

Table 5.8: Predicted Noise Levels along Project Road Alignment

S.No.	Locations	Category of Area	Monitored Noise level dB (A) 2014		Predicted Noise level dB(A) 2024		Predicted Noise level dB(A) 2034	
			Day	Night	Day	Night	Day	Night
1	Mandi at Km 264	Residential	*61*	17	61.4	17.1	61.6	17.2
2	Kotli at Km 242.57	Commercial	75	21	75.4	21.1	75.8	21.2
3	Kulhar at Km 215	Residential cum Commercial	64	18	64.3	18.1	64.9	18.3
4	Shiv Dawala at Km 194	Residential cum Commercial	70	22	70.7	22.2	70.9	22.3
5	Rakoh Bus Stop at Km 172	Residential cum Commercial	68	20	68.2	20.1	69.0	20.3
6	Tyoni Devi at km 172	Commercial	72	21	72.2	21.2	72.8	22.0
7	Mandi at km 141	Commercial	*82*	26	82.4	26.2	82.9	26.4

Day and night values in Residential and Commercial areas are exceeding the limits because of frequent honking due to traffic congestion at intersections and narrow streets in the residential areas. These increased noise levels will prevail only for short duration and are temporary in nature.

5.6 BIOLOGICAL ENVIRONMENT

During the design and construction of the project road, the following impacts are anticipated :

A. Impact on Trees

For upgradation of the project road, 29600 trees are likely to be felled, however cutting of trees will be linear, there adverse impact will be minimum. The loss of trees and ground cover during the construction phase, is likely to produce some negative impacts over the population of avi-fauna and insects. The micro-ecosystems supported by the trees are also a point of environmental concern.

B. Impact on Forest

For upgradation of the project road, diversion of 59.7059 ha forest land for non-forest propose will be required. The forest land requirement for the subproject is linear up to 8 to 18 meters from edge of existing carriage. Therefore, no natural habitat adjacent forest areas due to proximity to highway will be affected. Hence, loss of any natural habitat is not likely due to diversion of 59.7059 ha forest land in linear form. Prior forest clearance will be obtained for diversion of forest land for the project road. Prior forest clearance will be obtained from Ministry of Environment, Forest and Climate Change (MOEF&CC) for diversion of 59.7059 ha forest land for the project road and conditions imposed in forest clearance will be complied.

- Reptiles and mammals may face problem to cross the road during operation phase.

C. Protected Areas and Fauna -Impacts

Since there are no protected wildlife areas such as wildlife sanctuaries, National parks etc falling within the PIA, no such impacts are foreseen due to the project. Survey was carried out in 10 km radius of the proposed road project. The ground studies along the alignment, together with Forest Department consultation have revealed that some wild mammalian species such as Leopard near the study area may be found on rare occasions, however during local people consultation at site no such wild animal was seen, while livestock of local people i.e. goat, sheep, cow etc and common animals as field mouse, Squirrel, Hare, dog, cat, bats, monkeys etc. are significantly using the area.

Impacts of the Project on Wildlife Crossings Both During the Construction And Operational Stages

Leopards are observed occasionally at locations along the project road. There is no fix seasons or times for crossing of Leopards at such locations. Minor bridges and culverts proposed in the subproject will provide free movement for leopards and other wild animals. The subproject will be upgraded to two lane undivided carriageway in mountainous terrain, which has low volume of traffic. Therefore, crossing of project road by wild animal is not likely to create any problem in crossing the road by leopard or any other wild animal. Further, signages will be provided on such locations to alert divers and road users about occurrence of wildlife at identified locations. During construction phase, construction work will be carried out during day time only.

Operation Phase

During the operation phase, no adverse impact is anticipated on the flora and fauna of the area except some animal accidents due to vehicle light at night time. Plantation along the road on available space will enhance vegetation in the area. Monitoring of survival of trees should be done at regular interval and suitable mitigation measures should be taken to protect the trees.

5.7 SOCIO-ECONOMIC AND HEALTH IMPACTS

Detailed socio-economic study of project road has been carried out for the project road. The overall objective of the study is to assess the adverse social impacts of the project road on property and life of people and also prepare a time bound action plan to assist the project affected persons (PAPs) in getting their entitlements (compensation - for affected land, structure and other properties and assets, and R&R assistances to enable them in improving or at least restoring their living standards and income earning capacity.

The specific objectives of the study are as under:

- Collect information using suitable tools regarding project impacts;
- Differentiate the properties and assets likely to be affected by type of ownership and construction, etc;
- Assess the extent of loss of properties (land, structure and others) of individual as well as that of community and loss of livelihood;
- Establish a baseline profile of population, social structure, employment, sources of income, access to social services and facilities, etc.

The impact of construction and its potential might vary in magnitude from individual to individual or family to family. The impacts of the project road on the socio-economic environment are systematically discussed under the following categories:

- Acquisition of land and structures;
- Resettlement of people within the corridor-of-impact;
- Relocation of community structures within the corridor-of-impact;
- Influx of construction workers;
- Economic impacts.

Detailed social impact assessment of project road has been carried out. A separate social impact assessment and resettlement action plan have been prepared.

The findings of the social impact assessment (SIA) study are given below:

5.7.1 Impact on Land and Private Properties

For the project road, total 45 ha land will be acquired for widening, curve improvements and realignments. Total number of 1366 structures will be affected due to the upgradation and widening project road.

5.7.2 Impact on Property

Individual and common properties likely to be affected as a result of upgradation and widening the project are given in **Table 5.9.** Geometric adjustments have been made to minimize the loss to any such facilities. Any such structures even falling within ROW but out of required formation

width have been saved. Alternate access has to be provided to these structures during construction stage. All community structures likely to be dismantled shall be suitably relocated before starting the construction.

Table 5.9 - Structures likely to be affected

Sr. No	Impacts	Numbers
1.	Religious structures	04
2.	Common property resources (CPRs)	2
3.	School	5
4.	Families to be affected	461
5.	Water Bowries	5

Source: Theme Social Survey 2019

5.7.3 Impacts of Construction Workers Camps and Immigration

During the construction phase of the project road, construction worker will be engaged in construction activities. A major number of skilled and unskilled workers will be from local area.

Construction stage

Although the construction contractors are likely to use unskilled labour drawn from local communities, use of specialized road building equipment will require trained personnel not likely to be found locally. Sudden and relatively short-lived influxes of construction workers to communities along road will not have the potential to 'skew' certain demographic variables and the traditional social coherence of towns and villages.

It is anticipated that the construction labour inputs for the construction works will be in the order of about 160-200 persons per day. However, this number will fluctuate, and the number of worker on any particular day will be higher or lower.

The construction workforce will be made up of the following groups:

- Supervision, specialist and administrative personnel, normally about 50 per cent of the workforce-the contractor would probably arrange local accommodation using boarding houses or rented houses.
- Skilled workers, normally about 25 per cent of the workforce - the contractor will probably establish a construction camp for the skilled workers.
- Unskilled workers, normally about 75 per cent of the workforce – contractors normally recruit these workers locally and do not need to provide accommodation.

- The contract documents will require the contractor to obtain all necessary approvals before building a construction camp.

5.7.4 Economic Impacts

Construction Stage

The relatively short-lived economic impacts of the construction stage are likely to be experienced in local communities for the duration of construction as workers will make everyday purchases from local traders. This is likely to give a short-lived stimulus to these traders that will disappear as soon as the construction is complete. Wider, flow-on economic impacts will be experienced in other sectors of economy as a result of purchase of construction materials and the payment of wages and salaries.

Operation Stage

Once the upgrading is complete, there is likely to be some long-term changes in the economic structures of the urban and rural areas served by the road. During the operation phase, transportation and traffic will be increased and selling of local products will be also increased.

5.7.5 Human Health and Safety

Pre-construction Stage

Pre-construction stage activities including site clearances and movement of heavy vehicles & machinery along with transport of earth in trucks is likely to have negative impacts on the health of the people coming in contact with dust and exhausts generated by such activities. Concerns regarding the safety of people due to accidents also arise but are limited. Occupational health & safety manual shall be prepared by the Contractor taking into consideration the OH&S risks.

Construction Stage

The general mobility of both local residents and their livestock in and around the construction area is likely to be hindered. Unmonitored construction activities like dismantling of structures, cutting of trees, haulage material obstruction vision, spillages of lubricants, on road making it slippery may create an accident risk for local residents, particularly to children. Traffic detours are also likely to have an impact on the safety of the vehicular traffic as improve signage during night time may result in accidents, especially for fast moving vehicles. Some of the OH&S risks identified are:

- Working at heights
- Deep excavations
- Falling of rocks/boulders
- Moving equipments/heavy machineries
- Materials handling
- Excessive noise
- Electrical incidents
- Slipping & Tripping

Operation Stage

Improvements in geometric design and increase in sight distances would result in increase of allowable traffic speeds. High speeding vehicles are a cause for concern and the impact is likely to increase due to the project, especially for the children, domesticated animals, market commuters along the highway fringe and people visiting the temples and religious places along the highway fringe. Separate lanes for traffic will potentially minimize the risk of collisions between vehicular traffic traveling at higher speeds. The improved roads on the other hand will increase accessibility to local and regional health centers and other community support facilities. Due to the project, pedestrians and school children may get inconvenience to cross the road.

CHAPTER - 6

ANALYSIS OF ALTERNATIVES

6.1 GENERAL

Analysis of alternatives involves a systematic study of the possible future conditions in the project area in response to a set of alignment alternatives without the project. The mandate of the current project is to widen the existing road to 2 lanes with provision of paved shoulder in the build-up sections and hence there is no alternative site is involved. However, the chapter discusses on the “With” and “Without” project scenarios. The methodology that has been adopted for the evaluation of the alternate alignment route for construction of Project Road and the selection is based on engineering, economic, environmental and social considerations have been highlighted. The minimization of environmental impacts by considering design alternatives determines the extent of mainstreaming of the environmental component. This chapter looks at the decisions made during the project when alternatives were available and describes the rationale behind each decision. The EIA study with EMP and without EMP has also been discussed in the context of Hamirpur-Mandi Project.

6.2 WITH AND WITHOUT PROJECT SCENARIO

The “with” and “without” project scenarios are analyzed with respect to the development of the state by the back-drop of requirement of reliable quality infrastructure for sustained growth economy and consequent well-being of its citizens. The comparison of both the scenario is presented at **Table 6.1 and Table 6.2.**

Base on analysis of “with” and “without” project scenario presented at **Table 6.1**, “with” project scenario, with its minor adverse impacts is more acceptable than the “without” project scenario which would mean an aggravation of the existing problems. The potential benefits of the proposed road improvements are substantial and far-reaching both in terms of the geographical spread and time. Hence, it is clear that the implementation of the project will have definite advantage to area in development of its economy and progress for its people.

Therefore, “With” project scenario, with its minor adverse impacts is more acceptable than the “Without” project scenario which would mean an aggravation of the existing problems. The potential benefits of the proposed road improvements are substantial and far-reaching both in terms of the geographical spread and time. Hence, it is clear that the implementation of the project will be a definite advantage to State of Himachal Pradesh in order to achieve all-round development of its economy and progress of its people.

By looking at the **Table 6.1** it can be concluded that “With” project scenario positive/beneficial impacts will improve the environment and enhance social and economic development of the region compared to the “Without” project scenario, which

will further deteriorate the present environmental setup and quality of life. Hence the "With" project scenario with minor reversible impacts is an acceptable option than the "Without" project scenario. The implementation of the project therefore will be definitely advantageous to achieve the all – round development of the economy and progress of the region.

Impacts on vegetation are expected during construction phase. Little increase in the pollution levels of the air is possible. Dust and particulate matter during construction will affect the air quality on a short-term basis. However, an important benefit which is not represented in this assessment will be major reduction in the Particulate Matter (PM_{10} and $PM_{2.5}$) levels from vehicles using a surfaced road (with project scenario) in the build condition, compared to a continued use of dusty unsurfaced/tracks (without project scenarios).

This project will reduce the travel time substantially. In addition this project road will provide further other benefits like:

- Fast and safe connectivity resulting in saving in fuel, travel time and Total Transportation cost to the society;
- Employment opportunities to local people during road construction;
- Development of local industries, agriculture and handicrafts;
- Development of tourism and pilgrimage;
- Transporting, processing and marketing of agricultural products;
- Reduction in accidents;
- Reduction in pollution;
- Opening of opportunities for new occupations;
- Better approach to medical & educational services and quick transportation of perishable goods like fruits, vegetables and dairy products; and
- Improved quality of life for people and so on

However, there would be an increase in the vehicular pollution-air and noise, in the vicinity of the highway. This road construction will result in loss of private properties and loss of living.

If the project is not implemented, there is likelihood that the roads presently carrying the traffic between Hamirpur and Mandi will deteriorate further and rampant traffic disruptions will hinder the free flow of the traffic. Increased air pollution, due to slow moving traffic and congestion, will follow suit. Noise levels in built up portions will rise due to deterioration of the pavement as well as increased honking.

6.3 ALTERNATIVE ANALYSIS FOR USE OF ALTERNATIVE CONSTRUCTION MATERIALS.

Green highway approach has been adopted for the project road by which use of construction materials such as aggregate and borrow soil has been minimized. The summary of cutting material, its reuse and material savings is shown in the **Table 6.2**,

Resource efficiency as per green highway concept for the project road is given in **Table 6.3.**

6.4 SAFETY ASPECTS

While assessing the impacts, safety of the road users and the roadside communities has been found to be a major concern. A number of measures have been proposed to reduce the risk of traffic accidents. In some places, these safety measures are co-terminus with the project's impact minimization measures. Horizontal profile correction and intersection improvement has been suggested for betterment of the project corridor. Other safety measures taken are (Nos. of items provided in chapter 4):

- Improvement of existing curves,
- Improvement of existing Curve at bridge approaches.
- Provision of adequate traffic signage,
- Widening of bridge with footpath in built-up location,
- Embankment protection in approaches to bridge,
- Foot path and pedestrian guard rails in built up zone,
- Improvement of existing highway junction
- Retro-reflective painting on roadside plantations.

The project road having a total length of 124 Km is majorly passing through mountainous and steep terrain. The existing alignment is deficient in geometry with horizontal curves and vertical gradient at places which is proposed to be improved. Hence, due to presence of steep terrain, availability of limited land and involvement of huge amount of cutting of rocks provision of any further realignment and bypass is not feasible. Also, provision of this will lead to heavy amount of land acquisition and increased project cost.

Table 6.1: With and Without Project Scenario

Sr. No	Parameters	Without Project Impacts		With Project Impacts	
		Positive	Negative	Positive	Negative
1.	All weather Accessibility	-	Due to improper line drains, damage and blockage of CD structures, poor slope stability and blockage of road during monsoon season.	• Road drainage and CD structures will be improved. • Road will be accessible throughout year since drainage will be improved along all sections.	
2.	Road Safety/ Accident rate	-	Road safety measures like sign boards, road width, crash barrier, Parapet walls, vehicle crossing space etc. are improper as compared to requirement. Vehicle accident data of existing data are provided in **Table 2.16 of Ch-2.**	**For the road safety, following measures are proposed:** • 1030 nos. speed limit boards near the locations of habitations, education institutions, hospitals etc. • 80 nos. octagon sign boards (Stop Boards) at the locations of major & minor junctions and villages. • 22.800 km long W metal crash barrier. • 840 sq. m Zebra crossing near the locations of junctions, bus bays, truck lay byes and villages. • 956 sq.m. hazard making at culverts. • 31430 sq.m. edge line making. • 12 nos. over head sign board	

Sr. No	Parameters	Without Project Impacts		With Project Impacts	
		Positive	Negative	Positive	Negative
				for truss and vertical support, and 8 for toll plaza. • 15011 nos. delineators • 5729 cats eye at curves and 4403 on road edges. . • Realignments at 25 locations and curve improvement at 89 locations • Improvement in road geometry and pavement conditions.	
3.	Transportation/ vehicle maintenance /operating cost	–	Operating and maintenance cost of vehicles running on the exist road is very high due to very bad pavement condition. More wear & tear because of frequent application of sudden brakes.	Operating and maintenance cost of vehicles will significantly reduce with smooth road and more comfortable driving at critical sections due to section improvement.	
4.	Travel time / increased speed	-	Travel time is more due to poor road geometry and traffic conjunction at market areas viz. Tauni Devi, Awah Devi, Sarkaghat, Kotli, Dharmpur, Balahar and Panjethi.	Reduction in travel time and speed will increase.	
5.	Change in Land use pattern	Area proposed to be diverted for realignment and curve improvement, is under agriculture, open & forest land.	–	–	Minor change in land use pattern will take place at realignment and curve improvement locations.

Sr. No	Parameters	Without Project Impacts		With Project Impacts	
		Positive	Negative	Positive	Negative
6.	Loss of property and livelihood		There are various markets along the road.	Project may provide job/ livelihood opportunities to people through commercial establishment in area due to good connectivity with other cities and towns.	Approx 121 nos. CPR, 1366 nos. structures will be affected widening, and curve improvement and realignment.
7.	Change in Environmental quality during construction	–	High noise level, high emission of particulate matter & gaseous pollutants due to slow speed of vehicles/traffic congestion and poor road surface.	–	**1.** Temporary degradation of air quality due to emission from hot mix plant, stone crusher, generator and other machinery during construction. **2.** Machinery will cause noise pollution **3.** Construction spills, wastes, degraded materials will cause deterioration of soil quality and surface water.
8.	Change in the Environmental quality after construction	–	Deterioration of air quality through dust, gasses and noise pollution because of vehicles speed and congestions.	Less Noise pollution because of ease in congestion and diversion of traffic through bypass.	-
9.	Loss of vegetative cover	–		Losses of 59.7059 ha forest area and 29600 trees in the corridor of Impact.	Compensatory plantation will enhance vegetative cover of area after 3-4 years.

Sr. No	Parameters	Without Project Impacts		With Project Impacts	
		Positive	Negative	Positive	Negative
10.	Access to basic facilities such as Markets, schools, Hospitals etc.	–	Difficulty in accessing the basic facilities due to hilly terrain and insufficient safety measures.	Easy access to basic facilities due to fine road and road safety measures.	
11.	Employment opportunities & local economy growth.	–	Very limited business opportunities. Very poor economic condition of local public due to hilly terrain and insufficient safety measures.	More business opportunities will be create and life style will be improved due to well connectivity with major cities like Mandi, Una, Dharmpur, Jogindra Nagar, Kullu, Manali, Dharmshala, Jalander, Chandigarh etc.	-
12.	Others (Fuel consumption, Tourism, Prostitution)	–	Increase in fuel consumption, dust pollution because of rough road	1. Fuel consumption will be reduced due to smooth road 2. Tourism opportunity may be developed at Hamirpur, Tauni Devi, Awah Devi, Dharmpur, Dharmshala, Mandi etc.	Prostitution can take place in case of tourism as economic condition of most of inhabitants is very poor.

Table 6.2: Resource Efficiency as per Green Highway Concept

Pavement Layer	Material	As per Conventional Method		As per New Green Method		Material Saving, cum	Density of Material in Ton/cum	Material Saving, Ton	Lead Distance in KM	
		Average Thickness in mm	Quantity in cum	Average Thickness in mm	Quantity in cum					
Pkg-1										
Embankment	**Earth**	480 mm	266022	480 mm	266022	-				
Subgrade	**Earth**	125 mm	57326	125 mm	57326	-				

GSB	**Aggregate**	150 mm	76511	150 mm	45906	30604	2.1	64269	25	
	Water	KL	4591	KL	4591					
WMM	**Aggregate type 1 (2.36 mm to 75 micron @ 30%)**	250 mm	81442	250 mm	52937	28505	2.2	62710	25	
	Water	KL	6515	KL	6515					
DBM	**Aggregate type 1**	70 mm	22397	70 mm	14558	7839	2.4	18813	25	
	Filler @ 2% of weight of aggregates.	tons	686	tons	446	240				
	Bitumen	tons	2342	tons	2225	117			433	
BC	**Aggregate type 1**	40 mm	13947	40 mm	13947	0	2.4	0	25	
	Aggregate type 2 or stone									
	Filler @ 2% of weight of aggregates.	tons	427	tons	427	0				
	Bitumen	tons	1765	tons	1755	10			433	
	Plastic Waste					10	-10			
Total road Cost in crore				**70.93**		**53.96**				
Pkg-2										
Embankment	**Earth**	430 mm	114742	430 mm	114742	-				
Subgrade	**Earth**	125 mm	26224	125 mm	26224	-				
GSB	**Aggregate**	150 mm	39826	150 mm	23895	15930	2.1	33454	22.5	
	water	KL	2390	KL	2390	-				
WMM	**Aggregate type 1 (2.36 mm to 75 micron @ 30%)**	250 mm	39471	250 mm	25656	13815	2.2	30392	22.5	
	Water	KL	3158	KL	3158					
DBM	**Aggregate type 1**	70 mm	10810	70 mm	7027	3784	2.4	9080	22.5	
	Aggregate type 2 or stone									
	Filler @ 2% of weight of aggregates.	tons	331	tons	215	116				
	Bitumen	tons	1130	tons	1074	57			453	
BC	**Aggregate type 1**	40 mm	5440	40 mm	5440	0	2.4	0	22.5	

	Aggregate type 2 or stone									
	Filler @ 2% of weight of aggregates.	tons	167	tons	167	0				
	Bitumen	tons	688	tons	684	4			453	
	Plastic Waste					4	-4			
Total road Cost in crore				**33.24**		**24.92**				
Pkg-3										
Embankment	**Earth**	285 mm	154268	285 mm	154268	-				
Subgrade	**Earth**	100 mm	44859	100 mm	44859	-				
GSB	**Aggregate**	150 mm	771710	150 mm	46302	30868	2.1	64823	39	
	Water	KL	4630	KL	4630	0				
WMM	**Aggregate type 1 (2.36 mm to 75 micron @ 30%)**	250 mm	79828	250 mm	51888	27940	2.2	61467	39	
	Water	KL	6386	KL	6386					
DBM	**Aggregate type 1**	70 mm	22139	70 mm	14390	7749	2.4	18597	39	
	Filler @ 2% of weight of aggregates.	tons	678	tons	441	237				
	Bitumen	tons	2315	tons	2199	116			473	
BC	**Aggregate type 1**	40 mm	11109	40 mm	11109	0	2.4	0	39	
	Aggregate type 2 or stone									
	Filler @ 2% of weight of aggregates.	tons	340	tons	340	0				
	Bitumen	tons	1406	tons	1398	8			473	
	Plastic Waste					8	-8			
Total road Cost in crore				**65.99**		**49.15**				

6.5 ANALYSIS OF ALTERNATIVES ALIGNMENT

There are three main routes from Hamirpur to Mandi, which are given below:

A. Hamirpur to Mandi via Tauni Devi, Awah Devi & Dharmpur.

This route flies on existing NH-70 (new no. NH-3) and covers two district (namely Hamirpur and Mandi), six Tehsil (Namely Hamirpur, Bhoranj, Sarkaghat, Dharmpur, Kotli and Mandi) and 97 villages **(Figure 6.1)**. The existing ROW is varied 5.4 to 15 m. This route provides excess to various markets and tourist spots Viz. Tauni Devi, Awah Devi, Dharmpur Sarkaghat and Mandi. Total length of this route is approx 124.0 km and proposed length after realignment & curve improvement it will be approx 104 km. Total land acquisition is approx. 45 ha and required forest land is 59.7059 ha. Total number of affected structures are 1366.

B. Hamirpur to Mandi via Dosarka, Bhareri, Chamdruhi, Dalli, Sarkaghat and Dharmpur.

Sarkaghat to Mandi stretch is overlap on NH70 but Hamirpur to Sarkaghat via Chandruhi is separate. This route passes through two districts (namely Hamirpur and Mandi), seven Tehsil (Namely Hamirpur, Bhoranj, Bamson, Sarkaghat, Dharmpur, Kotli and Mandi) and more than 100 villages. The existing ROW is varied 5 to 10 m except Sarkaghat to Mandi portion where available ROW varied from 5.4 to 15 m. In the Hamirpur to Chamdruhi section, no major pilgrim or tourist spot are exist and more hill cutting is also required as compared to NH-70 route. In this route more structures demolition, more forest and private lands are required as compare to Hamirpur to Sakaghat section via Tauni Devi because available ROW is low and total cost will be also high in comparison to option 1. Hamirpur to Mandi via Dosarka, Bhareri, Jahu, Rawalsar section is given in **Figure 6.2**. Total length of this option is approx. 128 km.

C. Hamirpur to Mandi via Dosarka, Bhareri and Jahu-Rawalsar

Total length of this route option is approx 87 km and it fly over NH103, SH-32 and Rawalsar-Mandi Road **(Figure 6.3)**. Major part of this route (NH-103 and SH-32) is already developed as 2-lane and intermediate lane so there is no need to further development of this route. If this route is taken up than village, markets, Mandies, tourist spots which are connected through NH-70, will not be developed.

After the examination it is concluded that route-1 is more feasible in term of number of benefited people, need of projects, total PCUs, quantity transported goods, number of stations for goods loading/unloading, generation of employments, required land etc.

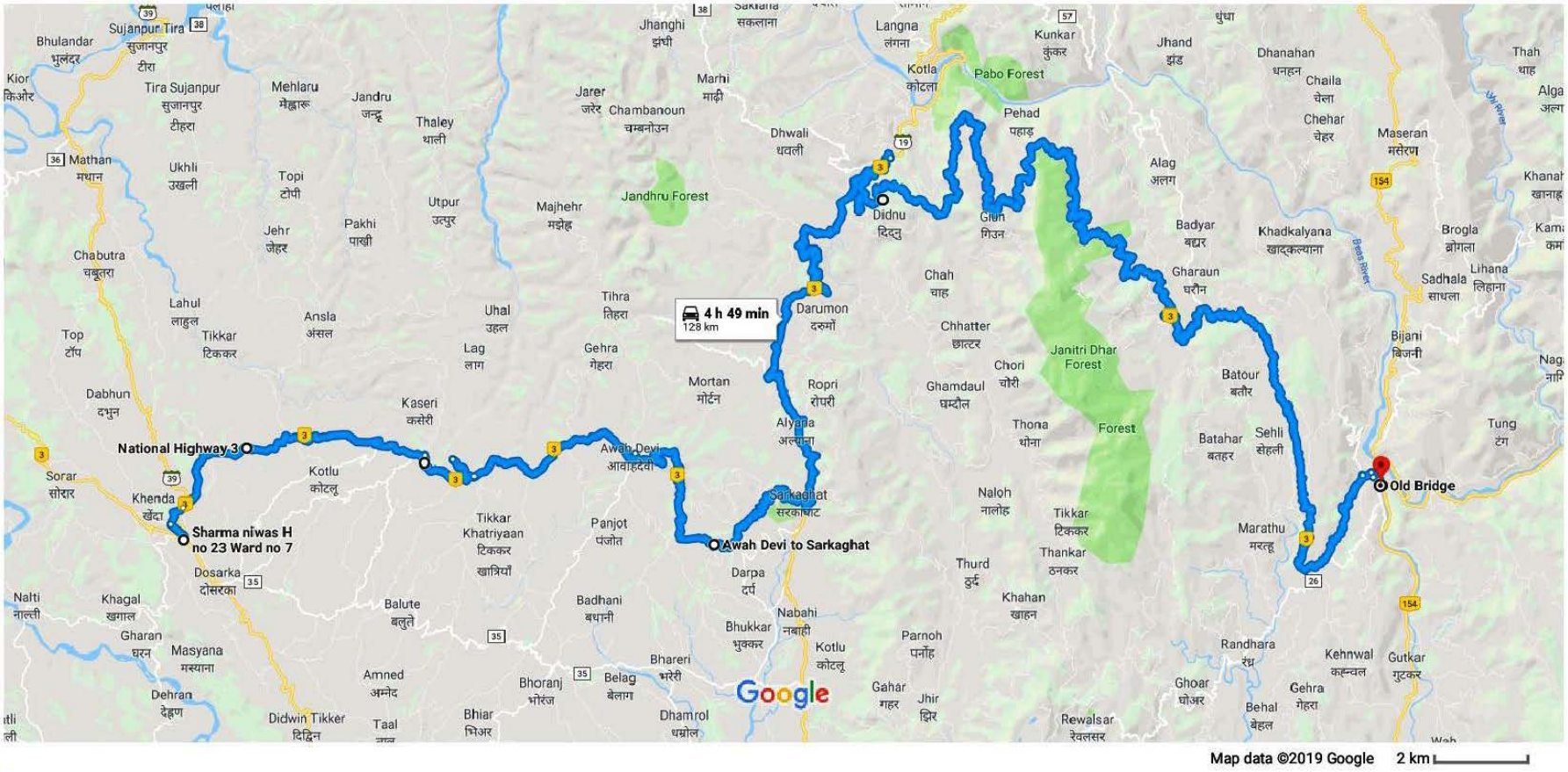


Figure 6.1: Hamirpur to Mandi via Tauni Devi, Awah Devi, Dharmpur.

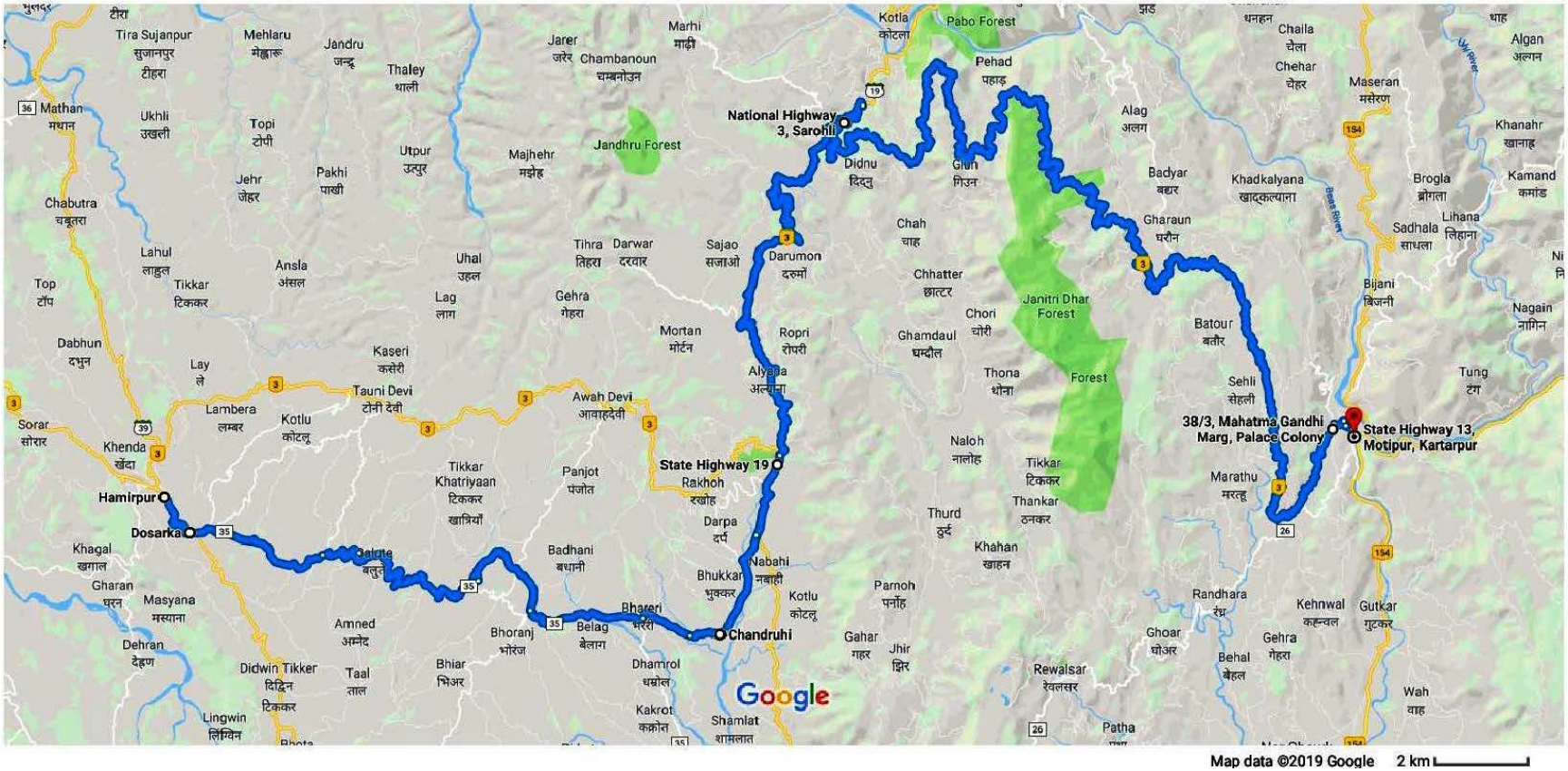


Figure 6.2: Hamirpur to Mandi via Dosarka, Bhareri, Chamdruhi, Dalli, Sarkaghat, Dharmpur.

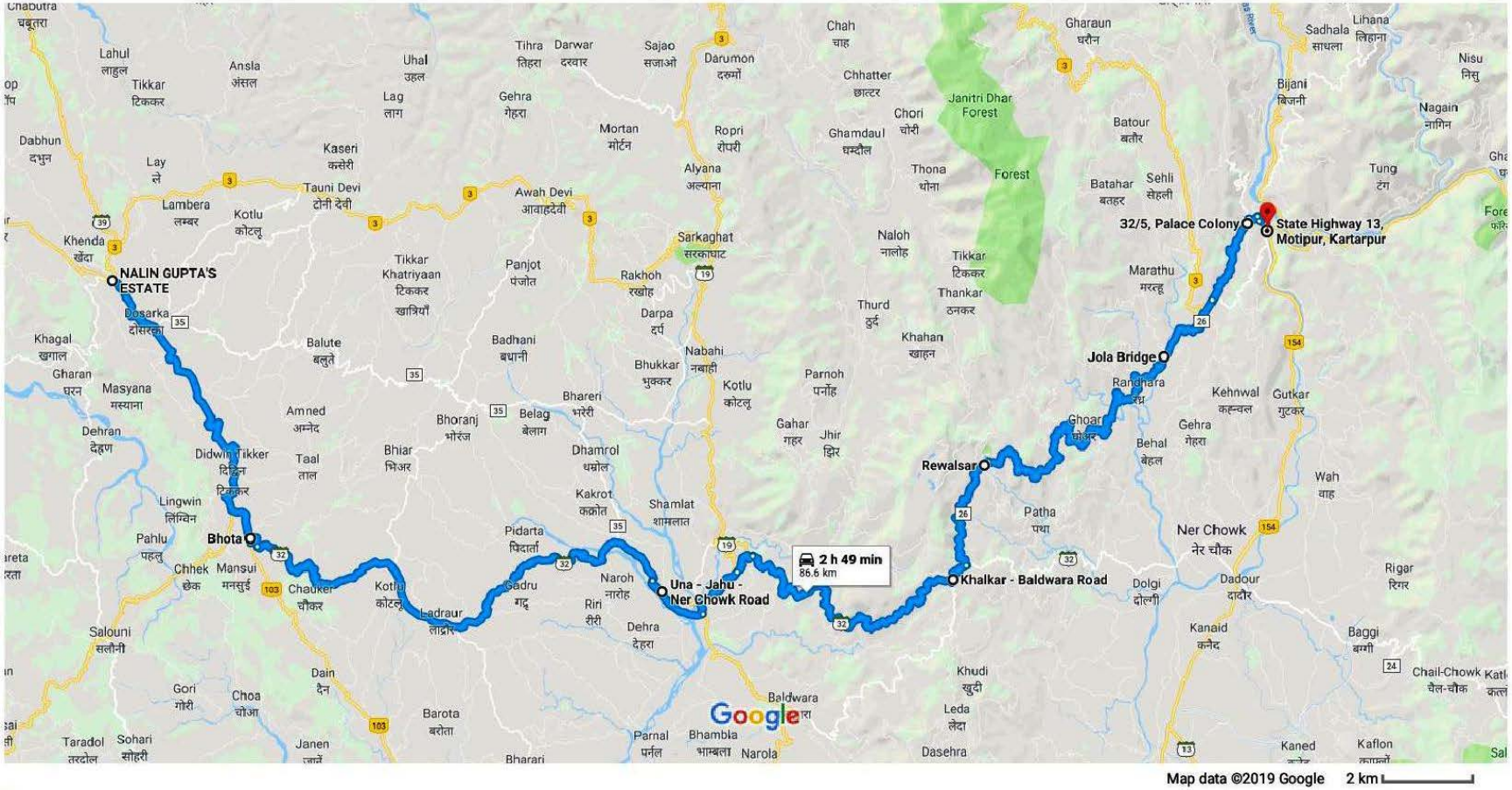


Figure 6.3: Hamirpur to Mandi via Dosarka, Bhareri, Jahu-Rawalsar

6.5.1 Analysis of Alignments for Major Realignments

A total of 25 nos. realignments are proposed to to improve the horizontal geometrics of the project road. Realignments are proposed on the basis of availability of ROW, road geometry, number of structures within required ROW etc. Details of realignment are given in **Annexure 2.4**.

6.6 ALTERNATIVE ANALYSIS FOR SELECTION OF DEBRIS DISPOSAL SITE

Hills cutting material to be dumped obtained from hill cutting after utilizing the same for construction of pavement and structures. Dumping sites have been identified for disposal of debris by keeping in view all the safety measures and standards need to be adopted to serve the purpose.

6.7 ALTERNATIVES CONSIDERED FOR MINIMIZING CUTTING OF SLOPES

Slope/earth retaining structure in the form of gabion wall, breast wall, toe wall, retaining wall and bioengineering measures has been proposed along the project road to ensure slope stability and reduction in soil erosion. This will result into minimization of cutting of slopes and minimum impact on land.

6.8 ALTERNATIVE FOR TREE CUTTING

The road side vegetation is likely to be impacted due to road widening. Total 29600 trees within the ROW were likely to fall.

By minimizing corridor of impact and optimizing widening scheme of the project road. All efforts have been made to reduce numbers of trees likely to be felled.

6.9 MINIMISATION OF DIVERSION OF FOREST LAND

The subproject is in mountainous terrain having one side hill in the form of forest and other side valley. For widening/upgradation of the subproject, diversion of forest area is inevitable. There is no other alternative to avoid forest land requirement. Diversion of 59.7059 ha forest land linearly along the project in the width of 8 to 18 m is required for the project road construction. This forest land diversion requirement has been kept minimum considering formation width for the upgradation/widening of the project road.

CHAPTER-7

CONSULTATION WITH KEY STAKEHOLDERS

7.1 OBJECTIVE OF STAKEHOLDERS CONSULTATIONS

Consultation with various stakeholders is an integral part of the environmental and social impact assessment and management process.

Stakeholder consultations have important role in the planning process for development projects. Globally, the practice of involving communities in the planning process has been recognized as an effective tool for mitigating the negative impacts due to the projects and ensuring its timely completion. The effectiveness of participation and consultation is directly related to the degree of involvement of the affected groups. The project requires detail planning to ensure that likely project affected persons, local community, interested groups, non-governmental organizations, civil society organizations; local government, line departments, etc are consulted regularly at different stages. Point-wise objectives of public consultation are following:

- Informing stakeholders
- Gaining their views, concerns and values
- Taking account of public inputs in decision making
- Influencing project design
- Obtaining local knowledge
- Increasing public confidence
- Improving transparency and accountability in decision-making
- Reducing conflict

Consultations at micro-level (*e.g.* project level along the road) and macro-level (e.g. District/State level institutional consultations) is to help the planners to integrate the short term and long terms requirements of the local, State, regional and National goals in to the planning process. The State, National and regional goals are generally set by the legislations and policies in the various human actions by controlling or limiting the activities in order to reduce and nullify the adverse impact generated by infrastructure projects like roads and highways. The quality of a road design does not limit itself into just the engineering requirements of the product but should integrate the quality assurance in the process, product and services as well. In that process, the benefits accrued due to the project implementation multiply many folds and the general appreciation from all sections of the society would be largely vibrant positive.

In this project, an all-out effort has been made to involve local institutions into the project

preparation/planning process. Although local institutions are the smallest administrative and planning unit that will have to suffer the direct impact due to the air/water/noise pollution and loss of productive land and buildings, accidents and safety issues, these units are largely neglected and rarely consulted.

7.2 DEFINITION OF STAKEHOLDER

A person, group, or organization that has direct or indirect stake in an organization because it can affect or be affected by the organization's actions, objectives, and policies.

Key stakeholders in a business organization include creditors, customers, directors, employees, government (and its agencies), owners (shareholders), suppliers, unions, and the community from which the business draws its resources. Although stake holding is usually self-legitimizing (those who judge themselves to be stakeholders are stakeholder), all stakeholders are not equal and different stakeholders are entitled to different considerations. It is extremely important to involve stakeholders in all phases of the project for two reasons: Firstly, experience shows that their involvement in the project significantly increases your chances of success by building in a self correcting feedback loop; secondly, involving them in project builds confidence and will greatly ease its acceptance in your target audience.

7.3 TYPES/ CATEGORIES OF STAKEHOLDERS

Based on their role towards the project, stakeholders have been categorized into following;

(i) Owners or Project proponent

This is related to the stakeholder who risks their own money in a venture. Whilst they will get a return on their investment, usually in the form of a dividend they have a vested interest in seeing the Organization being successful, to not only guarantee their dividend but also to ensure it grows.

(ii) Government Agencies

Some government departments which will be affected positive or negative or both by proposed road are required to give their inputs to make project successful. These government agencies are Revenue department, Forest Department, Electricity department, Agriculture department, Panchayti-Raj Department, Education department etc.

(iii) Communities

This is very important stakeholder category *i.e.* PAFs/PAP who are being affected directly through land acquisition or their structures removal full or partial. Persons other than PAF/PA but residing in same location are also significant to provide their opinions/ suggestions in terms of project design.

(iv) Non-Governmental Organizations (NGOs)

The non-government organizations which are working in project affected area can be considered as stakeholder.

7.4 DISSEMINATION MATERIAL

During the meetings, the project team usually explains the various components of the project and its implementation, prior to obtaining their concerns and issues, where ever required, consultants has provided a summary of the project as a dissemination material.

7.5 TYPE OF CONSULTATIONS

Various types of consultations so far carried out during the investigations include;

- One to one meetings with affected communities.
- Focus group meetings with a group or section of communities.
- One to one meetings are generally held with a few members of local communities. These consultations sometimes focus on one or more specific issues for example flood problem in a given section of the project road. Wherever possible such type of consultations is generally held with informed people. Informed people are those members of the local communities who in their past had a thorough experience and has geographic, political and general knowledge about the country and requirements of the communities.
- Focus group meetings are usually conducted with a sample section of the community usually with a good representation from the affected communities. Such meetings usually provide substantial information about the community concerns.
- Further stake holder institutions were consulted at project level (e.g. DFOs, Forest Range Officer etc) and also at State level (Wildlife warden, WWF State officer etc).

7.6 FORMAL AND INFORMAL LOCAL CONSULTATIONS

A number of formal and informal consultations have been carried out as a part of the project preparation. Minutes of meetings have been prepared for all important formal meetings. Since meetings with DFOs are crucial to implement the forest regulations, all meetings with DFOs have been minuted. The informal consultations are usually held informally with officials to understand the institutional concerns at a given specific location for example a section of the project road.

7.7 LEVELS OF CONSULTATIONS

The public consultations were carried out at three stages namely screening, feasibility and social impact assessment of the project. Public consultations at screening and feasibility levels were conducted at those locations which could likely have more impacts than other affected areas in the region. SIA consultations were carried out at village and district level.

Types of consultations done with various participants using different tools including, interviews with government officials, individual consultations, key informant interviews, focus group discussion, stakeholder consultations, etc, are presented in **Table 7.1.**

Table 7.1: Types of Consultations

Level	Type	Key Participants
Individual	Local level Consultation	People along the project corridor
Individual	Sample Door to Door Personal Contact	People along the project corridor including those that are impacted directly or indirectly
Settlement	Focus Group Discussions	PAP, women, truckers, weaker sections, agriculturist, school teachers
Institutional	Stake holder Discussion	Line departments

7.8 METHODOLOGY ADOPTED INCLUDING INFORMATION DISSEMINATION

Different techniques of consultation with stakeholders were used during project preparation, viz., in-depth interviews, public meetings, group discussions, Individual Consultations etc. to understand the socio-economic profile of the community and the affected families, structured questionnaires were used and information was collected from the individuals on one-to-one basis. The consultations have also been carried out with special emphasis on the vulnerable groups. The key informants during the project preparation phase included both individuals and groups namely:

- Heads and members of households likely to be affected
- Project affected Persons (PAPs)
- Village and Panchayat, Sarpanch and members
- Local voluntary organizations and NGO
- Government agencies and departments such as local revenue authority (update by including other Govt Department like Forest & Wildlife, Irrigation, Horticulture, etc)
- Other project stakeholders with special focus on PAPs belonging to the vulnerable group.

7.9 SUMMARY OF KEY STAKEHOLDER CONSULTATIONS

For the minimization of adverse impacts on locality, optimum utilization of available resources in sustainable manner, use of local information's about project related issues Stakeholder Consultations was conducted with public, project affected people, various govt. departments, govt. agencies and unions existed in Hamirpur and Mandi districts, and it listed in **Table 7.2** and **Table 7.3.**

Table 7.2: Summary of Stakeholder Consultation

S No.	Date	Place	Issue Raised	Resolution	No of Participants and Photo
1.	**20.09.2018**	**Kotli**	• It was suggested that as this road is through middle of the main market so utmost care should be taken during construction of works. • Speed breakers and installation of solar lights must be proposed in the project proposal. • Public facilities should be developed under project	• Utmost care with safety during construction works and to deal with any arising issue regular consultation with stakeholders will be practiced. • Speed breakers will be built as per IRC guidelines. • Solar lights at require places will be installed as per IRC guidelines.	No of Participants: 22  
2.	**21.09.2018**	**Padchu**	• Gram Pradhan of the village ***Mr Kamlesh Kumar*** suggested that a public ground which is available	• The suggestion was also overwhelmed by the present participants at the meeting. It also feels	No of Participants: 18 nos.

			nearby village can be used as dumping place for debris during construction phase and after construction phase is over it should be leveled and as per requirement such as playing ground, public /individual function or helipad in emergency. • Play ground of G S Sec School, ***Sajao, Peeplu*** can also be used as dumping place and after leveling it can be used by school children as playground. • A downstream check dam can be developed in nearby *Nala* of village which overflows during rainy season and stored water can be used for agricultural purpose • Barbed wire fencing which is done by *Gram Panchayat* earlierif necessary can be removed and should be fixed at suitable place with village consultation	feasible but will be done after technical and environment clearance and if possible can be linked with MNREGA programme. • Technical advice will be asked before selecting the site and if feasible can be done as part of corporate social responsibility (CSR). • It was again a good suggestion as this could be a solution to landslides and to deal with water scarcity in harvesting season. The idea will be put before technical team and only after then it will be finalized with consultation with nearby residents and village community. For better proposal prospect it will be forwarded to Forest, Irrigation and District Development Office. If found feasible can also be covered under ESR. • Feasible and should be done.	 

S No.	Date	Place	Issue Raised	Resolution	No of Participants and Photo
					
3.	**21.09.2018**	**Sarkaghat**	• Compensation on market rate should be given to every Residential/ Commercial owner of affected person • If possible bypass should be proposed in ***Sarkaghat*** which linked other roads of the area as well, • A site available at ***Kangoglu,Tuddy*** and near ***Veterinary hospital*** can be used as dumping zone during construction phase and after completion and leveling it can be used as playground or Helipad, • Public facilities should be developed during construction	• Procedures would be followed as per Government and multilateral funding agencies guidelines. • This suggestion is not feasible but to regard this suggestion technical advice will be given importance. • All technical procedures will be followed before finalizing and implementing this suggestion. If found feasible can be linked with MNREGA program.	No of Participants: 16 nos. 

S No.	Date	Place	Issue Raised	Resolution	No of Participants and Photo
				• This is one of the feasible suggestions and will be given upper most priority.	
4.	**22.09.2018**	**Tauni Devi**	• Participants suggested that every affected religious property (partially or fully) must be modified/ relocated and enhanced properly prior to the commencement of work, • Taxi stand of ***Tauni Devi*** should be developed, • Retaining wall of two (02) schools at ***Tauni Devi*** to ***Chowk*** should be rebuild, • Public facilities should be developed during construction, • Site as Dumping zone at ***Darkoti*** (Police Chowki) can be used and after leveling it can be used as play ground,	• It is recommended that all the structures likely to be affected need to be modified or relocated at new places as the case is in consultation with local community. The cost of construction/ relocation will be borne through project. • Beautification will be done as per IRC guidelines. • Will be done and covered under civil work construction. • Will be given upper most priority under CSR. • The suggestion also feels feasible but will be done after technical and environment clearance and if possible can be linked with MNREGA programme.	No of Participants: 35 nos. 

S No.	Date	Place	Issue Raised	Resolution	No of Participants and Photo
			• Inspection should be done for re-alignment of ***Uhal Chowk (Tauni Devi)***	• As the drawings for the road project are finalized taking utmost care and following all available options, the suggestion is not found feasible.	
5.	**23.08. 2018**	**Awah Devi**	• Proposed bypass at place ***Chothra*** should be postponed and present /road should be widened, • Space available at Government Middle School ***Shroan*** can be used as dumping zone and after leveling it can be used as playground by students, • Taxi stand should be developed and modification and beautification of water source available at Middle School, ***Shroan*** should be done, • Every affected family of the proposed project should be taken in confidence before starting construction work	• The bypass proposed at ***Chothra*** is finalized after rigorous field work by technical team. Road widening cannot be the option and solution. So the idea was dropped. • The suggestion feels feasible but will be done after technical and environment clearance and if possible can be linked with MNREGA programme/ Corporate Social Responsibility head. • Suggestion was good and utmost care will be taken during construction period. Consultation with	No of Participants: 14 nos. 

S No.	Date	Place	Issue Raised	Resolution	No of Participants and Photo
				stakeholders will be a regular feature of this project proposal.	

Table 7.3: Stakeholder Consultations

S. No.	Name & Designation of Stakeholder	Mode of Interaction And Venue	Finding of Interaction	Remark	Photograph of the Interaction
1.	Name:- Mr. Vikrant Kapoor , Deputy Director District Udyog Center Mandi Mobile:- 9418050364 & 9816228716	Mode:- By Personal Interaction Place:- Mandi Date:- 19.09.2018 Time:- 1:25 PM	***(A) Production of Local Products:-*** ➢ Handloom: In Himachal Pradesh, handloom industry plays a very important role in the state economy. The uniqueness and specialty in weaving makes them famous	➢ Road should be good with better connectivity. ➢ The proposed road project will be beneficial for local producer as the produce will reach the destination in minimum time.	

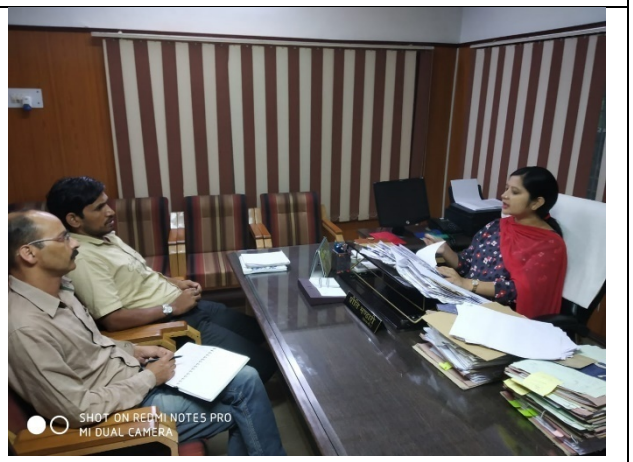
S. No.	Name & Designation of Stakeholder	Mode of Interaction And Venue	Finding of Interaction	Remark	Photograph of the Interaction
			on the national and international levels. ➢ The handloom sector is the most important earning sector after agriculture providing direct and indirect employment to the locals. ➢ In recent years, two handloom clusters have been sanctioned for the districts of Chamba and Mandi. Together, these will benefit over 1000 artisans of the area. ***(B) Under construction Power Plant near Kotli:-*** ➢ 119 MW Hydroelectric Power plant	➢ It would also benefits to the owner and transporter as it will minimize the operating cost of the vehicles.	Photo: 

S. No.	Name & Designation of Stakeholder	Mode of Interaction And Venue	Finding of Interaction	Remark	Photograph of the Interaction
2.	Name:- Mr. B. D. Sharma & Mr. NavinGoshla (District Agriculture Office) Mobile:- 9418048899	Mode:- By Personal Interaction Place:- Mandi Date:- 19.09.2018 Time:- 11:50AM	***(A)***The main cereals cultivated in Himachal Pradesh agriculture are wheat, maize, rice, and barley. Mandi district is among the major producers of wheat, maize, and rice. ***(B)***Agriculture Development Project Scheme: - Going on in Mandi District (along Mandi-Kullu NH). Off season vegetable cultivation is going on in following places:- ➢ Ball Velley ➢ Siraj Velley ➢ Crasock ➢ Katola Velley ❖ Off season vegetable from the area is transported to Chandigarh, Jalandhar, Pathankot and Delhi for good prices. ❖ Route used for transportation:- **(a)** Hamirpur – Una **(b)** Buta - Una ❖ A soil testing lab is available at Sunder Nagar area for soil testing purposes as	➢ In future transportation of agriculture based material/produce transportation will be increase resulting in vehicle load therefore pavement should be good. ➢ Vehicle crossing/ passing spots will be developed. ➢ Provision for rest areas.	 

S. No.	Name & Designation of Stakeholder	Mode of Interaction And Venue	Finding of Interaction	Remark	Photograph of the Interaction
			well as to benefit the farmers of surrounding area ❖ In addition to fruits, vegetable and flower cultivation is undertaken for off season supplies to the plains, while the mushroom cultivation is being taken up even by the landless for the augmentation of their income. ❖ Dharampur is major area for mushroom production ➢ In Dharampur JICA funded programme is also running for organic farming (Zero Burst natural farming without using chemical, fertilizers and pesticide)		

S. No.	Name & Designation of Stakeholder	Mode of Interaction And Venue	Finding of Interaction	Remark	Photograph of the Interaction
3.	Name:- Mr. Bhumi Singh & Mr. Sher Singh (Regional Officer) Mobile:- 7018288186 & 9418019017	Mode:- By Personal Interaction Place:- Saighu Near Kotli Date:- 20.09.2018 Time:- 1:20 - 1:40	➢ Distinct vegetation zones of Mixed Deciduous Forests, Bamboo, Chil, Oaks, Deodar, Kail, Fir and Spruce, are found in the forests of Himachal Pradesh. Forests of the state are rich in vascular flora, which forms the conspicuous vegetation cover. ➢ There are no Khair species trees along the Hamirpur – Mandi National Highway. It is found in the interior areas of deep forest. ➢ There are no fixed or define location of wild animal crossing spot on proposed road project. ➢ Presence of Leopard is generally found in Ghandhiru forest block and they generally do not cross the NH.	• Ornamental plants, Soil binder plants & grass species and shadow tree species will be preferred in compensatory plantation through project.	 

S. No.	Name & Designation of Stakeholder	Mode of Interaction And Venue	Finding of Interaction	Remark	Photograph of the Interaction
					
4.	Name:- Mr. Arun Kumar (President) Local Businessman (with Vyapar Mandal Kotli) Mobile:- 9418408650	Mode:- By Personal Interaction Place:- Kotli Date:- 20.09.2018 Time:- 10:15 - 10:30	➢ Two laning of Hamirpur-Mandi will be beneficial for local market as it will be convenient to transport local goods to nearby markets as well as to also transport goods to the area from there. ➢ Will also increase employment in the area.		

S. No.	Name & Designation of Stakeholder	Mode of Interaction And Venue	Finding of Interaction	Remark	Photograph of the Interaction
					
5.	Name:- Mrs. Priti Bhandhari D.F.O Hamirpur District Mobile:- 8219698742 and Local Ranger for project NH area – Mr. Ravi Chander (R.O. Hamirpur)	Mode:- By Personal Interaction Place:- Hamirpur Date:- 22.09.2018 Time:- 12:17	➢ There is no specific route of Leopard crossing to the NH ➢ There are some spots where monkey menace is active		

S. No.	Name & Designation of Stakeholder	Mode of Interaction And Venue	Finding of Interaction	Remark	Photograph of the Interaction
6.	Name:- Mrs. Dr. Jeena (District Horticulture Officer) Mobile:- 9418183875	Mode:- By Personal Interaction Place:- Hamirpur Date:- 21.09.2018 Time:- 01:45 pm	• She suggested flower and ornamental plants for proposed highway project.		
7.	Name:- Truck union and Various Truck Drivers	Mode:- By Meeting Place:- Mandi Date:- 29.09.2018 Time:- 11:45 am	• By the up gradation and strengthening of existing NH-70 from Hamirpur to Mandi will increase transportation of goods, vegetables, fruits from Mandi to Dharmpur, Jogindernagar, Sarkaghat, Baijnath by Trucks. • This road project will save 3-4 hour of traveling time as well as operating cost of vehicles.	• Present and future traffic composition and related traffic load data has been used for highway designing.	

S. No.	Name & Designation of Stakeholder	Mode of Interaction And Venue	Finding of Interaction	Remark	Photograph of the Interaction
			Tourism Spot/Religious Place in nearby location of Mandi:- ➢ Laghu Haridwar ➢ Shitla Mata complex ➢ Kandabattan ➢ Sikari Devi ➢ Jangali ➢ Kersock ➢ Tata Pani ➢ Kamru Nag ➢ Devidar ➢ Brasar ➢ Barrot ➢ Rivalsar lake ➢ Kanilah Fort ➢ Chhoti Kashi ➢ Nature Park-Jidi ➢ Hanogi Mata Temple ➢ Jhadol (Sundar Nagar)		

S. No.	Name & Designation of Stakeholder	Mode of Interaction And Venue	Finding of Interaction	Remark	Photograph of the Interaction
8.	District Collector ; Hairpur	Mode:- By Meeting Place:- Hamirpur Date:- 10.10.2018 Time:- 11:45 am	• Issues related to availability, nature and ownership of land along the proposed alignment.	• Land acquisition for the proposed project will be as per requirement and Government guidelines will be followed.	
9.	Prem Kumar Dhumal (Ex CM Himachal Pradesh)	Mode:- By Personal Interaction Place:- Hamirpur Date:- 21.10.2018 Time:- 01:45	• Local Issues related to employment, education, health facilities etc.	❖ Availability of labour in nearby villages will be preferred for construction work of proposed road.	

7.10 WOMEN'S PARTICIPATION IN CONSULTATIONS AND OUT COMES

Public consultation, interaction and discussion were held with Local women, various women govt. officials, self-help groups and College Students along the project road emphasizing issues on Women safety and Women empowerment (photos are given below). The participants were requested to express their views and any other suggestions for this road project. Questionnaire used in the public consultation regarding Women safety & Empowerment and Answers by female participants has been given in this report. The details of discussion and suggestions put forward during this meeting are summarized below:

1

	
Date and Venue: on 21.09.2018 near Panchayat Bhawan, Padchu.	**Date and Venue:** on 22.09.2018 near Kotli Village.
Issuse Discussed: • Woman employement in road construction. • Impact of land acquistion on livestock and agriculture. • Amount of compensation for and acquisition. • The major part of the stretch depends on the hand-pumps for its water needs; the issue of replacement of hand-pumps attains a very special significance in context of the women • The women feel that their mobility will increase as market & relative's places will be easily accessible for them as better road condition will induce more transport vehicles to operate. More shops, markets will open within the village approach area and as a result they will get quality leisure time at their disposal .	Issuse Discussed: • Approaches from road to houses during road construction. • Debris/muck disposal sites. • Local employment generation duirng road construction phase. • Women participation in road construction works. • BPL Woman House Holds should be minimum displaced

7.11 MAJOR FINDINGS OF KEY STAKEHOLDERS CONSULTATIONS

Stakeholders consultations were conducted at Awah Devi, Kotli, Padchhu, Tauni Devi, Sarkaghat. Major findings related to key issues such as general perception about the project, suggestions to mitigate hardships resulting from dislocation and loss of livelihood, the details of which are presented below:

1. Most of the people were aware about the project:
2. People were convinced about the importance of proposed highways in their region since it will reduce accidents and enhance economic opportunities.
3. People consented to cooperate if adequate compensation is given.
4. Most people preferred to resettle if required near to their previous place of business and residence and preferred self-resettlement.
5. Cultivators preferred cash compensation at market rate.
6. Requests were made by the people for providing public facilities and amenities like Street lights, toilets, rain shelter and safer accessibility at points of congestion and intersections
7. Minimum impact on structures along the road was requested.
8. Compensation rates should be as par at market rates,
9. Every affected religious property (partially or fully) must be modified/ relocated and enhanced properly prior to the commencement of work.
10. Additional assistance for employment/ income restoration for locals, cross drainage should also be provided.
11. On site relocation for small business enterprise (SBE) is preferred option. They perceived low business growth at new locations
12. Affected People asked about creation of new employment opportunities during road construction and later phases of the project for them.
13. More consultations should be conducted during project implementation phase for public participation in the project etc.
14. People suggested that adequate safety measures should be provided such as Crash barriers, retaining walls, speed breakers, signages etc. near inhabited areas, school and hospitals.
15. Based on the finding of the consultation with the various stakeholders and especially with the people living along the project corridor, options have been worked out to reduce the loss of assets and livelihood of the people in project impact zone. The consultation process was continued during the design period to minimize the adverse impact.

16. The community perceives that the project will help in increasing road safety, promote more business, better service facilities, and better conveyance and promote local employment opportunities.
17. They consider that it would lead to increase in land rates and smooth traffic.
18. Apprehensions raised by the community include more accidents, houses coming closer to the proposed alignment, increase in noise, etc. Hence, requested for incorporation of suitable mitigation measures.

The minutes of meetings and photos of key stakeholders consultations are given in **Annexure 7.1,** respectively.

CHAPTER 8

ENVIRONMENTAL MANAGEMENT PLAN

8.1 INTRODUCTION

Environmental Management Plan has been prepared which mainly centered on the understanding of the interactions between the environmental setting and the project activities and the assessment of the anticipated impacts. Mitigation measures for anticipated environmental impacts have been elaborated as specific actions which would have to be implemented during the project implementation. The EMP would help the contractors/PIU to implement the project in an environmentally sustainable manner and where contractors, understand the potential environmental impacts arising from the subproject and take appropriate actions/mitigation measures to properly mitigate/manage such environmental impacts. EMP can thus be considered to be an overview document for contractors that will guide environment management of all anticipated impacts in proposed two lane upgradation with paved shoulders of Hamirpur Mandi Section (Km 141.000 to Km 265.00) of NH-70 in the Himachal Pradesh State. This EMP may also be considered as flexible and will be further developed by the Contractor in the Contractor's Environmental Management Plan.

8.2 Outline of EMP and its Implementation Strategy

The EMP is a guiding and dynamic/live tool which discusses the potential environmental impacts and specific mitigation/management measures for the proposed two lane upgradation with paved shoulders of Hamirpur Mandi Section (Km 141.000 to Km 265.00) of NH-70. It refers to the responsibilities ensuring commitment for implementation and means of verifying/supervision whether the same has been implemented properly. The timing and frequency of monitoring along with the supervision responsibility and reporting requirements are also provided in the Environmental Management Plan. As a part of the EMP, the contractors will commit to identification of the environmental and social impacts at the project road. In case of any future changes in the project road design, the EMP will need to be updated to reflect the new scope of the activities. such revisions will be finalized in consultation with the World Bank.

The PIU/Authority Engineer will be responsible to ensure implementation of EMP by the contractor with the overall accountability resting with the GNHCP-PMU. Whereas, the Authority Engineer will ensure periodic quality audit/ guidance to the PIU and by imparting regular training, monitoring and ensuring that all EMP provisions and requirements are

translated into ‘contract documents and that these requirements are implemented to their full intent and extent.

Overall responsibility will be of Contractor for effective implementation of EMP and adherence to all the mitigation measures as outlined in this EMP associated with their respective activities. The Contractor will require to comply with the provisions of the EMP.

8.3. ENVIRONMENTAL MANAGEMENT MEASURES

8.3.1 Mitigation Measures Considered During Design Stage

During the design stage, environmental mitigation measures have been considered to control and minimisation of anticipated environmental impacts due to the proposed road. During design stage, following have been considered and incorporated in the DPR report**:**

Table 8.1: Mitigation Measures Considered During Design Stage

Impacts	Mitigation Measures
Removal of Tree	Alignment design adjusted reducing 29600 numbers of trees to be impacted through adoption of appropriate widening options.
Impact on Cultural sites	Widening along the existing alignment has been finalized considering minimum damage to religious structures (26) of different communities.
Borrow Pits	Locations selected considering minimum loss of productive land and feasibility of restoration for its productive use.
Drainage	One major bridge, 7 nos. minor bridges, one causeway and 487 nos. culverts are proposed to prevent water logging and flooding and to maintain natural drainage.

8.3.2 Disposal of Hill Cuttings and Excavated Waste (Disposal Sites)

During the construction phase, 2903159 cum wastes will be generated from the project road. Dumping sites have been identified for the disposal of debris during construction waste have been planned. For the disposal of debris, only pre-identified disposal locations conforming to local environmental regulation and approved by the Authority Engineer will be used. The locations of the identified disposal site are given in **Table 8.2.**:

Table 8.2: Disposal Sites for Dumping of Surplus Debris

Package 1 Ch. From km - 141+000 to 188+450		Package 2 Ch. From km - 188+450 to 208+950		Package 3 Ch. From km - 208+950 to 250+592	
Dumping site		Dumping site		Dumping site	
S. No.	Design Chainage	S. No.	Design Chainage	S. No.	Design Chainage
1	153+350	1	206+050	1	215+600
2	171+400	2	207+450	2	218+631
3	180+980			3	219+100
4	183+600			4	220+400
				5	225+450
				6	226+600
				7	230+600
				8	232+589
				9	233+800
				10	235+900
				11	240+600
				12	243+100

8.3.3 Disposal of Excavated Wastes

535032 cum excavated materials (266022 cum from pkg-1, 114742 cum from pkg-2 & 154268 cum from pkg-3) will be used for backfilling embankments, filling pits, and landscaping.

8.3.4 Carbon Footprint of Reuse hill cutting material in Aggregates and GSB

The carbon footprint of reuse hill cutting materials in aggregates and GSB is given in **Table 8.3.**

Table 8.3: Carbon Footprint of Reuse hill cutting material in Aggregates and GSB

S.No.	Type of Excavation	Quantity of excavated material	How much quantity will be reused?	Reuse in which material?	CO2 emission factor (Kg/tone) as per source[1]	How Much Quantity of CO_2 emission Controlled through reuse of material
1	Without using blasting	1719733 cum	1960496 tone	GSB	1.6	3136.794 tone
2	By using blasting	1719733 cum	1365031 tone	Aggregates	20.82	28419.954 tone

Source[1]: Bhandari K., Gangopadhyay S. & Shukla A., (2009): Carbon footprint- a tool to quantify the impact of road construction on the environment, Journal of the Eastern Asia Society for Transportation Studies, Vol.9.

8.3.5 Road Safety Sign Boards at Various Locations

Providing and fixing of retro- reflective cautionary, mandatory and informatory sign as per IRC guideline is essential. The package wise derails of the road safety sign boards are given in **Table 8.4.**

Table 8.4: Package Wise Derails of Road Safety Sign Boards

Type of Sign	Numbers			Locations
	Pkg-I	Pkg-II	Pkg-III	
speed limit boards	252	314	464	Near habitations, education institutions & hospitals etc.
Octagon sign boards/Stop Boards	58	6	29	near major/minor junctions & villages
over head sign board	9	0	3	near major/minor junctions & villages
delineators	5530	285	6630	On road edges
cats eye	2023	1215	2491	At curves
	1683	834	1886	On road edges

8.3.6 Reconstruction/Repairing of Bowaries and Khatris

Enhancement measures for various water Bowaris and Khartis (rainwater Storage structures) are given in **Table 8.5.**

Table 8.5: Enhancement measures for Water Bowaris and Khartis

I.D.	Existing km	Nome of Environment Sensitive Item	Possible Impacts	Mitigation/Enhancement measures
107	151.814	Water Bawadi	- -Interance gate may be impacted.	➢ Masonary Wall is proposed to prevent free deposition od particles/objects into water.
16	154.550	Water Bawadi	- Interance gate may be impacted.	➢ Entrance gate will be clsoded through RCC wall and iron door.
15	156.500	Water Bawadi	- Interance gate may be impacted.	➢ Entrance gate will be clsoded through RCC wall and iron door.
17	158.100	Water Percolation Well/Khatris	- Whole structure will be impact.	➢ Repairing of entrance gate
13	159.000	Water Percolation Well/Khatris	- Interance gate may be impacted.	➢ Entrance gate will be clsoded through RCC wall and iron door.
14	159.000	Water Percolation Well/Khatris	- Interance gate may be impacted.	➢ Repairing of entrance gate
12	160.350	Water Percolation Well/Khatris	- Interance gate may be impacted.	➢ Repairing of entrance gate
11	160.350	Water Percolation Well/Khatris	- No direct impact	➢ Repairing of entrance gate
10	160.364	Water Percolation Well/Khatris	- No direct impact	➢ Entrance gate will be clsoded through RCC wall and iron door.
8	160.384	Water Percolation Well/Khatris	- No direct impact	➢ Entrance gate will be clsoded through RCC wall and iron door.

I.D.	Existing km	Nome of Environment Sensitive Item	Possible Impacts	Mitigation/Enhancement measures
4	160.403	Water Percolation Well/Khatris	- No direct impact	➢ Entrance gate will be clsoded through RCC wall and iron door.
3	160.410	Water Percolation Well/Khatris	- No direct impact	➢ Entrance gate will be clsoded through RCC wall and iron door.
2	160.415	Water Percolation Well/Khatris	- Interance gate may be impacted.	➢ Entrance gate will be clsoded through RCC wall and iron door.
1	160.415	Water Percolation Well/Khatris	- Interance gate may be impacted.	➢ Repairing of entrance gate
65	169.290	Bawadi	- -Approx. half area of structure will be impacted. - -Structure will be shifted backside.	➢ Reconstruction of Bawadi (Length=2m, Breadth=2m and Height=2m)
55	176.211	Bawadi	- -Outer bondary and plateform may be impacted.	➢ Massonary wall (Length=1.5m, Height=1m) to protect the Bawadi.
46	181.007	Bawadi	- -Outer bondary and plateform will be impacted.	➢ Massonary wall (Length=4.6m, Height=1m) to protect the Bawadi.
35	184.556	Bawadi	- -Intrance Gate will becimpacted.	➢ Massonary wall (Length=3.3m, Height=1m) to protect the Bawadi.
23	189.410	Bawadi	- -Whole structure of water Bawadi will be impacted.	➢ Reconstruction of Bawadi (Length=3m, Breadth=2.5m and Height=2.5m)
51	197.670	Bawadi	- Whole structure will be impacted	➢ Reconstruction of Bawadi (Length=2m, Breadth=2m and Height=2m)
49B	210.990	Bawadi	- Whole structure will be iimpacted.	➢ Reconstruction of Bawadi (Length=2m, Breadth=2m and Height=2m)

I.D.	Existing km	Nome of Environment Sensitive Item	Possible Impacts	Mitigation/Enhancement measures
61	240.285	Bawadi	- -Foundation of Water Bawdi will be impacted.	➢ Reconstruction of Bawadi (Length=2m, Breadth=2m and Height=2m)
37	249.500	Bawadi	- Whole structure will be impacted	➢ Reconstruction of Bawadi (Length=2.5m, Breadth=2m and Height=2m)
18	256.599	Bawadi	- -PCL has been shifted in RHS to save the Bawadi structure. - -No major impact will be come from road construction.	➢ Pipe culvert is proposed for discharging the water to vellay side.
7	260.814	Bawadi	-PCL has been shifted in LHS, Therefore scale of impact will be minimum. -Bawdi water may be impacted from containinmination and sedimentation.	➢ -Proposed Massonary wall (1/5 m height) on entrance to prevent direct falling of soil sediment and other objects to bawadi water.
5	261.823	Bawadi	-Its fall undaer PROW but out of formation width, Therefore scale of impact will be minimum.	➢ -Prposed construction of steps to make easy approach to water bawadi.

8.3.7 Green Belt Development

Green belt development will be done at sensitive receptor and open available space locations given in **Table 8.6.** The proposed green belt will be help in reducing noise level and ornamentation of the project road**.** Recommended species for plantation are *Ailanthus excels, Azadirachta indica, Alstonia scholaris, Acacia auriculiformis, Butea monosperma, Cassia fistula, Dalbergia sissoo, Gmelina arborea,Pongamia pinnata, etc* ((IRC: SP:21-2009).

Table 8.6: Plantation at Sensitive Receptor Locations

S.No.	Existing Chainage	Location for Plantation	Length of Plantation
1	Km 141 to km 142.600	On the available space along the road on both side of road.	One row plantation for 1.412 km length on both side of road (from km 141.300 to km 142.600).
2	Km 143.050 to km 143.750	On the available space along the road on both side of road.	One row plantation for 500m length on both side.
3	Km 144.800 (Near Kalngali Mata Temple) to km 144.900	On the available space in LHS along the road.	One row plantation for 500m length in LHS.
4	Km 145.600 to km 145.900	On the available space in LHS along the road.	One row plantation for 300m length in LHS.
5	Km 153.100 to km 153.400	On the available space in RHS along the road.	One row plantation for 300m length in RHS.
6	Km 162 to km 162.100	On the available space along the road on both side of road.	One row plantation for 100m length on both side.
7	Km 163.400 to km 164.0	On the available space in RHS along the road.	One row plantation for 600m length in RHS.
8	km 160.600	Govt. Primary Middle Secondary School	One row plantation for 100m (50+50) length).
9	km165.628	Govt. Se. Sec. School Cholthara	One row plantation in three nos. playgrounds for 287 m (90m+80m+117m) length.

S.No.	Existing Chainage	Location for Plantation	Length of Plantation
1	Km 141 to km 142.600	On the available space along the road on both side of road.	One row plantation for 1.412 km length on both side of road (from km 141.300 to km 142.600).
2	Km 143.050 to km 143.750	On the available space along the road on both side of road.	One row plantation for 500m length on both side.
3	Km 144.800 (Near Kalngali Mata Temple) to km 144.900	On the available space in LHS along the road.	One row plantation for 500m length in LHS.
4	Km 145.600 to km 145.900	On the available space in LHS along the road.	One row plantation for 300m length in LHS.
5	Km 153.100 to km 153.400	On the available space in RHS along the road.	One row plantation for 300m length in RHS.
6	Km 162 to km 162.100	On the available space along the road on both side of road.	One row plantation for 100m length on both side.
7	Km 163.400 to km 164.0	On the available space in RHS along the road.	One row plantation for 600m length in RHS.
10	km 178.113	Govt. Se. Sec. School.	One row plantation for 600 m (400+100+100) length.
11	km 189.655	Govt. Upper Sec. School, Hukkal	One row plantation for 150m length (40+50+60) length.
12	km 231.250	Govt. Se.Sec. School	One row plantation for 150m length.
13	km 248.835	Gram Panchayat.	One row plantation for 83m (15+20+20+28) length.
14	km 246.461	Govt. Hospital, Saigalu	One row plantation for 60m (20+20+20) length.
15	km 247.189	Govt. Se. Sec. School, Sai	One row plantation for 90m (20m+50+20) length.
16	km 242.650	Govt. Se. Sec. School, Kotli	One row plantation for 150m (60+50+40) length.

8.3.8 Solar Lighting Facility

Approx. 400 nos. Solar Lights are proposed at junction, bridges, sharp curves, bus shelters, schools, hospitals and at water Bowaries. Some important location of proposed solar lighting facilities are given in **Table 8.7.**

Table 8.7: Location of Proposed Solar Light Locations

S.No	RHS	Number	Location	Design Chainage (km)
1	LHS	1	At Y - Junction	143.057
2	RHS	1	At Govt. Middle School (Thana)	149.200
3	RHS & LHS	1	At Realignment	149.700
4	LHS	1	At Dhar Koti village near community fruit processing training centre	150.750
5	RHS & LHS	1	At Near Tyoni devi Temple	151.300
6	LHS	1	At Bus shelter	152.050
7	RHS & LHS	2	At Bus shelter (RHS)	152.477
8	RHS	1	At Solar light at Bus shelter and temple at Glu	153.100
9	RHS	1	At Realignment	153.500
10	RHS & LHS	2	At Bus shelter	153.600
11	RHS	1	At Bus shelter	153.700
12	RHS	1	,At Curve	153.800
13	RHS	1	At Solar light at Kali Mandir	153.850
14	RHS & LHS	2	At Laliyar Village	153.860
15	RHS & LHS	2	At Near Samirpur PWD Guest house	157.820
16	LHS	1	Y-junction	158.150
17	LHS	1	At Realignment	158.380
18	LHS	1	On road	158.483
19	LHS	1	At bus shelter	159.975
20	RHS & LHS	2	At Tri junction	160.820
21	RHS	1	On Road	161.090

S.No	RHS	Number	Location	Design Chainage (km)
22	RHS	1	At start point of realingment of Cholthra	162.040
23	RHS	1	At Y-Junction near Kangu Da glu village	165.050
24	RHS	1	At Y-junction	165.270
25	RHS	1	near Temple	166.600
26	RHS	1	On road	170.577
27	LHS	1	At Y-Junction	172.200
28	RHS	1	At Y-Junction	175.800
29	RHS	1	At Y-Junction for Sarori	176.867
30	LHS	1	At T Junction at Parchhu village	181.200
31	LHS	1	At Y-Junction And Bus Shelter at Bedi Village	183.500
32	RHS	1	At Y-Junction	184.250
33	RHS	1	At Near Govt. School, Huccal	184.900
34	RHS	1	At Y-Junction	190.400
35	LHS	1	At Y-Junction	191.673
36	LHS	1	At Bannal Village	193.376
37	RHS	1	At Y-Junction	204.150
38	LHS	1	At Y-Junction	205.200
39	LHS	1	At Curve	208.800
40	LHS	1	At Curve	209.920
41	LHS	1	At Curve	211.500
42	LHS	1	At Curve	214+250
43	LHS	1	At Curve	214+700
44	LHS	1	At Near Bus Shelter	218+250
45	LHS	1	At Uparli Suradi	222+900
46	LHS	1	At Sihlli Village	223+900
47	RHS	1	At Ropad village	224+690
48	RHS	1	At Ropad village	224+715
49	LHS	1	At Curve	225+200

S.No	RHS	Number	Location	Design Chainage (km)
50	LHS	1	At Y-Junction	227+550
51	LHS	4	At Govt Central Primary School =4 Solar Light	228+050
52	LHS	1	At Fhagla Village	229+400
53	LHS	1	At Curve	230+00
54	RHS	1	At Water Bawadi	230+600
55	LHS	1	At Kasan Bus Stand	233+500
56	LHS	1	At Gram Panchayat	234+050
57	LHS	1	At Sai village	234+750
58	LHS	1	At Post Office, Sai Village	234+900
59	LHS	1	At Sai Village	235+550
60	LHS	1	At Sai Village	235+560
61	LHS	1	At Sai Village	235+570
62	RHS	1	At Temple Main Gate	237+500
63	LHS	1	At Bus Shelter	237+620
64	RHS	1	At Curve	237+950
65	RHS	1	At Dhara College (Satohal)	238+520
66	RHS	1	At Satohal village	239+870
67	RHS	1	At Satohal village	239+900
68	RHS	1	At Satohal village	239+920
69	RHS	1	At Satohal village	239+920
70	RHS	1	On Road	241+00
71	RHS	1	On Road	241+100
72	LHS	1	At Fatewahan Village	242+040
73	LHS	1	At Fatewahan Village	242+050
74	RHS	1	At B.Ed College	243+840
75	RHS	1	At Bal Grah Old Age Home	245+050
76	LHS	1	At Govt School And Cross Junction	245+800
77	LHS	1	At Curve	246+300

8.3.9 Land Scaping

Landscaping will be done at junctions and open space along the road. Recommended species for landscaping are *Bougainvellia, Cassia glauca, C. alata, Jatropa podagarica, Nerium oleander, Poinciana pulcherima, Thevetia nerifolia* etc. These shrubs species has been selected based on climatic condition of project areas (IRC: SP: 21-2009). Locations of land scaping are given in **Table 8.8.**

Table 8.8: Location of Landscaping

S.No.	Land Scaping Location	Desin Chainage (km)	Side
1	At Junction	km 146	LHS
2	At Junction	km 147.200	RHS
3	At Junction	km 149.700	RHS
4	At Junction	km 149.920	RHS
5	At Open Space along the road	km 152.050	LHS
6	At Junction	km 159.660	LHS
7	At Junction	km 161.870	RHS
8	At Junction	km 163.150	RHS
9	At Junction	km 167.780	RHS
10	At Junction	km 167.860	RHS
11	At Open Space along the road	From km 181.000 to km 181.100	RHS
12	At Open Space along the road	From km 189.950 to km 190.080	LHS
13	At Open Space along the road	From km 191.700 to km 191.750	LHS

8.4 Environmental Management Plan

The Environmental Management Plan (EMP) will guide the environmentally-sound construction of the project road and ensure efficient lines of communication/co-ordination between the PIU/Authority Engineer, Contractor and GNHCP-PMU. The EMP has been prepared for three stages of project road construction activities as: (i) Pre-construction Stage; (ii) Construction Stage; and (iii) Demobilization Stage. The EMP for the subproject

road have been prepared and presented in **Table 8.9.** Various guidelines, for implementation of EMP are given as Annexures at the end of EIA Report.

The purpose of the EMP is to ensure that the activities are undertaken in a responsible non-detrimental manner with the objectives of: (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (ii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impacts of the project road; and (iv) ensure that safety recommendations are complied with.

Budgetary provisions for implementation of EMP shall be integrated with the bid/construction contract in the form of technical specifications and environmental performance requirements. The costs to be incurred on implementation of EMP shall be incidental to the civil works and therefore, no separate environment budget/cost will be provided to the contractor for implementation of EMP. The contractor will ensure effective implementation of EMP during pre-construction, construction and demobilization stages. EMP for operation stage will be implemented by PIU/PMU.

Table 8.9: Environmental Mitigation Measures and Management Plan

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
A.	**Pre-Construction Stage**			
I.	**Pre-construction Activities By the PIU**			
A.1	Diversion of Reserve Forest	• Effort will be made to minimise area of diversion of forest land. • For upgradation of the project road, 59.7059 ha forest land diversion will be required. • Prior Forest Clearance will be obtained from Ministry of Environment, Forest and Climate Change (MOEF&CC). • Conditions imposed in Forest Clearance by the Forest Department will be complied and compliance status report will be prepared and submitted to Forest Department. • CA land as required under the provision of Forest Conservation Act (1980) has been provided.	PIU	PMU
A.2	Tree Cutting Permission	• Approximately 29600 trees are likely to be felled for upgradation of the project. All efforts will be made to minimise cutting of trees. • Prior permission will be obtained for cutting trees required for construction of the road.	PIU	PMU
A.3	Preservation of Trees	• All efforts will be made to preserve trees including evaluation of minor design adjustments/alternatives (as applicable) to save trees. • In the event of design changes, additional assessments including the possibility to save trees shall be made. Stacking, transport and storage of the wood from trees cuttings will be done as per the norms of Forest Department. • Systematic documentation for the trees cutting and those saved will be maintained.	PIU	PMU
A.4	Utility Shifting	• Prior permission will be taken from line departments of Electricity (PDD), Telecommunications (for OFC underground cables etc), water pipeline (PHE) etc. Utility shifting required to be undertaken by PIU.	PIU	PMU
A.5	Orientation of Implementing Agencies	• The PIU/Authority Engineer shall organize orientation sessions for the contractor. This shall include on-site training (general as well as specific) to the context of this project road. In training session PIU officers, project staff, contractors project managers, consultants etc will be involved.	PIU	PMU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		• Training of key workers and staff of the contractor about EMP implementation will be ensured before starting the construction works		
II	**Pre-construction Activities By the Contractor**			
A.6	Appointment and Mobilization of Environment Officer	• The contractor will appoint qualified and experienced Environment Officer, who will dedicatedly work and ensure implementation of EMP including occupational health and safety issues of workers. • Contractor will inform the PIU for the appointment and mobilization each Environment Officer	Contractor	Authority Engineer /PIU
A-7	Regulatory Approvals	• Prior permission will be obtained from concerned department for any works under scope of subproject. • Labour license will be obtained from Department of Labour. • If contractor opens new stone quarry or borrow areas, prior Environmental clearance will be obtained from SEIAA/DEIAA. • For setting–up of stone crusher plant (fix or mobile), hot mix plants, WMM and Batching Plant Consent to Establish and Consent to Operate will be obtained from Himachal Pradesh Pollution Control Board (HPPCB). • If blasting is required, prior permission will be obtained from Chief Controller of Explosives. • If contractor intends to procure construction materials from local authorized third party agencies then contractor will collect and submit necessary clearance/approval to PIU/Authority Engineer from authorized third party agencies. • Permissions for taking construction water from surface water bodies and drilling borewell for extraction of ground water, permission will be obtained from competent authorities.	Contractor	Authority Engineer /PIU
A-8	Common Property Resources (CPR's)/ Cultural/Religious Sites	• All common property resources shall be relocated and restored before the commencement of the road improvement activities. • Before commencement of works, a joint field monitoring will be conducted by the contactor and Authority Engineer/PIU to map out the alignments, to check if any CPR is being impacted due to construction works. • While relocating any CPR/cultural/religious sites, concerned agencies including Contractor shall take necessary precautions and shall	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		provide barricades/delineation of such sites to prevent pedestrian and other road users.		
A.9	Procurement of Machinery, Crushers, Batching Plants, etc and establishment of Plants/crusher.	• All vehicles and equipment to be procured for the proposed up-gradation works of the project road will conform to the relevant Bureau of Indian Standard (BIS) norms/vehicles emission standards. The discharge standards promulgated under the Environment (Protection) Act, 1986 and Motor Vehicles Act, 2019 will be strictly adhered to. • The silent/quiet equipment like DG set as per regulations will be used at the construction site or labour camp. • The contractor will maintain records of Pollution Under Control (PUC) certificates for all vehicles used during the contract period, which will be produced to PIU for monitoring and whenever required. • Specifications of construction machinery, crushers, batching plants, WWM and Hot Mix Plants shall comply with the requirements of the relevant environmental legislations. • Batching plant, WMM and hot mix plants shall be located minimum 250m away from population settlements preferably in the downwind direction. • Crusher shall be located as per distance criteria given by Himachal Pradesh Pollution Control Board in Consent to Establish letter.	Contractor	Authority Engineer /PIU
A.10	Construction Camp Locations Selection, Design & Lay-out	• The Contractor will obtain consent from land owners in writing for temporary use of land for construction and labour camps, etc.. • The Contractor shall submit a detailed layout plan for construction and labour camps and seek prior approval of PIU/Authority Engineer before entering into formal agreement with a land owner for setting-up such sites. • Layout of construction camp will ensure proper planning of plants, materials storage, sufficiently wide roads for free and safe movement of vehicles, construction equipment and workers.	Contractor	Authority Engineer /PIU
A.11	Arrangement for Construction Water	• The contractor will not take construction water from public water supply. • The contractor shall source construction water preferentially from surface water bodies in the project area after obtaining necessary permission from the competent authority.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		• Boring of any tube well for water for the road construction shall be drilled only after obtaining necessary permission from Ground Water Authority. • To avoid disruption/disturbance to other water users, the contractor shall extract water from identified locations in consultation with local community.		
A.12	Labour Requirement and compliance of labour regulations	• The contractor preferably will deploy unskilled/semiskilled labour from local areas to give the maximum benefit to the local community and to avoid any additional stress on the existing facilities. On an average150 to 200 labours/ day will be required during construction stage depending upon extent of construction work. • All applicable labour regulations will be complied by the contractor. • Necessary facilities to workers will be provided to workers as per The Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996	Contractor	Authority Engineer /PIU
A.13	Traffic Management Plan- Planning for Traffic Diversions and Detours	• Detailed traffic control plan for construction phase shall be prepared by the contractor before starts the construction and same shall be submitted to the PIU/Authority Engineer for approval. • The traffic control plan shall contain details of temporary diversions, traffic safety arrangements including night time safety measures, details of traffic arrangement after cessation of work each day, safety measures undertaken for transport of construction materials and arrangement of flagmen etc to regulate traffic congestion in narrow stretches in work zones. • The contractor shall provide specific measures for safety of pedestrians and workers as a part of traffic control plans. The contractor shall ensure that the diversion/detour are always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. • To maintain road safety during the construction necessary signages will be provided as per applicable IRC codes and guidelines.	Contractor	Authority Engineer /PIU
A-14	Stockyard/Storage of Construction Material and	• Contractor in consultation with PIU/Authority Engineer shall identify the site for temporary storage of construction materials. These sites	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
	Establishing Equipment Lay-down Area	shall not cause an inconvenience to local population / traffic movement. • Selection of locations for materials storage and equipment lay-down areas must take into account prevailing winds, distances to adjacent settlements, general on - site topography and water erosion potential of the soil. Impervious layer on surfaces must be provided wherever necessary. • Construction materials stockpiles shall be protected from storm water (e.g. by excavating a cut-off ditch around stockpiles to keep away storm water). • Storage of fuel with non- permeable flooring (cemented floor) will be enclosed to protect from rainwater. • Equipment lay-down area will be compacted and paved by cement properly to avoid any possibility of percolation of leaked and spilled fuel or lube oils. • Runoff from Equipment lay-down area will be passed through oil & grease trap.		
A-15	Information Dissemination and Communication Activities	• Prior to construction activity, information dissemination will be undertaken by contractor at the project site. • Project information boards showing the name of work, project cost, duration, date of commencement, date of completion, executing agency and contact details (including telephone numbers) shall be displayed both sides of the road packages in both in English and Vernacular. • Information boards will also be setup at the sites of construction camps and labour camps, plants and stockyard site. • Details of nodal officer with telephone numbers will be displayed for registering compliant/grievances by stakeholder/general public.	PMU Contractor	PMU Authority Engineer /PIU
A-16	Contractor's Environmental & Social Management Plan	As per the provision of Contract agreement, the Contractor shall prepare C-ESMP & OH&S plan.	Contractor	Authority Engineer
B.	**Construction Stage**			
B.1	**Procurement of Construction Materials**			

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
B.1.1	Quarry operations & crushers for procurement for aggregate and other construction materials	• Aggregate will be obtained only from approved stone quarries and crushers having valid clearance and consents. • If contractor plans to open new stone quarry, prior environmental clearance will be obtained from SEIAA/DEIAA. • The crushers will be operated after obtaining consent to establish and consent to operate from HPPCB. • If mobile crusher is used for onsite production of aggregate from hill cuttings, prior consent will be obtained from HPPCB. • Borrow area (if required) shall be opened without obtaining necessary regulatory permission. The location, shape and size of the designated borrow areas will be as approved by the Environmental Expert of Authority Engineer. • Borrowing earth shall be carried out in accordance with the IRC recommended practice for borrow pits for road embankments (IRC 36: 2010).	Contractor	Authority Engineer /PIU
B.1.2	Transporting Construction Materials	• Vehicles delivering fine materials like aggregate, cement, earth, sand, etc, to the site will be covered by tarpaulin to avoid spillage of construction materials and wind blown dust from the top of vehicles. • Existing road used by vehicles of the contractor or any of his subcontractor or suppliers of materials will be kept clear of extraneous construction materials dropped by such vehicles. • The contractor will make effort to transport construction materials to the site in non- peak hours	Contractor	Authority Engineer /PIU
B.2	**Work/Construction Zone Safety**			
B.2.1	Work/Construction Zone Safety	• The Contractor shall prepare work zone construction safety plan as per the provisions under IRC 67-2001, IRC SP-55, which shall be duly approved by the PIU/Authority Engineer prior to start of road works. • Warning, informatory and safety signages for ongoing works shall be erected as per IRC guidelines. • Suitable retro reflective warning signages shall be placed at near construction locations and should be visible at night also. • The contractor shall take necessary measures for the safety of traffic during construction and shall provide, erect and maintain such	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		barricades, including signages, markings, cones, delineators, flagmen, etc as proposed and approved by PIU/Authority Engineer. The contractor shall ensure that all signs, barricades, pavement markings are provided as per applicable IRC Codes and guidelines. • At hills cutting sites necessary signages and flagmen will be ensured to regulate traffic. • In narrow road stretch especially in mountainous terrain, safety of traffic will be ensured through traffic marshals, signages, etc • In case, controlled blasting is required for breaking rocks, prior information will be given for stopping traffic for required duration.		
B.3	**Site Clearance (Clearing and Grubbing)**			
B.3.1	Clearing, grubbing and levelling	• If required vegetation like shrubs and ground flora will be removed from the construction zone only. • All works will be carried out such that the damage or disruption to flora other than those identified for cutting is minimum. Only ground cover/shrubs that impinge directly on the permanent works or necessary temporary works will be removed with prior approval of PIU/Authority Engineer. • The contractor, under any circumstances will not cut or damage trees, which was not marked for cutting.	Contractor	Authority Engineer /PIU
B.3.2	Stripping, stocking and preservation of top soil	The topsoil from areas to be permanently covered will be stripped to a specified depth of 150 mm and stored in stockpiles. A portion of the temporarily acquired area and/or right of use will be earmarked for storing topsoil. The locations for stock piling will be pre-identified in consultation and with approval of Environmental Expert of Authority Engineer/PIU. The following precautionary measures will be taken to preserve top soil till they are used: (a) Stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and height of the pile is restricted to 2 m.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		To retain soil and to allow percolation of water, silt fencing will protect the edges of the pile. (b) Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or vegetation. (c) It will be ensured by the Contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles. Such stockpiled topsoil will be utilized for: • Covering all disturbed areas including borrow areas, only in a case where there are to be rehabilitation • Dressing of slopes of road embankment • Reclamation of debris disposal areas. • Agricultural fields of farmers acquired temporarily land.		
B.4	**Controlled Blasting for Cuttings of Rocks/Hills**			
B.4.1	Controlled Blasting for Hill Cutting	• If controlled blasting is required for cutting of hills, same shall be carried only by competent person. • For transportation and storage of explosives, prior permission will be obtained from Chief Controller of Explosives (CCE). • Before blasting, all the workers and road users from blasting impact zone will be evacuated. • Controlled blasting shall be carried out in day time only. • The contractor shall take necessary measures to control flying rock lumps during blasting. • Any damage to trees and properties due to controlled blasting shall be compensated by the contractor.	Contractor	Authority Engineer /PIU
B.5	**Dismantling of Construction & Demolition Wastes**			
B.5.1	Dismantling of old culverts/ bridges	• Demolition wastes from dismantling of culverts/bridges and will be collected and disposed as per the provision of Construction & Demolition Waste Rule 2016. • All necessary measures shall be taken especially while working close to cross drainage channels to prevent earthwork,	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		stonework, materials and appendage as well as the method of operation from obstructing flow of streams, water channels and drainage systems. • Demolition wastes shall not be disposed in drainage channels, water bodies, forest areas, etc. • Demolition wastes will be collected and efforts shall be made to use demolition wastes in road construction works as per design provisions, filling, construction of side/approach roads, etc after approval of Authority Engineer.		
B.5.2	Generation & disposal of debris from dismantling of existing road	• Debris generated due to the dismantling of the existing road shall be suitably reused in the proposed construction after approval from Authority Engineer. • Scarified asphalts, dismantled road and the other construction wastes shall be appropriately re-used in road construction with the approval from Authority Engineer. • Surplus quantity of scarified bitumen wastes and other construction wastes shall be utilized for the road construction, paving of cross roads, access roads and paving works in construction sites and camps, temporary traffic diversions, or in any other manner approved by the Authority Engineer. • The Contractor will suitably dispose of unutilized debris and waste materials subject to the approval of the Authority Engineer • All arrangements for transportation during construction including dismantling and clearing debris will be considered incidental to the work and will be planned and implemented by the Contractor as approved and directed by the Environmental Expert of Authority Engineer. • The pre-identified/designed disposal locations will be a part of Solid Waste Management Plan to be prepared by Contractor in consultation and with approval of Environmental Expert of Authority Engineer. • Debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
B.5.3	Utilization of Hill's cutting Materials	• Materials generated from the cuttings of hills shall be used in road construction to the maximum possible extent. • Surplus quantity of hills cuttings shall be disposed of on preidentified and approved disposal sites. • Disposal sites shall not be located in forest area and shall away from drainage channels also. • Disposed cutting materials will be properly compacted and slope will be suitably stabilized using engineering and bioengineering techniques. • Disposal sites will be properly developed (for parking of vehicles, play ground, etc) in consultation with local people.	Contractor	Authority Engineer /PIU
B.5.4	Disposal of construction debris	• Debris generated from construction of bridge and culverts will be collected and disposed in environmental sound manner.	Contractor	Authority Engineer /PIU
B.6	**Protection of Drainage and Surface Water Bodies**			
B.6.1	Drainage and Control of Accumulation of Water	• The contractor shall ensure that natural drainage is not altered due to road construction, disposal of debris/surplus cutting materials, etc • The Contractor shall ensure that no construction materials/debris shall block the water flow or create water lodging at the culvert and bridge construction sites. • The contractor shall take appropriate remedies to remove accumulated water (if any) from the construction sites, camp sites, storage yard, excavated areas etc. • On completion of construction or before onset of monsoon, debris from bridge and culvert construction sites shall be collected and drainage channels will be cleared properly. • Construction works should be planned well in advance prior to on-set of monsoon to avoid water- accumulation. • The contractor shall take necessary precautions to ensure that construction materials and excavated materials are enclosed in such a manner that erosion or run off in sediments are controlled. • Silt fencing shall be installed prior to the onset of the monsoon at the required locations, as directed by PIU/Authority Engineer.	Contractor	Authority Engineer /PIU
B.6.2	Siltation of Water Bodies and	• The project road is crossing natural streams at places, which remain dry in non-rainy days.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
	Degradation of Water Quality	• The Contractor will not excavate beds of any stream/ any other water body for borrowing earth for embankment construction. • The Contractor will construct silt fencing at the base of the embankment construction for the entire perimeter of any water body (including wells) adjacent to the project road and around the stockpiles at the construction sites including ancillary sites close to water bodies. • The fencing will be provided prior to commencement of earthwork and continue till the stabilization of the embankment slopes, on the particular sub-section of the road. • The contractor will ensure that construction materials containing fine particles are stored in an enclosure such that sediment-laden water/runoff does not drain into nearby watercourse. • On completion of construction of culverts and bridges, drainage channels will be cleared by collecting debris and disposed suitably. Detours/diversions constructed for construction of culverts and bridges will be also be cleared before onset of monsoon.		
B.7	**Mitigation Measures for Flora & Fauna**			
B.7.1	Occasional Presence of Leopards	• The contractor will implement set of engineering *i.e.* provision of animal crossing structures, traffic calming, protection works, signage, construction management related measures on debris, timing of works etc in these areas. • Height of culverts will be kept enough to provide crossing for leopards/jungle cats. Height of culverts shall be increased among other minor design adjustments such as access to the crossing structures and surface/bottom treatment. • In these stretches, contractor will arrange water pits and vegetation plantation etc. in consultation with PIU and Environmental Expert of Authority Engineer. • No construction/labour camp will be established in the areas, where occasional occurrence of leopards was reported in EIA Report. • Signage will be displayed in these stretches to drivers and calming traffic. • Debris will not be disposed in these starches.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
B.7.2	Aquatic Fauna in the river near and crossed by the subproject	The following mitigation measures will be implemented by the Contractor to mitigate the anticipated environmental impacts on the water quality of the major rivers nearby and crossed by the sub project: • Wastes/debris will not be dumped in the rivers and streams during construction phase. • On construction of bridges, both side protection works will be constructed to control the erosion. • No worker will be allowed to take bath, washing clothes, litter/defecation near in the rivers. • Construction camps will be located minimum 500 m from rivers. • All efforts will be made by the contractor to prevent silt in runoff during rains from excavated area and debris/hill cuttings disposal area. • Fishing by workers in these rivers will be strictly prohibited.	Contractor	Authority Engineer /PIU
B.8	**Slope Protection and Control of Soil Erosion**			
B.8.1	Slope Protection and Control of Soil Erosion	• In the project road, slope protection and control of soil erosion in hill cutting, embankment and landslide/slip will be required at places as per details given in DPR and schedules. • Slope protection provisions shall be adopted as specified in Schedule-B for project road packages. • Breast wall, gabion wall with geo-grid mesh along the hill side and retaining wall with gabion facing and toe wall shall be provided on the valley side of the project stretch as per schedules for the project road to accommodate TCS configuration within ROW and to provide protection from hill slope. • Slope protection measures shall be provided along the project stretch in the form of: (1) coco fibre/jute erosion control blanket with shrub/grass plantation, (2) Hydro seeding, (3) interlink chain mesh with grass strips and (4) Bio-engineering for debris disposal site sites.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		• Specification for Bio engineering, slope stabilization and protection shall also be adopted Issued by state PWD, Government of Himachal Pradesh. • The tentative locations for above slope protection provisions are listed in Schedules for project road. Any additional locations shall be provided by Contractor after consultation with authority without any change in scope. • Additionally, the contractor shall consider use of vetiver grass to prevent /control soil erosion on valley and hill sides. • The bio-engineering shall be provided for slope protection at debris disposal sites. The actual location of the same shall be determined by the contractor as per site requirement. Any variation in the location and length specified in this clause of Schedule-B shall not constitute a change of scope.		
B.9	**Longitudinal Drains Along Road Sections**			
B.9.1	Construction of longitudinal drains along the road	• Drainage arrangement of earthen drain and RCC drain (both sides) at built up locations are proposed along the project road. • At the excavation site, warning sign boards will be displayed in vernacular and English languages. • Entry of general public/unauthorized person will be restricted in construction zone. • During excavation for laying of concrete (RCC) cover drains necessary safety measures will be taken by the contractor. • Excavation of 1.5 meters deep or greater requires a sides protection (close timbering and step cutting) unless the excavation is made entirely in stable rock. • Contractor to follow strict protocol during excavation and construction for longitudinal drain especially along the sensitive receptors like schools, religious places, community buildings, etc. • Excavated earth will be collected and disposed in pre-identified site with the approval of Authority Engineer. Excavated earth shall not be temporarily dump on the carriageway or shoulders. • Casted drain blocks and drain covers will not be stacked on the road.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		• To ensure elimination of excavation hazards, excavation will be carried in the presence of competent person. • Suitable barricading will be provided around the excavation site. • Proper outfalls will be provided for road side drains • Drains will be properly covered to avoid unsafe conditions to pedestrian. • Suitable personal protective equipment will be provided to the workers engaged in drain construction works.		
B.10	**Sensitive Receptors- Impact Management**			
B.10.1	Sensitive Receptors- Impact Management	• At each sensitive receptor like schools, religious places, community resources, etc and near general residential houses, the construction operations in these areas should be limited to time period of 7:30 am to 6:00 pm. • Periodic maintenance and calibration of construction equipment's/ vehicles to meet applicable CPCB emission standards. • Contractor to ensure regular dust suppression measures by way of standard and efficient water sprinkling through water tankers at these designated sensitive receptors. • Silencers/mufflers fitted construction equipment shall be used to control noise from construction activities. • Construction materials and debris will not be stored or dump near the settlements/populated areas. Debris generated from road /drain construction will be collected and disposed on daily basis. • Adequate barricading and signages will be provided in settlement areas and near schools, religious structures, community buildings, etc.	Contractor	Authority Engineer /PIU
B.11	**Pollution Control**			
B.11.1	Control of Water Pollution	The project road is crossing natural streams at places. The following water pollution control measures will be taken by the contractor: • The contractor will take necessary precautionary measures to prevent entering of wastewater into streams and water bodies during construction. • Contractor will avoid construction works close to the streams or water bodies during monsoon.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		• Construction vehicles shall not be washed in river water and shall not enter riverbed for that purpose. • Any type of construction wastes will not be disposed in rivers or water bodies. • Workers shall not be allowed to litter/defecate, bath or washing of cloth in the water bodies crossed by the project road. • Proper fixed or portable toilets fitted with septic tank and attached to soak pit will be provided for workers at bridges/culverts sites.		
B.11.2	Control of Water Pollution from Fuel and Lubricants	• The Contractor will ensure that all construction vehicle parking locations, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refuelling sites will be located at least 250 m away from rivers and water streams. • The Contractor will submit locations and layout plans of such sites prior to their establishment and will be approved by the Environmental Expert of Authority Engineer. • The contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refuelling will be carried out in such a manner that spillage of fuels and lubricants does not contaminate the ground and subsequently water channels. • Wastewater from vehicle parking, fuel storage areas, workshops, wash down and refuelling areas will be treated in an oil interceptor before discharging into on land. • Contractor will make arrangement for collection, storing and disposal of oily wastes to the pre-identified disposal sites as per guideline of State Pollution Control Board. • Oil spills and used oil from maintenance vehicles engines and of DG sets shall be disposed of in accordance with Himachal Pradesh Pollution Control Board (HPPCB) guidelines.	Contractor	Authority Engineer /PIU
B.11.3	Waste Water from Labour Camp	• Waste water generated from the sanitary facilities at labour camps/construction camps/toilers at bridge construction sites will be treated in septic tank followed by soak pit. • No untreated raw sewage/waste water will be discharged into any river and water body. • Workers will not be allowed for open defecation in any circumstances.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		• Proper fixed or portable toilets fitted with septic tank and soak pit will be provided for workers at small labour camps for bridges construction sites.		
B.12	**Air Pollution**			
B.12.1	Control of Dust Pollution	• Road construction works specially earth work and movement of construction vehicles plying on the road during construction phase may add to dust and gaseous air pollution along the project road. • Frequent dust suppression like water sprinkling on the road will be ensured by the use of water tankers. • The contractor will procure the construction machineries, which conforms to the pollution control norms specified by the MoEF&CC/CPCB/HPPCB. • Regular maintenance of vehicles to be used for materials transportation and equipment will be carried and vehicular pollution check will be mandatory. • The excavated earth /construction materials will be stored properly so that it does not generate fugitive emissions. • Cement bags will be stored and emptied in covered area to control fugitive dust emissions. • While handling and emptying cement bags, workers will wear masks, hand gloves and protective goggles. • Mask and other PPE shall be provided as a mandatory effort to the construction workers in dust prone areas.	Contractor	Authority Engineer /PIU
B.12.2	Emissions from Construction Vehicles, Equipment and Machineries	• The contractor will ensure that all vehicles, equipment and machineries used for construction works will regularly maintained and conform that pollution emission levels and comply with the requirements of CPCB and/Motor Vehicles Rules. • Pollution under control certificate (PUC) will be obtained for the all vehicles engaged in the construction, • DG sets will be provided with chimney of adequate height as per CPCB guidelines (Height of stack in meter = Height of the building + 0.2 √KVA). • Environmental monitoring will be carried out as per the monitoring plan.	Contractor	Authority Engineer /PIU
B.13	**Noise Pollution**			

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
B.13.1	Noise Levels from Construction Vehicles and Equipment's	The contractor will ensure the followings to control the noise levels and its impact: • All construction equipment used in excavation, cutting, paving, concreting, etc, will strictly conform to the MoEF&CC/CPCB/HPPCB/BIS noise standards. • All vehicles and equipment used for construction works will be fitted with exhaust silencers/mufflers. • Maintenance and servicing of all construction vehicles and machineries will be done regularly. • Only acoustic enclosures fitted DG sets will be allowed at the construction site and labour camp. • At the construction sites within 250 m of the nearest habitation, noisy construction work and use of high noise generation equipment will be stopped during the night time between 6.00 pm to 7.30 am. • Working hours of the construction activities will be restricted around educational institutes/health centers (silence zones) up to distance of 100 m from the sensitive receptors. • Noise monitoring shall be carried out in construction areas through the approved monitoring agency. • If controlled blasting for hills cutting is required, same shall be carried in daytime only.	Contractor	Authority Engineer /PIU
B.14	**Archaeological Resources and Cultural Properties**			
B.14.1	Chance Found Archaeological Property	• All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. • The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He/She will, immediately upon discovery thereof and before removal inform the Environmental Expert of the Authority Engineer/PIU of such discovery and carry out the PIU's instructions for dealing with the same, waiting which all work shall be stopped.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		• The PIU will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.		
B.14.2	Impacts Cultural Properties	• All necessary and adequate care shall be taken to minimize impact on cultural properties which includes cultural sites and remains, religious places, monuments and any other important structures as identified during design stage. • Relocation and enhancement measures shall be taken up as per design and in consultation with local community. • Access to such properties from the road shall be maintained clear and clean.	Contractor	Authority Engineer /PIU
B.15	**Personal Safety and Health**			
B.15.1	Personal Safety Measures for Labours and Staff	• The contractor will take necessary measures for the personal safety of workers during construction works: • Protective safety shoes, gum boots, helmet/hard hat, hand gloves, protective goggles, safety belt, etc (as required) will be provided to the workers engaged in construction works including excavation, steel rebaring and bending, concrete works, etc. • Welder's protective eye-shields will be provided to workers who are engaged in welding works in workshops and bridge construction sites. • Earplugs/earmuff will be provided to the workers exposed to high noise levels. • High visibility safety vests will be used by all workers when on construction sites. • The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. • The contractor will comply with all the precautions as required for ensuring the safety of the workmen as far as those are applicable to this contract. • The contractor will make sure that during the construction work all relevant provisions of Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		• The contractor will not employ any person below the age of 18 years for any work. • Contractor' environmental expert will carry out regular audit to identify unsafe conditions and necessary remedial measures will be taken to enhance safe working conditions in construction works.		
B.16.2	Emergency Management	• Emergency numbers will be displayed at the construction sites and camp sites, • First boxes will be made available at construction sites and camp sites, • Fire extinguishers for petroleum oil fire and electrical fire will be made available at camp sites, fuel storage sites, construction sites etc.	Contractor	Authority Engineer /PIU
B.16.3	Risk Force Measure	• The contractor will make required arrangements so that in case of any mishap during, operation of construction machinery/ vehicles, dismantling, excavation, hills cutting, concrete pouring, hot asphalt handling, etc all necessary steps can be taken for prompt first aid treatment. • Construction safety plan for the all the road stretches, embankment development, protection works, longitudinal drains, ancillary sites shall be prepared by the contractor and will identify necessary actions in the event of an emergency.	Contractor	Authority Engineer /PIU
B.16.4	First Aid Facility	• The contractor will arrange for first aid facility during construction works and at plants /camps sites: • A readily available first aid unit including an adequate supply of sterilized dressing materials, burn ointment and appliances as per the state rules will be maintained all the time by the contractor. • Availability of first aid trained persons will be ensured at the project site during construction phase. • Trained person for Cardio Pulmonary Resuscitation (CPR) at construction camps and bridge construction sites will be available. • Availability of suitable transport will be ensured all times to take injured or sick person(s) to the hospital. • Designated vehicles, which can be used as ambulance will be available at construction site at all the time.	Contractor	Authority Engineer /PIU
B.16.5	Occupational	• The contractor will prepare and follow the Occupational Health and Safety (OHS) plan, including provisions for emergency response plan	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
	Health and Safety of Workers	• All workers will be provided with requisite personal protective equipment. • Before deployment of workers at hot mix plant, WMM and Batching plants health check will be carried out. • Emergency Telephone Numbers shall be displayed at camp and plant site. • Necessary medical facilities shall be provided for workers at Labour camp and plant sites.		
B.17	**Labour/Construction Camp and Project Site Management**			
B.17.1	Labour Camp	• Proper barricading and boundary walls will be provided around the labour camp. • Project information board will be displayed at the labour camp site. • Emergency numbers and layout plan will be displayed at the entrance of camp site. • Electrical cables and wires will be properly arranged with proper electrical safety. Loose electrical connections will not be allowed at the labour camp. • Red danger sign with bone & skull will be displayed as per The Electrical Rules at three phase motors, electrical panels and electrical machines, DG sets, etc. • Housekeeping at labour camp will be maintained satisfactory. Daily sweeping and cleaning will be done at the labour camp. • HIV Aid awareness posters will be displayed at the camp site. • Solid waste generated at the camp site will be collected in covered waste bins. Then, it will be segregated as biodegradable (food waste, paper, etc) and non-biodegradable (plastic, polyethylene bag, etc) wastes. Polyethylene/plastic wastes will be stored and to be sent for recycling through scrap dealer. Biodegradable (food waste, etc) solid waste will be disposed in compost pit. Non-biodegradable inert wastes will be sent to nearest land fill site. • Drinking water, well ventilated accommodation with beds, sanitation, canteen facilities will be provided to workers at the labour camp. • Waste water and sewage accumulation will be not be allowed at and around the labour camps. • First aid facilities will be provided at the labour camp.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		• Wood shall not be used for cooking food for workers. LPG cylinder will be arranged and kept with proper safety. • Suitable signages will be displayed at labour camps. • There will be separate accommodation, toilet and bathrooms in case female worker are staying or working at labour camp.		
B.17.2	Accommodation for Laborers	• Contractor will follow all relevant provisions of the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp. • The location, layout and basic facility provision of labour camp will be submitted to Environmental Expert of Authority Engineer/PIU prior to their construction. • The construction will commence only upon the written approval of the Environmental Expert of Authority Engineer/PIU. • The contractor will provide necessary well ventilated living accommodation, toilets, bath rooms and ancillary facilities functional and in hygienic manner. • Proper ventilation along with standard exhaust fans will be provided in labour accommodation rooms. • Regular cleaning and sweeping will be ensured at the labour camp site. • Systematic waste collection management at labour /construction camps shall be managed as per Solid Wastes Management Rules 2016. • Standard first aid box including an adequate of sterilized dressing materials. • Mosquito nets shall be provided to all workers in the camps.	Contractor	Authority Engineer /PIU
B.17.3	HIV/AIDS Prevention Measures	• Necessary HIV/AIDS prevention measures will be taken at labour camp. • HIV/AIDS awareness program will be organized by the contractor's Environmental Officer.	Contractor	Authority Engineer /PIU
B.17.4	Potable Water for Workers	• The contractor will provide potable water facilities within the precincts of workplace, bridges/culverts construction sites and labour/construction camps at an accessible place, as per standards	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		set by the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. • If water storage tank is provided, same will be kept such that the bottom of the tank is at least 1 meter above the surrounding ground level. • If water is drawn from any existing well/ hand pump, which is within 30 meters proximity of any toilet, drain or other source of pollution, the handpump/well water will be disinfected before it is used for the drinking. • Environmental Expert of Authority Engineer/PIU will inspect the labour camp once in a week to ensure the compliance of the EMP.		
B.17.5	Sanitation and Sewage System at Labour Camp	The contractor will ensure that: • The sewage system for the camp will be designed, built and operated in such a manner that no health hazard occurs and no pollution to the air, soil, ground water or adjacent water courses takes place, • Separate toilets/bathrooms, as required, will be provided for male and female, marked in vernacular language, • Toilets will be provided with septic tank followed by soak pit. • Adequate water supply will be provided in all toilets and urinals, • Night soil can be disposed of with the help of municipality or will be disposed of in a earthen pit to produce manure.	Contractor	Authority Engineer /PIU
B.17.6	Solid Waste Collection and Disposal	• The contractor will provide garbage bins in the camp & construction site and ensure that these are regularly emptied and disposed of in a hygienic manner according to Solid Waste Management Plan as per Solid Waste Management Rule 2016. • Burning of solid wastes at construction site & labour camp, road side or at any other places will not be allowed. • Solid waste generated at the construction site & labour camps, will be collected in covered waste bins and segregated as biodegradable (food waste, paper, etc) and non-biodegradable (plastic, polyethylene bag, etc) wastes. Polyethylene/plastic wastes will be stored suitably and to be sent for recycling through scrap dealer. Biodegradable (food waste, paper, etc) solid waste will be disposed in the compost pit.	Contractor	Authority Engineer /PIU
B.18	**Environmental Monitoring**			

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
B.18.1	Environmental Monitoring-Construction Stage	• Environmental monitoring for ambient air quality, noise levels and ground and surface water quality will be carried out through NABL accredited laboratory as per environmental monitoring plan and in accordance to instruction of Environmental Expert of Authority Engineer/PIU.	Contractor	Authority Engineer /PIU
C.	**Sites Clean-up and Restoration (On Contractor's Demobilization)**			
C.1	Clean-up Operations, Restoration and Rehabilitation	• The contractor will prepare site restoration plan for construction work sites and labour/construction camp sites, which will be approved by the PIU / Environmental Expert of Authority Engineer. • The clean-up and site restoration works shall be implemented by the contractor prior to demobilization from construction site and labour/construction camps. • The contractor will clear all temporary structures, debris, construction wastes, garbage, night soils, etc in environmental sound manner. • All disposal pits or trenches will be filled in and effectively sealed off. • All construction places including camps and any other area used/affected due to the construction works will be left clean and tidy at the contractor's expense to the entire satisfaction to the PIU/ Environmental Expert of Authority Engineer.	Contractor	Authority Engineer /PIU
C.2	Land Rehabilitation	• All surfaces hardened due to construction activities will be ripped & imported materials thereon removed and disposed in environmental sound manner. • All rubbles to be removed from the sites shall be disposed in approved disposal site. Burying of rubble on site is prohibited. • Land surfaces of works sites and camps sites shall be checked for waste materials from activities such as concreting or asphalting and cleared in a manner approved by the PIU/ Environmental Expert of Authority Engineer. • All embankments will be trimmed, shaped and replanted to the satisfaction of the PIU.	Contractor	Authority Engineer /PIU
C.3	Borrow Area Rehabilitation	• Borrow pits shall be closed and rehabilitated in accordance with the pre-approved Borrow Area Rehabilitation and management plan for each borrow area. • The contractor shall maintain record of borrow areas used for the subproject keeping photographs of before after its rehabilitation.	Contractor	Authority Engineer /PIU

S. No.	Environmental Issues	Environmental Mitigation Measures	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		• IRC guidelines shall be followed for rehabilitation of borrow areas. Borrow areas shall be rehabilitated by levelling of land for agriculture or other purpose, developing fish or water harvesting ponds, etc as per owner choice and satisfaction.		
D	**Post Construction Stage**			
D.1	Environmental Monitoring- Post Construction Stage	Environmental monitoring for ambient air quality, noise levels and water quality as per environmental monitoring plan and in accordance to instruction of Environmental Expert of PIU.	PIU	PMU
D.2	Monitoring of Bio-Engineering and Landscaping	• Regular monitoring of bio-engineering measures and landscaping shall be carried for its performance and survival rate. • Provision will be made for manure application and watering as required.	PIU	PMU
D.3	Soil Erosion and Monitoring of Borrow Areas	• Visual monitoring and inspection of erosion of slopes, conditions of slope stabilisation measures, hills cutting slopes will be carried regularly. • Frequency of monitoring and inspection will be increased during monsoon season.	PIU	PMU

Note: Management measures for labour influx management, labour-management procedures and Gender Based Violence (GBV) have been covered in SIA.

8.5 CLAUSE FOR NONCONFORMITY TO EMP

The Contractor will implement necessary mitigation measures for which responsibility is assigned to him as stipulated in the EMP. Any lapse in implementing the same will attract the damage clause as detailed below:

- Any complaints of public, within the scope of the Contractor, formally registered with the PIU and communicated to the Contractor, which is not properly addressed within the time period intimated by the PIU shall be treated as a major lapse.
- Non-conformity to any of the mitigation measures like unsafe conditions, non-collection of excavated material (during laying of drainage pipes) regularly and other unattended Health, Safety & Environment (HSE) issues, as stipulated in the EMP Report (other than stated above) shall be considered as a minor lapse.
- On observing any lapses, PIU shall issue a notice to the Contractor, to rectify the same.
- Any minor lapse for which notice was issued and not rectified, first and second reminders shall be given after ten days from the original notice date and first reminder date respectively. Any minor lapse, which is not rectified, shall be treated as a major lapse from the date of issuing the second reminder.
- If a major lapse is not rectified upon receiving the notice PIU shall invoke reduction, in the subsequent interim payment certificate.
- For major lapses, 10% of the interim payment certificate will be withheld, subject to a maximum limit of about 0.5% of the contract value.
- If the lapse is not rectified within one month after withholding the payment, the amount withheld shall be forfeited immediately.

8.6 ENVIRONMENTAL MONITORING PLAN

The monitoring programme consists of performance indicators, reporting formats and necessary budgetary provisions. The contractors monitoring plan should be in accordance with the baseline environmental monitoring, locations provided in the environmental impact assessment report.

The monitoring plan has the following objectives:

- To ensure effectiveness of implementation of EMP
- To evaluate the performance of mitigation measures proposed in the EMP
- To comply with all applicable environmental, safety, labour and local legislation
- To ensure that public opinions and obligations are taken into account and respected to the required satisfaction level
- To modify the mitigation measures or implementing additional measures, if required

8.7 PERFORMANCE MONITORING INDICATORS

Environmental components identified of a significance in affecting the environment at critical locations have been suggested as Performance Indicators. For example, near the construction site, a thick layer of dust over the nearby vegetation/leaf is an indication that the dust control measures are not effective. The performance indicators will be evaluated under three heads as mentioned below:

- Environmental condition indicators to determine efficacy of environmental mitigation measures for controlling air, noise and water pollution.
- Environmental management indicators to determine compliance with the suggested environmental management measures.
- Operational performance indicators have also been devised to determine efficacy and usefulness of the proposed mitigation measures for the project road.

The performance indicators and monitoring plan prepared for the project road are presented in **Table 8.10**. Details of the performance indicators parameters for each of the component have to be identified and reported during all stages of the implementation.

Table 8.10: Performance Indicators and Monitoring Plan

Sn.	Description of Item	Indicator	Stage	Responsibility
1.	Identification and verification of the earth borrow areas and stone quarries	Compliance of site selection criteria	Preconstruction	Contractor
2.	Identification of locations for the construction camp and construction plants sites	Compliance of site selection criteria	Preconstruction Phase	Contractor
3.	Progress on the tree cutting	Tree Cutting numbers	Preconstruction Phase	PIU/PMU
4.	Location of the temporary storage areas for excavated materials to be reused in road construction, embankment and sub grade.	Storage of excavated/cutting materials	Preconstruction and Construction Phase	Contractor
5.	Implementation of mitigation measures specified in the EMP	Prevention/ Control of Pollution	Construction Phase	Contractor
6.	Environmental monitoring as per the conditions stipulated in the consents / as described in environmental monitoring plan	Environmental conditions at construction Sites/plants/ camps	Construction Phase	Contractor

Sn.	Description of Item	Indicator	Stage	Responsibility
7.	Environmental monitoring in accordance with the frequency and duration of monitoring as well as the locations as per the monitoring plan**.** Before the onset of monsoon all the debris/excavated materials will be cleaned from the work sites and disposed of temporarily stock piled debris for final disposal properly away from the water bodies.	Ambient Air Quality, Ambient Noise Level, Ground and Surface Water Quality, Silting of Water bodies	Construction Phase	Contractor through External agency and will be supervised by the Environmental Expert of Authority Engineer/PIU / PMC
8.	Monitoring of work zone safety	Use of PPEs and signages.	Construction Phase	Contractor and will be supervised by the Environmental Expert of Authority Engineer / PMC
9.	Implementation of the enhancement measures suggested for the pond redevelopment areas, cultural/community properties	Enhancements/ Shifting	Construction Phase	Contractor
10.	Reporting of accidents at work sites/road construction sites	Accidents Reporting	Construction Phase	Contractor
11.	Plantation of shrubs and grass and bio-engineering measures on cutting slopes/high embankment/ enhancement sites	Landscaping	Construction and Defect Liability Period	Contractor
12.	Compensatory tree plantation and reporting of the survival rate. The survival rate should be monitored and reported on quarterly basis.	Tree Plantation and Survival Rate	Construction and Post operation Stage	Forest Department and PMU/PIU
13.	Inspection and verification of the borrow area	Status of Borrow Areas	Construction and	Contractor & PMU/PIU

Sn.	Description of Item	Indicator	Stage	Responsibility
	redevelopment as specified in the redevelopment plan and satisfaction of the owners/IRC guidelines		Post operation Stage	
14.	Site restoration/de-mobilization of camps and plant on completion of works	Clean-up and restoration of the sites.	De-mobilization	Contractor and will be supervised by the Environmental Expert of Authority Engineer / PMC

8.8 MONITORING PARAMETERS AND STANDARDS

The environmental monitoring parameters and National Ambient Air Quality Standards are discussed below:

8.8.1. Ambient Air Quality Monitoring (AAQM)

The ambient air quality parameters viz: Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Particulate Matters (PM_{10}, $PM_{2.5}$), shall be monitored six monthly at identified locations from the start of the construction activity. The ambient air quality parameters shall be monitored in accordance with the National Ambient Air Quality Standards as given in **Table 8.11**. The duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan.

Table 8.11: National Ambient Air Quality Standards

Sl. No	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural & other areas	Ecologically Sensitive Area (Notified by Central Government)	Methods of Measurement
1	Sulphur Dioxide, (SO_2), µg/m^3	Annual* 24 hours**	50 80	20 10	-Improved West and Gaeke -Ultraviolet fluorescence
2	Nitrogen Dioxide, (NO_2) µg/m^3	Annual* 24 hours**	40 80	30 80	-Modified Jacob & Hochhieser (Na-Arsenite) -Chemiluminescence
3	Particulate Matter(size less than 10 µm), or PM_{10} µg/m^3	Annual* 24 hours**	60 100	60 100	-Gravimetric -TOEM -Beta attenuation

4	Particulate Matter(size less than 2.5 µm), or $PM_{2.5}$ µg/m^3	Annual* 24 hours**	40 60	40 60	-Gravimetric -TOEM -Beta attenuation
5	Carbon Monoxide (CO), µg/m^3	8 hours* 1 hours**	02 04	02 04	-Non Dispersive Infra Red (NDIR) spectroscopy

**Annual arithmetic* *mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals*

***24 hourly* or *(8 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.*

8.8.2. Noise Quality Monitoring

The noise levels shall be monitored at designated locations in accordance with the Ambient Noise Quality standards given in **Table 8.12**. The duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan**.**

Table 8.12: National Ambient Noise Quality Standards

Area Code	Category of Zones	Limits of Leq in dB(A}	
		Day*	Night*
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence Zone**	50	40

**Daytime shall mean from 6:000m to 10:00 pm and Night shall mean from 10:00 pm to 6:00 am*

***Silence zone is defined an area up to 100 meters around premises of hospitals, educational institutions and courts, Use of vehicles horns, loud speakers and bursting of crackers are banned in these zones*

8.8.3. Water Quality Monitoring

Water quality parameters such as pH, BOD, COD, DO coli form count, total suspended solids, total dissolved solids, Hardness, Conductivity etc. shall be monitored at identified locations during the construction stage as per standards prescribed by Central Pollution Control Board specifications presented in **Table 8.13** The duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan.

Table 8.13: Surface Water Standards

S. No	Parameters	IS:2296 (Class C)	Method Adopted
1.	pH	6.5-8.5	pH meter
2.	BOD (3 day, 27^0C)	3.0	DO-Azide modification of Wrinkler's Method
3.	Temperature (^{0}C)	NS	Thermometer
4.	Dissolved oxygen	4	Azide modification of Wrinkler's method
5.	Color (Hazen)	300	Visual Comparison method
6.	Chloride (Cl)	600	Argentometric Titration
7.	Total Dissolved Solids	1500	Gravimetric Analysis
8.	Sulphates (SO_4)	400	Barium Chloride method

S. No	Parameters	IS:2296 (Class C)	Method Adopted
9.	Oil and Grease	0.1	Partition -Gravimetric method
10.	Nitrates	50	Chromotropic acid
11.	Total Coliform (MPN/100 ml)	5000	Multiple Tube Fermentation Technique

NS: Not specified. All the values in mg/l if otherwise mentioned

8.9 MONITORING PLANS FOR ENVIRONMENT CONDITIONS

For each of the environmental components, the environmental monitoring plan specifies the parameters to be monitored; location of the monitoring sites and duration of monitoring. The monitoring plan also specifies the applicable standards, implementation and supervising responsibilities. The monitoring plan for the various environmental condition indicators of the project in construction stages is presented in **Table 8.14** Monitoring plan does not include the requirement of arising out of regulation provision such as obtaining Consents for plant site operation.

Table 8.14: Brief Description of Measures

Sl. No.	Locations of Work Site	Site Safety Measures
1	Construction Sites	Caution boards, Safety Cones, Delineators
2	Deep Cutting	The construction zone should be barricaded with G.I Sheet or arrangement to be made as per plan approved by the PIU / PMU. [Provide Safety Sign Boards and Safety Barriers marked with reflective tapes]
3	Temporary Diversion (if any)	Diversion Board, Barricading [Provide 'Diversion Ahead' boards at 50m, 100m and 150m ahead of diversions with reflective tape for illumination at night at the all diverted locations]
4	Safety for the Workers	Helmets, Safety-Shoes, Goggles, Dusk mask. etc

Furthermore, periodical site monitoring should be carried out by the Environmental Expert of PIU for surveillance & monitoring of road safety during the road construction. The brief description of measures has been given in **Table 8.15**:

Table 8.15: Environmental Monitoring Plan

Attribute	Timing	Parameter	Standards	Frequency	Duration	Location	Implementation
Ambient Air	Construction	$PM_{2.5}$, PM_{10}, SO_2, NO_2 & CO	National Ambient Air Quality Standards (NAAQM) 2009	Two samples for one week (on non consecutive days) for in winter and summer seasons (six monthly).	24 Hours Sampling, 2 Samples in on Week	Construction labour camps, plants sites and settlements along the work zones (Locations will be decided by Environmental Expert of Authority Engineer /PIU)	Contractor
Ground Water	Construction	Organoleptic and Physical, Chemical & Bacteriological Parameters	Potable Water Standards (IS 10500: 2012)	Winter and Summer Seasons	Grab Sampling Once	Construction labour camp, plants sites, settlements along the work zones (locations will be decided by Environmental Expert of Authority Engineer /PIU)	Contractor
Surface Water	Construction	pH, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), BOD, COD, Oil & Grease (O&G) and Turbidity	Indian Standards (IS:2296-1982) for inland surface waters	Winter and Summer Seasons	Grab Sampling Once from	Construction labour camp, plants sites, River and Ponds (locations will be decided by Environmental Expert of Authority Engineer /PIU)	Contractor
Noise	Construction	Level Equivalent L_{Day} and L_{Night} based on hourly Noise Measurements	Ambient Noise Standards	Winter and Summer Seasons	Hourly noise measurements for one day in winter and summer seasons	Construction labour camp, plants sites, settlements along the work zones (locations will be decided by Environmental Expert of Authority Engineer /PIU)	Contractor

8.10 Resource Efficiency, Green Highway and Climate Resilience

Resource efficiency: The project road includes the following measures towards increasing resource efficiency:

- Re-using cut material in the construction of pavement, structures, slope protection works and construction of parking/loading and unloading facilities.
- Use of local aggregates (stone) for construction of gabions, parapet walls, breast walls, retaining walls, drains, pitching etc.
- Minimizing the requirement of crushed stone for construction of pavement layers
- use of cement in concrete construction by using locally available conglomerate and hard sand stone in stabilization of sub-base layers in order to provide more strength to the newly constructed highway, gabion walls, breast walls, and retaining walls.
- Using the bituminous materials of existing crust after recycling.
- Minimizing the use of high-grade cement in concrete construction by using locally available low heat generating low-grade cement which will reduce the heat and carbon emission.

Green Highway: The proposed project includes the following specific interventions towards the 'green highway' concept:

- The project will not require any borrow material (i.e. aggregate and soil) for construction of pavement as cut material will be used for embankment and slopes.
- Restoring the green cover that would be lost due to widening of the highway, as per the conditions in tree felling permission obtained from the State Forest department which stipulates the ratio of 1:3.
- Water conservation through rainwater harvesting, creation of artificial storage ponds, use of energy dissipation techniques such as use of gabion walls (~16 km) in steps, channelization of water. Efforts would be made to conserve and utilize the traditional rain water harvesting structures ("khaatary") present along the stretch.
- Provision of solar lighting in all the built-up areas along the project stretch.
- Reducing requirement in quantity of bitumen and its transportation by using recycling of existing asphalt/bituminous wearing course and reducing the corresponding transportation requirements.
- Gabion walls, retailing walls, breast walls, parapet walls etc. will be built using locally available cut material in lieu of concrete walls and thereby reducing the necessity of procurement of materials (stones, cement, crushed aggregates, sand etc.) and their transportation requirements.

Climate Resilience: The proposed project highway would incorporate the following measures for enhanced climate resilience:

- Bioengineering along the project stretch in the form of hedge brush layers, turfing and bamboo net plantation.

- Water management through water conservation and use of energy dissipation techniques.
- Providing roadside drainage throughout the project stretch.
- Increasing life of pavement and protection of slide slopes by providing sub-surface drainage for quick and efficient discharge of water (to act as a cut-off drain) on some road stretches, and roadside drainage throughout the project stretch.

8.11 ENVIRONMENTAL REPORTING SYSTEM

The environmental reporting system for the suggested monitoring programme will function at two levels:

- Reporting for environmental condition indicators and environmental management indicators
- Reporting for operational performance indicators at the PMU/PIU level. Environmental monitoring involves regular checking of the environmental management issues detailed in the EMP and to ascertain whether the mitigation measures are achieving desired objectives for environmental protection, with the progress of the works. It provides the necessary feedback for the project management to keep the programme on schedule for achieving the expected outcomes.

The contractor, Authority Engineer /PMC and PIU/PMU will operate the reporting system for environmental conditions and environmental management indicators. The reporting system is presented in **Table 8.16**. The reporting schedule for contractors and Authority Engineer have been prepared, which are on the basis of the implementation of EMP by the Contractor and monitoring by the Authority Engineer /PMC and PMU/PIU.

The reporting system will start with the Contractor who is the main executor of the implementation EMP activities. The Contractor will report to the Authority Engineer /PMC, who in turn will report to the PMU/PIU. The reporting system will comprise the following:

- The contractor will submit monthly environmental compliance reports along with formal monthly project progress report to the Authority Engineer
- The Authority Engineer will submit separate quarterly environmental monitoring reports to PMU/PIU in addition to submission of the summary of the activities of the month in the formal monthly report including any deviations and corrective actions
- PMU/PIU will be responsible for the preparation of the targets for identified non compliances for the EMP compliance
- Solutions for further effective implementation may also emerge as a result of the compliance monitoring reports.

The photographic records will be kept providing useful environmental monitoring tools. All material sources points, disposal locations, plants locations, camp locations, crusher locations etc will be photographed (for before and after conditions) and kept as a record will be part of progress report. A full record of construction activities and EMP implementation will be kept as part of normal contract monitoring system. The reporting and monitoring systems for various stages of construction and related activities have been proposed in **Table 8.16**.

Table 8.16: Environmental Reporting System

Item	Contractor	Construction Supervision Consultant (Authority Engineer /PMC)		PMU/PIU	
	Implementation and Reporting to Authority Engineer /PMC	Supervision	Reporting to PMU/PIU	Oversee Compliance Monitoring	Report to World Bank
Pre-construction Stage					
Sites of Camps and Plants	Weekly	Weekly	Monthly	Monthly	Quarterly
Locations of Borrow Area	Weekly	Weekly	Monthly	Monthly	Quarterly
Location of Stone Quarry	Weekly	Weekly	Monthly	Monthly	Quarterly
Shifting of Community/ Cultural Structures	Weekly	Weekly	Monthly	Monthly	Quarterly
Tree cutting and Clearing of Vegetation	Weekly	Weekly	Weekly	Weekly	Monthly
Construction Stage					
Monitoring of construction site and construction camp	Regular	Regular	Monthly	Monthly	Quarterly
Pollution Monitoring	Six Monthly	As required	In Monthly Report	In Quarterly Report	In Quarterly Report
Monitoring of Enhancements	Weekly	Weekly	Monthly	Monthly	Quarterly
Top soil preservations	Weekly	Weekly	Monthly	Monthly	Quarterly
Borrow area/ quarry area/ debris disposal area	Weekly	Weekly	Monthly	Monthly	Quarterly
Bio-engineering and landscaping	Monthly	Monthly	Monthly	Monthly	Quarterly

Site Restoration Demobilization of Plants					
Clean-up of plants & camps sites and Restoration of Sites	Monthly	Monthly	Monthly	Monthly	Quarterly

8.12 INSTITUTIONAL ARRANGEMENTS FOR ENVIRONMENTAL MANAGEMENT

The environmental management requirements/guidelines/plans need to be applied and implemented at all stages of the project. This requires an institutional mechanism to deal with various processes and requirements at each stage. Within the institutional framework proposed for the project, preparation, implementation, supervision and monitoring of environment functions, particularly the Environment Management Plans (EMP), will be carried out at the three levels - national center, state level and the project/community level with an inbuilt mechanism for coordinating activities between the said levels.

8.12.1 Implementation Structure

The Externally-Aided Projects Cell (EAP-Cell) at MoRTH, supported by a Project Management Consultants (PMC), will have the overall project implementation responsibility.

At the central level, the Chief Engineer, Externally Assisted Projects (CE, EAP), MoRTH, Govt. of India will be responsible for the over-all implementation of EMF and EMP. The CE, EAP will have all delegated administrative and financial decisions regarding the implementation of the project as well as environment management and safeguard related functions. CE (EAP) will be assisted by a team comprising Executive Engineer (EE) designated as an Environment and Social Officer (ESO) and a suitable number of technical and secretarial staff. The EE will ensure that all project activities are complied with as per the EMF and EMP.

MoRTH will engage a Project Management Consultant (PMC), which will include an Environment Specialist, to work with the CE, EAP's team. The PMC will be responsible for training, guidance, and recommendations for handling policy and implementation issues at the state and sub-project levels to comply with the EMF and requirements laid out in the EMP.

At the state level, the National Highways (NH) divisions in the state Public Works Department will be responsible for the project execution. In Project Co-ordination Unit, there will be an Environment Officer who will coordinate the preparation/implementation of EMP. He/she will ensure that these comply with requirements laid out in the EMF for GNHCP and are implemented in accordance to provisions laid out in the contract documents.

Finally, for the project road, a Project Site Team (PST) or Project Implementation Unit (PIU) will be responsible. The PST, to be headed by Executive Engineer, will oversee the EMP implementation. An Assistant Executive Engineer will support him in day to day implementation of environment, health and safety plan, including on issues pertaining to tree cutting, plantation works, utility relocation and worksite safety management.

Supervision consultant/ Authority Engineer to be engaged by MORTH will provide the regular supervision and administration services. The Authority Engineer's team will have Environment and Safety personnel for day-to-day supervision and monitoring. The Environmental and Safety Officer on the Contractor's team[1] must ensure compliance with the environmental contractual clauses and will report on progress or challenges to the Construction Supervisory team, as per the requirements/obligations stated in the Contract Document.

Independent Quality Assurance Consultants (QAC) would be engaged to oversee the quality of the green national highway upgrading contracts, including environment management, health and safety related aspects. This will determine whether the project is complying with regulatory performance standards. It entails a systematic, documented and periodic review of project implementation and could be a useful tool to improve project management performance on EHS aspects.

8.13 GRIEVANCE REDRESSAL MECHANISM

Grievance Redressal Mechanism (GRM) arrangements to address public/workers' grievances has been described in SIA.

8.14 ENVIRONMENTAL MANAGEMENT – BUDGET

8.14.1 Implementation of Environmental Management

The environmental budget for the various environmental management measures proposed for construction and post operation of the project road is detailed in **Table 8.17**. There are several other environmental issues that have been addressed as part of good engineering practices, the costs for which have been accounted for in the engineering cost.

[1] The 120 Km package will be divided into contracts. Each Contract will have Environmental & Safety Officer.

Table 8.17: Budget for Implementation of Environmental Management Plan

Sr. No	Component	Item	Unit Cost (INR)	Quantity	Total Cost
A. Construction Stage					
1.	Tree Cutting	Cutting of Roadside Trees for construction of road	Cost to be part of DPR		
2.	Environmental Monitoring	Ambient Air Quality noise and surface and ground water Monitoring as per monitoring plan,	Lump sum		1200000
3.	Topsoil Management				
4.	Air	Dust Suppression Measures	Cost to be part of DPR		
5.	Labour camp and ancillary facilities	Labour Camp and all associated facilities as per EMP	Cost to be part of DPR		
6.	Personal Protective Equipment's (PPE's)	Personal Protective Equipment like vest, helmet, safety shoe, hand gloves, gumboots, earplug, Harness belt, Welding Glasses etc	Cost to be part of DPR		
7.	First Aid Kits	First Aid Kits at the construction site, camp and ancillary sites	Cost to be part of DPR		
8.	Compensatory Plantation	Replantation of Trees (1:3)	**1500**	88800	133200000
9.	Oil Interceptor	Oil Interceptor at Workshop at Camp Site	150000		150000
10.	Borrow Area Rehabilitation and Quarry Management	Rehabilitation and Restoration	Cost to be part of DPR		
11.	Slope Protection Measures	Gabion, Stone Pitching, Bioengineering, etc	Cost to be part of DPR		
12.	Debris and Waste Disposal	Solid wastes, demolition Wastes, Hazardous Wastes	Cost to be part of DPR		
13.	Display of Safety Signages and Work Zone Safety	Sign boards, retro reflective tapes, cones, barriers	Cost to be part of DPR		
	Project Enhancement				
14.	Development of Debris/Muck Disposal Sites	Parking, apples storage area, playground, etc	Cost to be part of DPR		
15..	Embankment Strengthening (By way of plantation)	Grass engraining with indigenous shrubs	Cost to be part of DPR		
16.	Protection on bridges, culvert and on high embankment	Slope protection measures	Cost to be part of DPR		
17.	Shifting of Community Property Resources,	Shifting and relocation	Cost to be part of DPR		
18.	Capacity building	Lumpsum Budget for Capacity Building	350000		
19.	Environmental Monitoring	Lumpsum Budget for Environmental Monitoring	1000000		
	Contingency Cost @ 5%				**6795000**
	Total Budget Cost				**142695000**