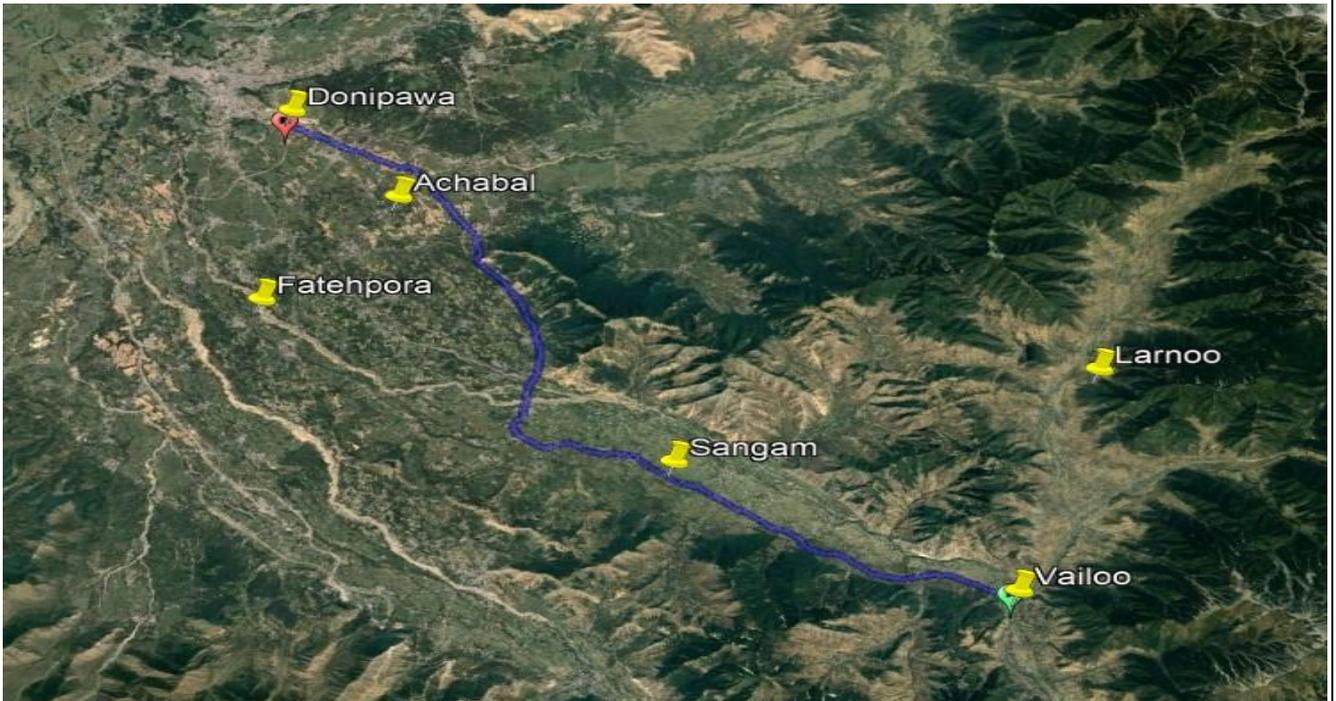




National Highways & Infrastructure Development Corporation Ltd.
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Consultancy Services for Preparation of Detailed Project Report for intermittent Two Lane plus Paved Shoulder stretches to Four Lane in between Design Km 148+589 (Existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir.



Final Detailed Project Report

**Vailoo to Donipawa on Khellani-Khanabal Section NH-244
August, 2025**

Volume-I: Main Report

Prepared by:

**Technocrat Advisory Services Pvt. Ltd
In association with
Space Engineers Consortium Pvt. Ltd**



Table of Contents

0.1 Executive Summary	6
0.11. Introduction	6
0.2 Project Overview	6
2.1 Key Features of Project	7
0.3 Project Description	8-9
0.3.1 Existing Road Features	10
0.3.2 Existing Condition of Project Road.....	10
0.3.3 Road Junction.....	10
0.3.4 Existing Bridge & Cross Drainage Structures	10
0.4. Traffic Surveys Anlysis and Forecast.....	11
0.4.1 Classified Volume Count Survey	11
0.4.2 Turning Movement Count.....	12
0.4.3 Axle Load Survey	13
0.4.4 Speed Delay Survey	13
0.4.5 Growth Rate	14
0.5 Improvement Propoals	14
0.5.1 Widening Scheme	14-20
0.5.2 major Bridge/ Minor Bridge & Cross Drainage Structures	20
0.5.3 Culverts.....	20
0.5.4 Drainage Works	20-24
0.5.5 Protection Works	24-28
0.6 Environmental Impact Assessment	28
0.6.1 Social Screening.....	28-29
0.7 Land Acquistion Requirement	29
0.8 Material Investigation	29
0.8.1 Borrow Pits for Soil	29
0.8.2 Sand	29
0.8.3 Gravel.....	29-30
0.8.4 Bitumen.....	30
0.8.5 Cement.....	30
0.9 Cost Estimate	30-32
.10 Conclusion and Recommendations	33
1.0 Introduction.....	34
1.1 General.....	34
1.2 Overview of MORT&H, NHDP and Project Financing.....	34
1.2.1 Introduction.....	34-35
1.2.2 Ministry of Road Transport & Highwys	35
1.2.2.1 Organizational Set-Up.....	35-38
1.2.3 NHDP.....	39
1.2.3.1 General.....	39
1.2.3.2 Need of NHDP	39-40
1.2.3.3 NHDP Phase	40-41
1.2.3.4 Finance Mechanisms.....	41-43
1.2.3.5 Policy Initiatives for Attracting private Investment	43
1.3 The Consultant.....	43-44
1.4 Objectives of Consultancy	44

1.5 Scope of Services	45
1.5.1 ROW and Land Related Aspects.....	45-50
1.5.2 General.....	51-53
1.6 Project Stages.....	53-54
1.7 The Draft Detailed Project Report	54-55
2.0 Socio-Economic Profile of the Project Influence Area	55
2.1 Background.....	55
2.2 Delineation of the Project Influence Area (PIA)	55
2.3 Classified Volume Count Survey	55
2.3.1 Jammu and Kashmir (Union Territory).....	55
2.3.1.1 Location and Geography	55-56
2.3.1.2 Administrative Setup.....	56-57
2.3.1.3 Demographic Features	57-58
2.3.2 Anantnag District	58
2.3.2.1 Location and Geography	58-60
2.3.2.3 Temperature in Anantnag.....	60-61
2.3.2.4 Administrative Setup.....	61-62
2.3.2.5 Climate.....	63
2.4 Employment pattern and Economy	64-68
2.4.1 Agriculture and Irrigation	68-71
2.4.2 Industrialization and Minerals	71-74
2.5 Transport System Network	74
2.5.1 Roads	74-75
2.5.2 Railways.....	75-78
3.0 Traffic Surveys and Analysis	79
3.1 General.....	79
3.2 Objectives	79
3.3 Project Road.....	79-80
3.4 Traffic Homogeneous Section.....	80-81
3.5 Traffic Surveys Schedule.....	81-83
3.6 Traffic Surveys Methodology	83
3.6.1 Classified Volume Count Survey.....	83
3.6.2 Axle Load Spectrum Survey	83
3.6.3 Origin-Destination and Commodity Movement Survey.....	84
3.6.4 Intersection Volume Count Survey	85
3.6.5 Speed and Delay Survey	85
3.7 Analysis of Traffic Surveys-Base Year Traffic Estimation.....	86
3.7.1 General.....	86
3.7.2 Classification of Vehicles and PCU Values	86-87
3.8 Analysis of Classified Volume Count Survey.....	87
3.8.1 Average Daily Traffic (ADT)	87-89
3.8.2 Traffic Composition.....	89
3.9 Estimation Seasonal Correction factors	89-90
3.10 Annual Average Daily Traffic (AADT).....	90-91
3.11 Axle Load Survey	91-92
3.12 Analysis of Origin-Destination (O-D) & Commodity Movement Survey	92
3.12.1 General	92

3.12.2 Zoning System	92-94
3.12.2.1 Discussion	94
3.12.2.2 Development of Origin Destination Matrices and Travel Characteristics	94-95
3.13 Analysis of Intersection Volume Count Survey	95
3.14 Analysis of Speed & Delay Survey	95-96
4.0 Engineering Survey, Material Investigation & Pavement Design	97
4.1 General	97-97
4.2 Inventory and Condition Survey of Road and Pavement	98
4.2.1 Road Inventory Survey	97-98
4.2.1.1 Existing Carriageway	98
4.2.1.2 Alignment and Geometry	98
4.2.1.3 Terrian and Land Use	98
4.2.1.4 Existing Major Intersections	98-99
4.2.15 Embankment and Surface Drainage	99
4.2.1.6 Existing Railway Crossings/ROB	100
4.2.2 Pavement Condition Survey	101
4.2.2.1 Condition Survey of Pavement	100
4.2.2.2 Pavement Condition Survey by Visual Inspection	101
4.3 Topographic Survey	102-103
4.4 Pavement Investigation	104-105
4.5 Sub grade Investigations	106-108
4.6 Source of Material	109
4.7 Inventory and condition survey of bridges and culverts	109-110
4.8 Manufactured Materials	111-112
5.0 Traffic Demand Forecast	113
5.1 Approach	113
5.2 Past Trends in Traffic growth	113
5.3 Past trend in growth of registered vehicle	113-113
5.4 Econometric Model Method (IRC-108:2015)	114-114
5.5 Past Trends in Economy and Population	115-117
5.6 Estimation of Corridor Traffic and Projection	118-118
5.7 Capacity Analysis and Level of Services	119
5.8 Lane Requirements	120
5.9 Lane Improvement Proposals	120-120
5.10 Intersection Improvement Proposals	120-121
5.11 Pedestrians Crossing Facilities	121
6.0 Social Impact Assessment of the Project Influence Area	122
6.1 Introduction	122
6.2 Objectives	122-143
6.3 About the Project Influence Area	144-151
6.4 Socio Economic Profile of Project Road	153-163
6.5 Stakeholder Consultation	164-164
6.6 Existing Key socio-economic issues and Risks of the Project	165-165
6.7 Access to government programs:	166-167
6.8 Resettlement policy and Framework	168
6.9 Land Acquisition and Budget	170-170
6.10 Environmental and Social Management & Capacity Building Consultant	171-171

6.11	Recommendation and Conclusion.....	172-174
7.0	Environmental Impact Assessment of the Project Influence Area	175
7.1	Introduction.....	175-188
7.2	Methodology Adopted for Environment Screening Exercise	1888-190
8.0	Improvement Proposals and Design.....	190
8.1	General.....	190
8.2	Design Standards	190-229
8.3	Widening Scheme	229-230
8.4	Requirement of bypass.....	230
8.5	Geometric Improvement Design	231
8.6	Improvement of Bridges	231-240
8.7	Formation Width for New Bridges and Culverts.....	240
8.8	Drainage Design.....	240-249
8.9	Road Markings, Signs and Other Safety Devices.....	249-250
8.10	Pavement Design	250-254
9.0	Cost Estimate	255
9.1	Introduction and Assumptions	255
9.2	Adoption of Unit Rates	255-256
9.3	Bill of Quantities for Civil Works.....	256-260
9.4	Costing for safety devices	260
9.5	Land Acquisition Cost	261
9.6	Cost of R&R	262
9.7	Total Cost Estimate.....	262
10.0	Conclusion and Recommendations	263
10.1	General.....	263
10.2	Project Clearances.....	263
10.3	Recommendations.....	263-264

0.0 Executive Summary

0.1 Introduction

The National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has assigned M/S Technocrat Advisory Services Pvt. Ltd In association with Space Engineers Consortium Pvt. Ltd as Consultants to carry out the "Consultancy Services for Preparation of Detailed Project Report for intermittent Two Lane plus Paved Shoulder stretches to Four Lane in between Design Km 148+589 (Existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir

The agreement was signed on 07 Nov 2024.

Proposals is hereby invited from eligible Consultants for Preparation of Detailed Project Report for intermittent Two Lane plus Paved Shoulder stretches to Four Lane in between Design Km 148+589 (Existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir. The Letter of Invitation (LOI) and Terms of Reference (ToR) including Request for Proposal (RFP) is available online on e-tender portal of <https://eprocure.gov.in>. The document can also be downloaded from NHIDCL website (www.nhidcl.com). NHIDCL Office Order dated 22nd March 2023 may be referred

However, end point of the project stretch shall be Donipawa at existing km 176+532 as per direction of NHIDCL official. Start point at Vailoo (Existing Km 148+589) and end at Donipawa (Existing km 176+532 i.e. Start of the Vailoo - Donipawa).

0.2 Project Overview

The project road lies on NH-244 (previously NH-18) and connects Batote with Khanbal, passing through the Union territory of Jammu & Kashmir. The proposed project alignment passes through Vailoo town. Achabal, Kokernag, Donipawa for a total length of 8.643 km. location of project road is shown in the fig. 0.1 below:



2.1 Key features of project

Key features of project road are represented in **Table 1**

Attributes	Details
NH No	244
Origin-Destination	Vailoo-Donipawa 33.564769 N, 75.358204 E 33.683576 N, 75.219166 E
Via Town	Vailoo, Achabal, Kokernag
Existing Carriageway	2 lane (7m) with paved shoulder 1.5 m & earthen shoulder 1 m
Service lanes and slip road	Nil
Condition of Existing Pavement	Good
Right of Way	30m
Land Use along project road	Built up & Agricultural
Structures along the stretches	Major Bridge at Hillar-1 no. Minor Bridge-8 no's, and Culverts-36 nos.
Terrain	Plain and Rolling
Key utilities in the proposed ROW	Electric poles & water pipeline etc.
Forest stretches along Row	Nil
Rail Crossing along Row	Nil
Other clearance related aspects	Nil

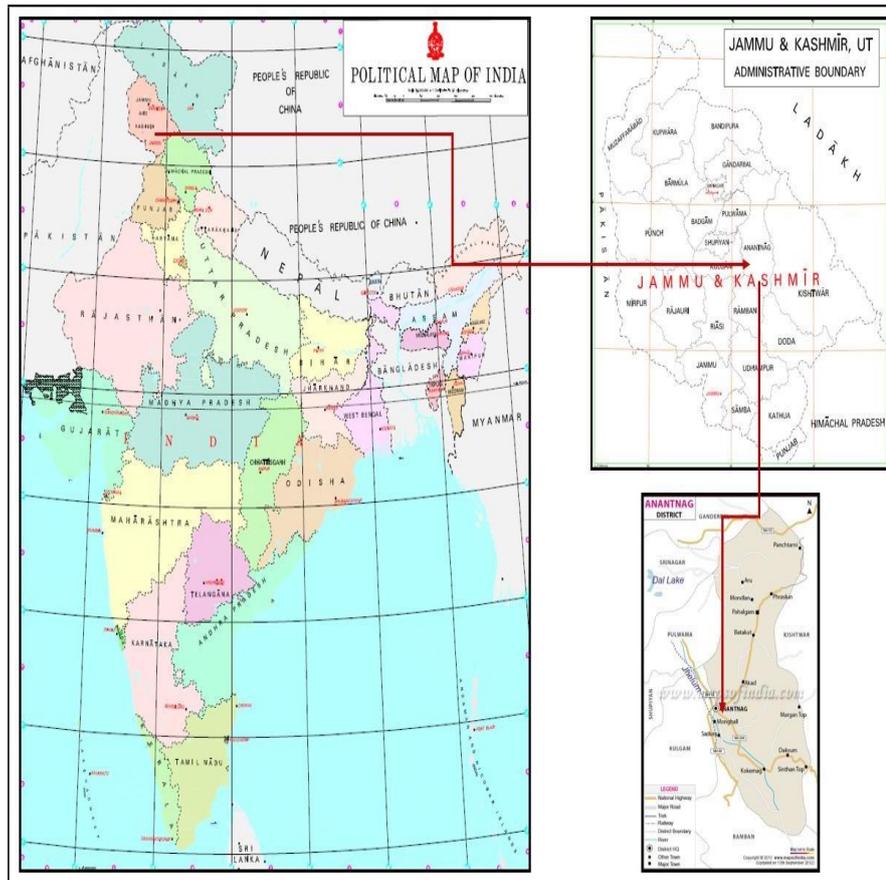
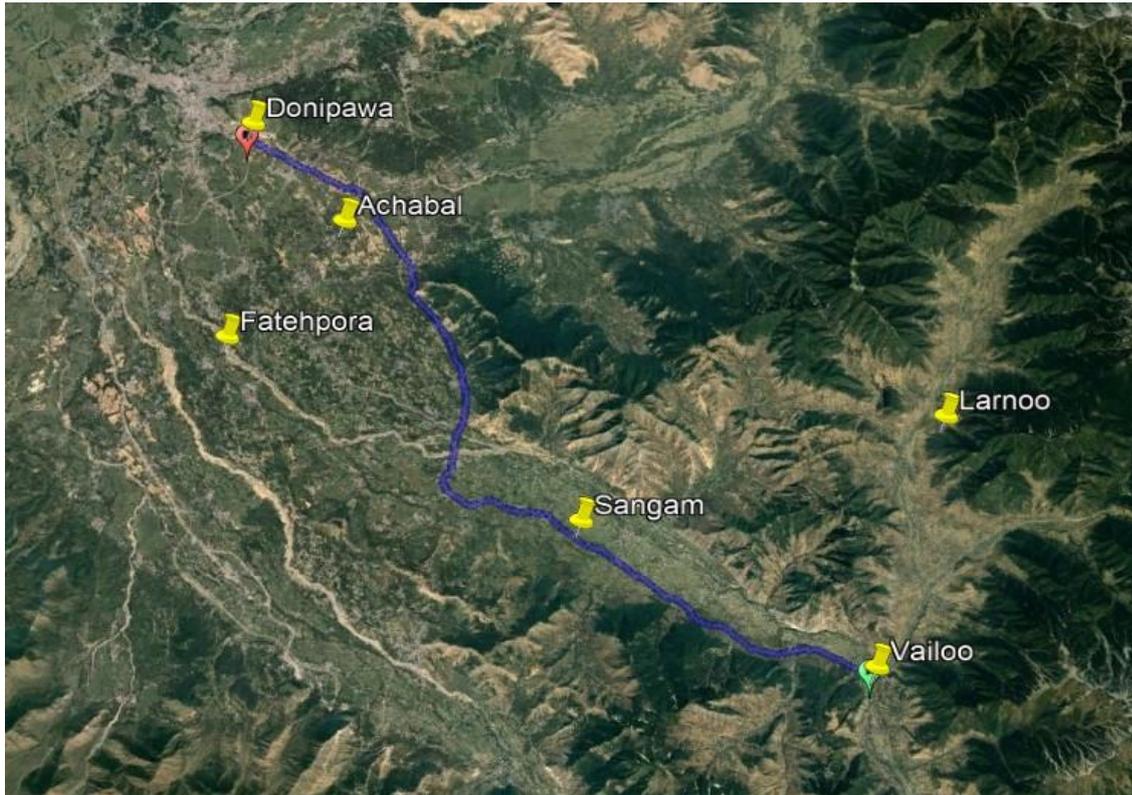
0.3 Project Description

The project site is located in the state of Jammu and Kashmir (J&K), a region in northern India, known for its rich cultural heritage, scenic beauty, and strategic significance. Jammu and Kashmir is bordered by several important regions: to the north, it shares an international border with China, to the west, it is bordered by Jammu and Kashmir and Gilgit-Baltistan; to the south, it adjoins the Indian states of Punjab and Himachal Pradesh; and to the east, it is connected to the Indian state of Ladakh. The state itself is renowned for its diverse topography, ranging from lush green valleys and alpine meadows to rugged mountains and glacial lakes, which contribute to its unique climate and biodiversity. Jammu and Kashmir also has historical and strategic importance, with a complex geopolitical landscape shaped by its location at the crossroads of South Asia, Central Asia, and China. The region's diverse population, consisting of different religious and ethnic communities, adds to the complexity and richness of its cultural fabric. The project's location in this sensitive and beautiful region underscores the importance of sustainable development, keeping in mind both environmental preservation and the socio-political dynamics that define Jammu and Kashmir. The project stretch begins at its junction with National Highway 244 (NH-244) at Vailoo and extends to Donipawa in the state of Jammu and Kashmir (J&K). The total length of the road is 8.643 kilometers.

The main goal of this consultancy service is to assess whether the project is technically, economically, and financially feasible. The work involves preparing detailed reports for upgrading certain sections of the road. Specifically, the project aims to widen a stretch of road from two lanes with paved shoulders to four lanes. This will be done along an 8.643 km section of the Khellani-Khanabal road (NH-244) in Jammu and Kashmir, between the locations Vailoo (Km 235+070) and Donipawa (Km 263+070).

The viability of the project will be assessed by considering several key factors, including the need for rehabilitation, upgrading, and improvement of the existing road. This includes evaluating the highway and pavement design, identifying the need for service roads where necessary, and planning the types of intersections required. Additionally, the project will look at the rehabilitation and widening of existing bridges or the construction of new ones. Road safety features, such as barriers and signage, will also be considered to ensure safe travel. The quantities of materials and work required will be estimated, along with detailed cost estimates.

Project key map: Vailoo-Donipawa



0.3.1 Existing Road Features

The entire length of project road has a carriageway width varying from 7.0m - 8m but majority of portion traverses as carriageway of 7.0 m. There is no Bus bay/ Truck lay bye in the project stretches.

The project road traverses through rolling terrain.

0.3.2 Existing condition of project road

The major portions of the project road are in good condition.

0.3.3 Road Junctions

There are number of earthen, gravel and bituminous roads meeting/crossing the project highway. The important junctions along the project road are Donipawa, Achabal, Shangus, and Dailgam. The project road has 3 Major junctions and about 07 minor junctions in the project stretch. The intersection details are given in Chapter 4 of this report.

0.3.4 Existing Bridge & Cross Drainage Structures

There is 01 no. Major bridges, 09nos minor bridges, and 31nos. culverts existing on the project road [Vailoo to Donipawa). Existing structures details are described in the engineering survey & investigation chapter (Chapter 4) and their improvement proposals are given in Chapter 8 of this report.

0.4 Traffic Survey Analysis and Forecast

It is very important, that the existing information on traffic flow, commodity movement and traffic pattern is required to assess the traffic behavior on a project road. To collect such information to satisfy the Terms of Reference (TOR) and project requirements, following various types of traffic surveys were carried out:

- Classified Traffic Volume Count Survey
- Intersection Volume Count Survey
- Axle Load Spectrum Survey
- Origin-Destination (OD) Survey and commodity movement Surveys
- Speed and Delay Survey

- Truck Terminal Survey

0.4.1 Classified Volume Count Survey

A comprehensive traffic survey plan has been prepared for the project road after considering traffic intensity on homogeneous sections and travel characteristics. Traffic surveys were conducted between 10th April 2025 to 17th April 2025. Traffic survey locations were finalized by consultation with client officials.

Table 1 Classified Traffic Volume Count (CVC)

Classified Traffic Volume Count (CVC)			
Sr. no	Chainage	Homogenous section	Justification for selecting the location
1	Km 176+532 near Donipawa	Km 176+390 to 176+532	Selected to get the idea of traffic in homogenous section
2	Km 170+660 near Achabal	Km 168+690 to km 172+410	Selected to get the idea of traffic in homogenous section
3	Km 148+600 near Vailoo	Km 148+589 to 148+790	Selected to get the idea of traffic in homogenous section

ADT (Average Daily Traffic)

The Average Daily Traffic (ADT) for all traffic survey locations is presented vide Table below and detail analysis is provided in Ch. 3 of main report.

Table2 Summary of Average Daily Traffic (ADT)

SR NO	Location	Total ADT (No.)	Total ADT (PCU)	Fast Moving Vehicles (PCU)	Slow Moving Vehicles (PCU)
1	Km 176+532 near Donipawa	11079	11512	11425	93

AADT (Annual Average Daily Traffic)

The seasonal correction factors are used to convert Average Daily Traffic (ADT) to Annual Average Daily Traffic (AADT). The Annual Average Daily Traffic for all traffic survey locations is presented vide Table below and detail analysis is provided in Ch. 3 of main report.

Table 4: summary of Annual Average Daily Traffic (AADT)

Sr.No	Location	Total AADT (No.)	Total AADT (PCU)	Fast Moving Vehicles (PCU)	Slow Moving Vehicles (PCU)
1	Km 176+532 near Donipawa	10197	11512	10384	93

Projected Traffic

Table 5: Summary of Projected Total AADT Traffic PCU Volume/day

Homogeneous Section	Year 2025	Year 2030	Year 2035	Year 2040	Year 2045
Vailoo To Donipawa	11512	14390	17987	22483	28104

0.4.2 Turning Movement Count

TMC survey count are conducted at one location on the project road namely Near Achabal Junction on NH-244 on the project road. The intersection volume count surveys at these intersections have been carried out during identified peak periods for 12 hours. The category-wise traffic is counted for all direction in a 15-minute interval. The counts were recorded in the specified survey formats.

The survey data have been analyzed to obtain the morning and evening peak hours with flow of vehicles in each direction. The detail summary of peak hour traffic flow through intersections is provided in Chapter 3 of main report.

0.4.3 Axle Load Survey

To estimate vehicle loading spectrum on the project road, and to determine vehicle damage factor for the commercial vehicles, the axle load surveys have been carried out at identified location. The survey is analyzed to obtain Vehicle Damage Factor (VDF) and is presented below:

TABLE 6: Adopted VDF

Sr no	VEHICLE TYPE	VDF
1	LCV	1.10
2	2 AXLE	2.94
3	3 AXLE	1.82
4	MAV	4.38
5	BUS	1.04

0.4.4 Speed-Delay Survey

Round trip was made on entire project road during identified peak period using new technology vehicle. The survey vehicle was kept maintaining the speed of existing traffic low. Start time, delay occurred, distance covered, and end time were recorded on the specified survey format. The data thus obtained is analyzed and presented below:

Table 7: Summary of Speed-Delay Survey

Sr no	Section		Distance (Km)	Average travel Time during off-peak (minutes)	Average speed during off peak (km/hr)	Travel time during peak (minutes)	Average speed during peak hours	Delay (minutes)	Reason for Delay
	FROM	TO							
1	VAILOO	DONIPAWA	27.943	60	35	70	45.5	20	Delay due to local traffic

0.4.5 Growth Rate

The various methods specified vide IRC 108: 2015 are taken into consideration for arriving at reasonable growth rate for traffic in future. The results of such methods along with proposed growth rate for each type of vehicle are presented vide Table below and detail analysis is provided in Chapter 5 of main report:

Table 8: Comparative Analysis and Adopted of Growth Rates

Sr no	Description	Two wheelers	Car/jeeps	Buses	Trucks	LCV and Mini LCV
1	Trend Growth of Vehicles	9.04	15.56	3.66	4.16	17.62
2	Growth from regression analysis	9.45	14.95	3.31	3.33	17.21
3	Considered for Revenue/Capacity	9.24	15.26	3.49	3.75	17.42

S no	PERIOD	TWO WHEELERS	CARS/ JEEPS	BUSES	TRUCKS			LCV and Mini LCV
					2 AXLE	3 AXLE	M AXLE	
1	2026-2030	8.0	8.0	5.0	5.0	5.0	5.0	8.0
2	2031-2035	7.0	7.0	5.0	5.0	5.0	5.0	7.0
3	BEYOND 2035	6.0	6.0	5.0	5.0	5.0	5.0	6.0

0.5 Improvement Proposals

The improvement proposals for the existing road shall be widening and reconstruction from 2-lane to 4-lane with carriage width of 3.5m per lane as per IRC specifications

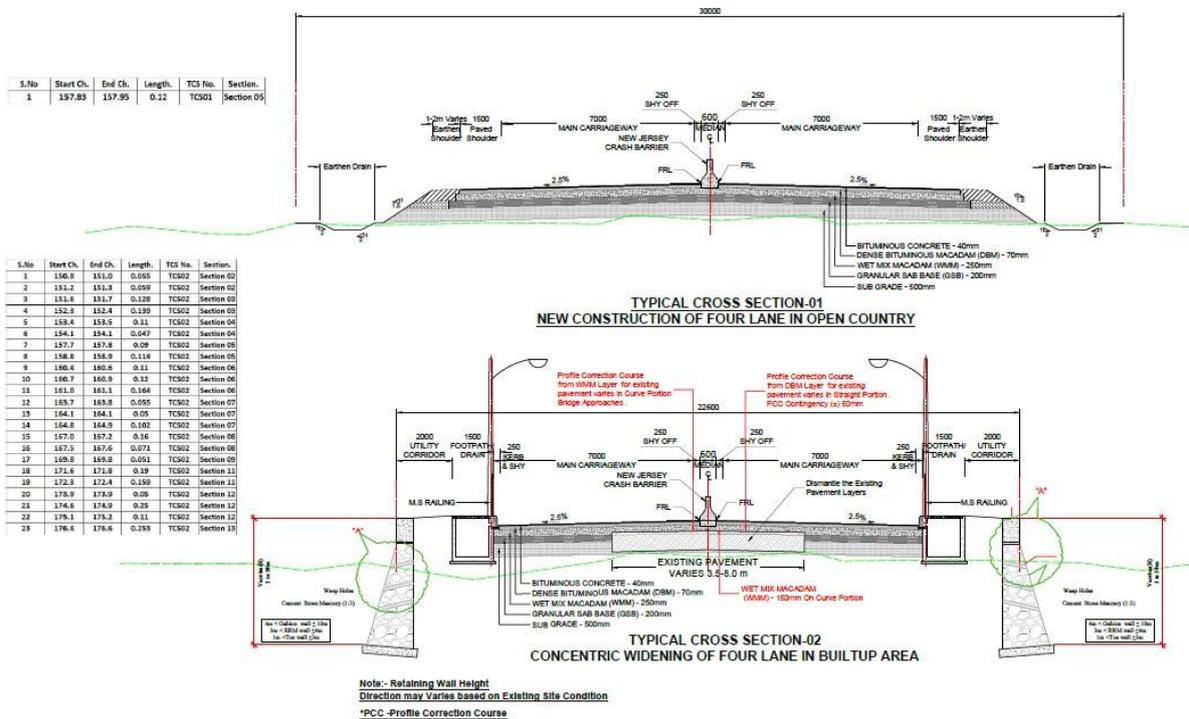
0.5.1 Widening Scheme

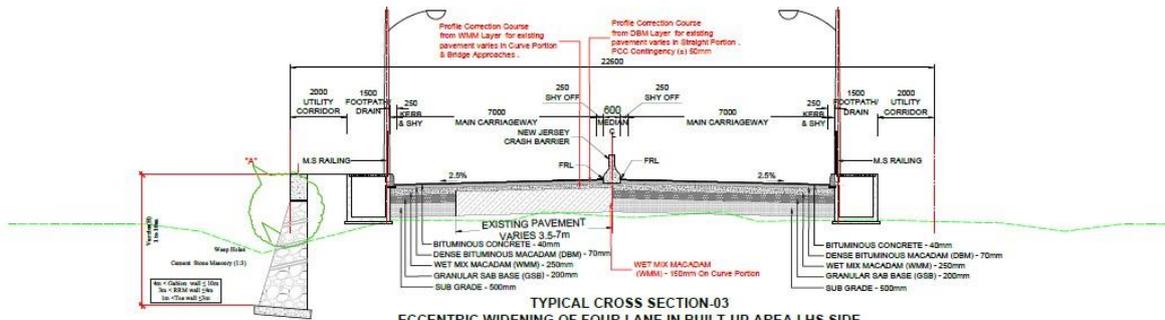
To meet future traffic requirement, the existing carriageway is proposed to upgrade to achieve high speed of travel with comfort and safety. Concentric widening scheme is followed to minimize land acquisition issues and to ensure maximum utilization of existing carriageway.

Table 10: Summary of widening scheme as per TCS

Sr.no	Detail	TCS	Length	
			(m)	(Km)
1	Typical Cross Section-01 New Construction Of Four Lane In Open Country	1	120	0.12
2	Typical Cross Section-02 Concentric Widening Of Four Lane In Builtup Area	2	2632	2.632
3	Typical Cross Section-03 Eccentric Widening Of Four Lane In Built-Up Area Lhs Side	3	2934	2.934
4	Typical Cross Section-04 Eccentric Widening Of Four Lane In Built-Up Area Rhs Side	4	650	0.65
5	Typical Cross Section-05 Concentric Widening Of Four Lane In Built-Up Area Protection Work Both Side	5	210	0.21
6	Typical Cross Section-06 Eccentric Widening Of Four Lane In Hill Area Lhs Side Along With Protection Works Both Side	6	194	0.194
7	Typical Cross Section-07 New Construction Of Four Lane In Hilly Area Along With Protection Works Both Side	7	340	0.34
8	Typical Cross Section-08 Bridge Widening Of Four Lane In Open Country	8	85	0.085
9	Typical Cross Section-09 Concentric Widening Of Four Lane In Hill Area With Load Bearing Drain Built-Up Area	9	330	0.33
10	Typical Cross Section-010 Concentric Widening On Both Hand Side Single Lane Bridge Built-Up Area	10	30	0.03
11	Typical Cross Section-11 Eccentric Bridge Widening Of Four Lane In Hill Area	11	115	0.115
12	Typical Cross Section-12 New Construction Of Bridge At Vailoo Road Junction	12	30	0.030

13	Typical Cross Section-13 Eccentric Widening Of Four Lane In Open Country Area Lhs Side	13	947	0.947
14	Typical Cross Section-14 Eccentric Widening Of Four Lane In Open Country Area Rhs Side	14	890	0.89
15	Typical Cross Section-15 Eccentric Widening Of Four Lane In Built-Up Area / Open Area Rhs Side	15	230	0.23
16	Typical Cross Section-16 Two Lane Bridge Approach Section Down Stream Side	16	129	0.129



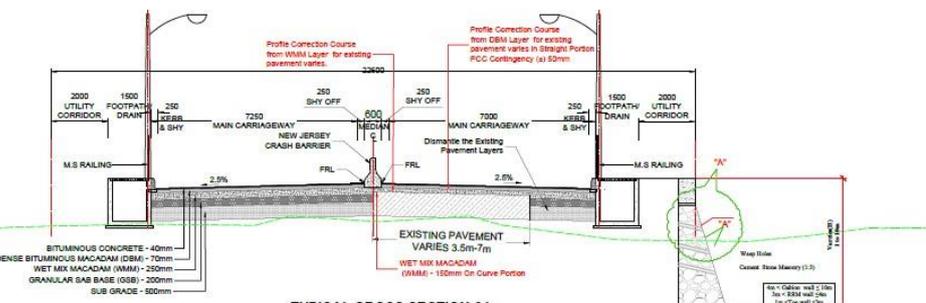


TYPICAL CROSS SECTION-03
ECCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA LHS SIDE

S.No	Start Ch.	End Ch.	Length	TCS No.	Section
1	151.7	152.8	0.58	TCS03	Section 03
2	153.8	154.1	0.3	TCS03	Section 04
3	156.5	156.7	0.391	TCS03	Section 05
4	160.9	161.0	0.1	TCS03	Section 06
5	164.2	164.4	0.193	TCS03	Section 07
6	168.6	168.8	0.17	TCS03	Section 09
7	168.8	169.5	0.63	TCS03	Section 09
8	174.1	174.6	0.9	TCS03	Section 12
9	174.9	175.1	0.23	TCS03	Section 12

Note:- Retaining Wall Height
Direction may Varies based on Existing Site Condition

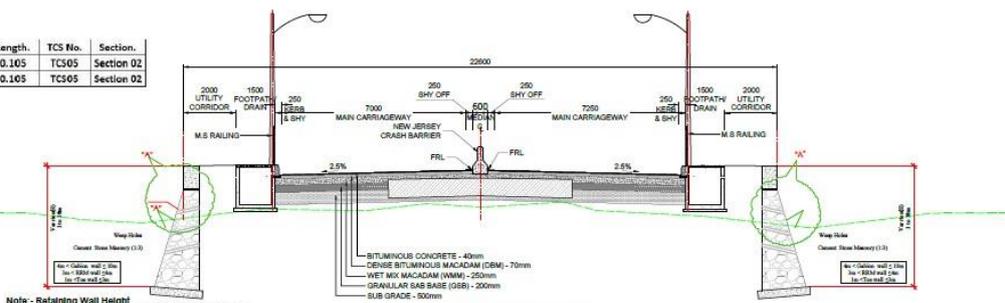
S.No	Start Ch.	End Ch.	Length	TCS No.	Section
1	165.95	166.75	0.18	TCS04	Section 02
2	171.78	172.25	0.47	TCS04	Section 11



TYPICAL CROSS SECTION-04
ECCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA RHS SIDE

Note:- Retaining Wall Height
Direction may Varies based on Existing Site Condition

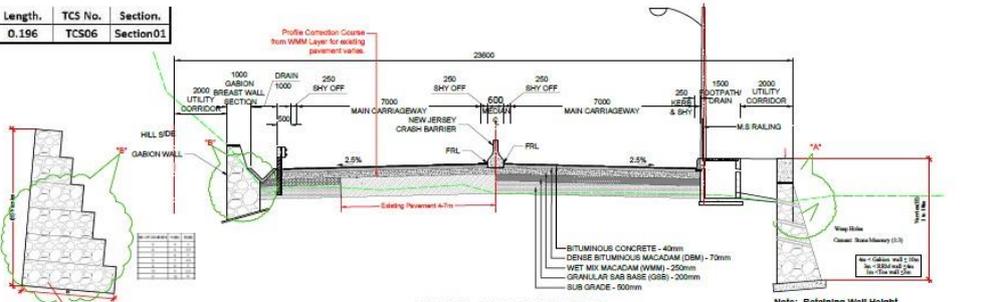
S.No	Start Ch.	End Ch.	Length	TCS No.	Section
1	150.98	151.085	0.105	TCS05	Section 02
2	151.115	151.22	0.105	TCS05	Section 02



TYPICAL CROSS SECTION-05
CONCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA
PROTECTION WORK BOTH SIDE

Note:- Retaining Wall Height
Direction may Varies based on Existing Site Condition

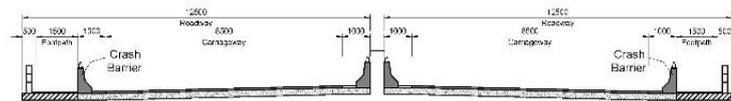
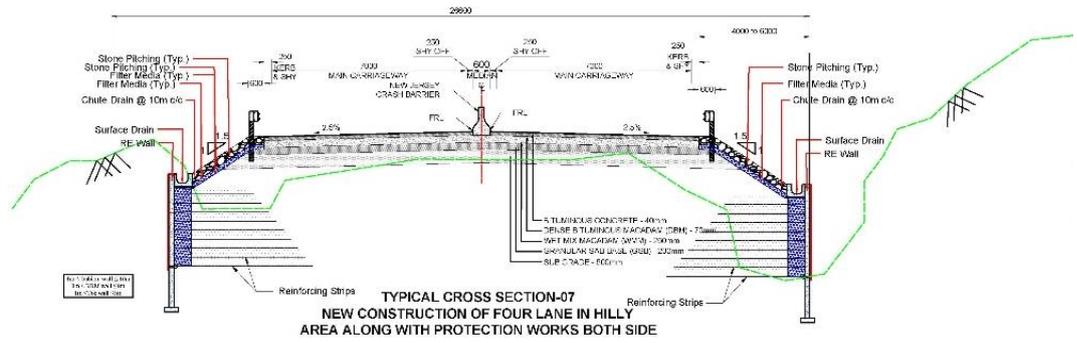
S.No	Start Ch.	End Ch.	Length	TCS No.	Section
1	148.610	148.806	0.196	TCS06	Section 01



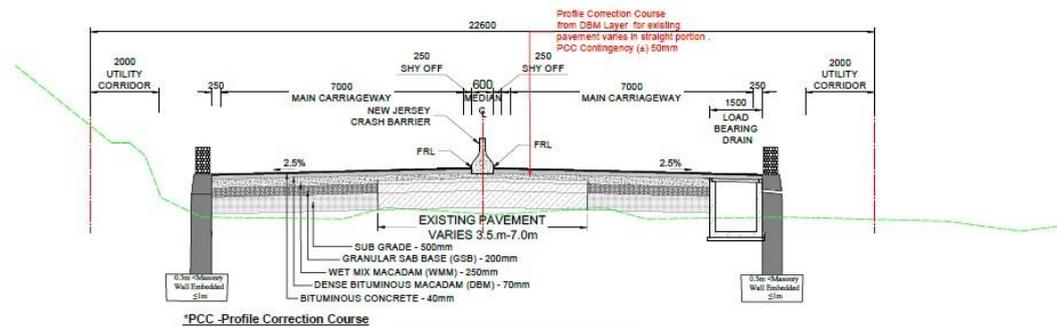
TYPICAL CROSS SECTION-06
ECCENTRIC WIDENING OF FOUR LANE IN HILL AREA LHS SIDE ALONG WITH
PROTECTION WORKS BOTH SIDE

Note:- Retaining Wall Height
Direction may Varies based on Existing Site Condition

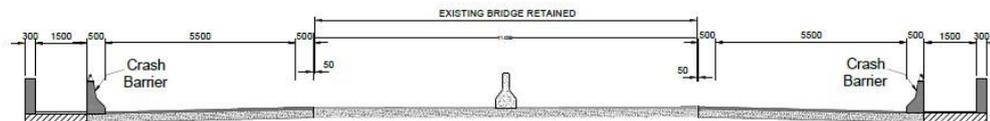
S.No	Start Ch.	End Ch.	Length.	TCS No.	Section.
1	169.45	169.79	0.34	TCS07	Section 09



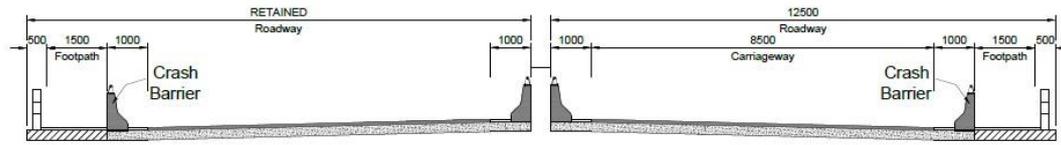
S.No	Start Ch.	End Ch.	Length.	TCS No.	Section.
1	158.05	158.06	0.01	TCS08	Section 05
2	163.80	163.81	0.01	TCS08	Section 07
3	164.39	164.42	0.03	TCS08	Section 07
4	164.72	164.76	0.04	TCS08	Section 07



S.No	Start Ch.	End Ch.	Length.	TCS No.	Section.
1	170.4	170.73	0.33	TCS09	Section 10

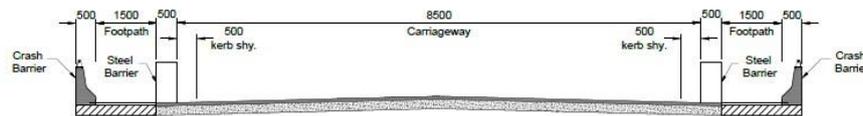


S.No	Start Ch.	End Ch.	Length.	TCS No.	Section.
1	151.085	151.115	0.03	TCS10	Section 02



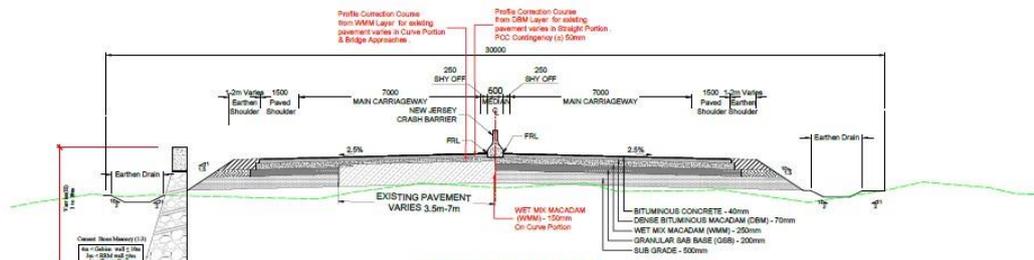
**TYPICAL CROSS SECTION-11
ECCENTRIC BRIDGE WIDENING OF FOUR LANE IN HILL AREA**

S.No	Start Ch.	End Ch.	Length.	TCS No.	Section.
1	163.935	164.05	0.115	TCS11	Section 07



**TYPICAL CROSS SECTION-12
NEW CONSTRUCTION OF BRIDGE AT VAILOO ROAD JUNCTION**

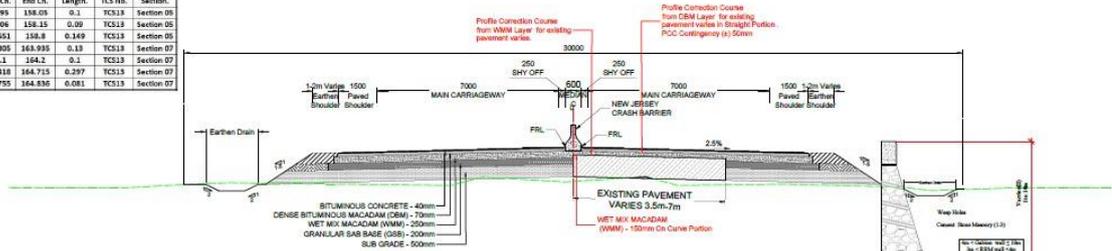
S.No	Start Ch.	End Ch.	Length.	TCS No.	Section.
1	148.547	148.577	0.03	TCS12	Section 01



**TYPICAL CROSS SECTION-13
ECCENTRIC WIDENING OF FOUR LANE IN OPEN COUNTRY AREA LHS SIDE**

Note - Retaining Wall Height
Direction may Varies based on Existing Site Condition

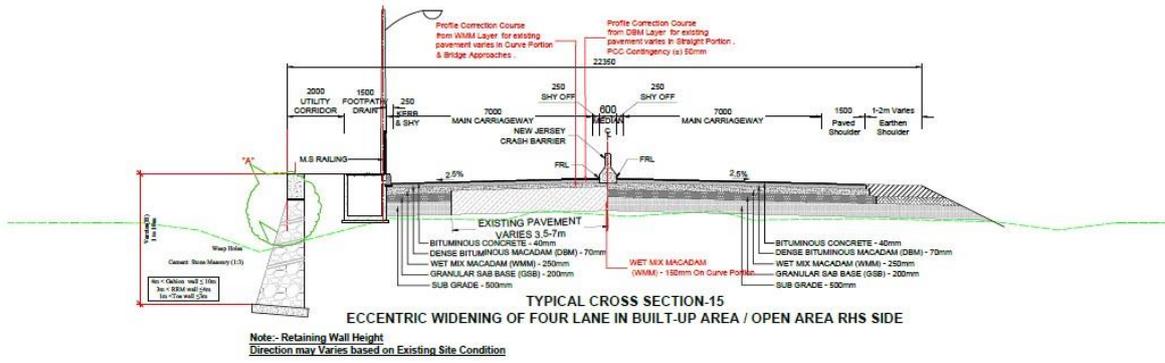
S.No	Start Ch.	End Ch.	Length.	TCS No.	Section.
1	157.95	158.05	0.1	TCS13	Section 08
2	158.05	158.15	0.09	TCS13	Section 05
3	158.651	158.8	0.149	TCS13	Section 05
4	163.895	163.935	0.13	TCS13	Section 07
5	164.1	164.2	0.1	TCS13	Section 07
6	164.618	164.715	0.397	TCS13	Section 07
7	164.755	164.836	0.081	TCS13	Section 07



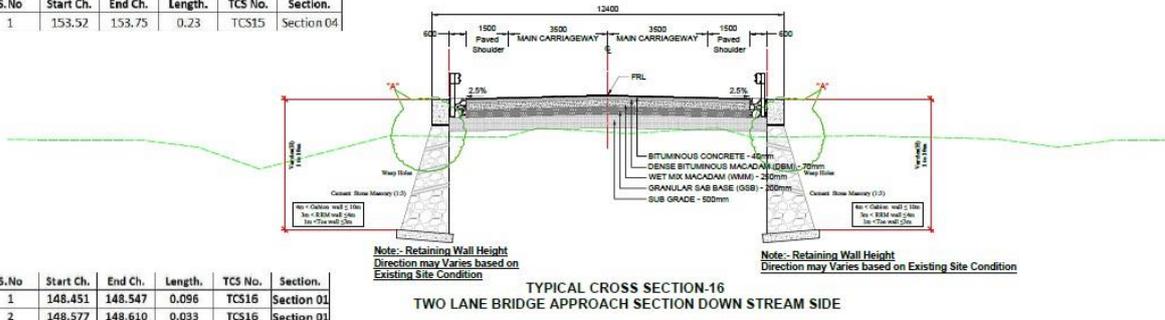
**TYPICAL CROSS SECTION-14
ECCENTRIC WIDENING OF FOUR LANE IN OPEN COUNTRY AREA RHS SIDE**

Note - Retaining Wall Height
Direction may Varies based on Existing Site Condition

S.No	Start Ch.	End Ch.	Length.	TCS No.	Section.
1	158.15	158.26	0.11	TCS14	Section 05
2	167.15	167.35	0.2	TCS14	Section 08
3	167.35	167.53	0.18	TCS14	Section 08
4	173.90	174.30	0.4	TCS14	Section 12



S.No	Start Ch.	End Ch.	Length.	TCS No.	Section.
1	153.52	153.75	0.23	TCS15	Section 04



S.No	Start Ch.	End Ch.	Length.	TCS No.	Section.
1	148.451	148.547	0.096	TCS16	Section 01
2	148.577	148.610	0.033	TCS16	Section 01

0.5.1 Pavement Design

Flexible pavement is proposed for new carriageway of the project road. Design period of 20 years considered for new carriageway. The Pavement improvement proposal for entire project road is presented in Table below.

Table 11: Improvement Proposal for New Pavement

Crust Composition for new Pavement as per IRC SP 84-2019										
Homogeneous section	Design Chainage		CBR	MSA	Crust				Sub-Grade	Total Thickness
	From	To			BC	DBM	WMM	GSB		
1	148.589	148.804	10%	20	40	70	250	200	500	1060
2	150.925	151.279	10%	20	40	70	250	200	500	1060
3	151.592	152.439	10%	20	40	70	250	200	500	1060
4	153.41	154.097	10%	20	40	70	250	200	500	1060
5	157.74	158.914	10%	20	40	70	250	200	500	1060
6	160.44	161.114	10%	20	40	70	250	200	500	1060

7	163.74	164.938	10%	20	40	70	250	200	500	1060
8	166.99	167.601	10%	20	40	70	250	200	500	1060
9	168.63	169.866	10%	20	40	70	250	200	500	1060
10	171.59	172.409	10%	20	40	70	250	200	500	1060
11	173.85	175.204	10%	20	40	70	250	200	500	1060
12	176.38	176.603	10%	20	40	70	250	200	500	1060
13	170.4	170.733	10%	20	40	70	250	200	500	1060

0.5.2 Major Bridge/ Minor Bridge & Cross Drainage Structures

A total of 10 bridges are proposed in which 1 is in reconstruction due to highway re-alignment, the details of improvement proposal for bridges are given in Chapter 8 and Annexure-8.2.

0.5.3 Culverts

A total of 36 culverts are proposed out of which 29 are to be widened. The improvement proposal for culverts is also given in **Annexure-8.3**.

0.5.4 Drainage Works

The longitudinal slope of the road alignment is generally varying in direction with respect to the countryside slope. Keeping this in view, it is proposed to locate the drain close to the toe of the road embankment on both sides in the rural area. In urban stretches, lined rectangular drains have been provided. In urban area the RCC cover drain with footpath & loaded RCC Cover drain has been considered for the ensuring the better drainage of rainwater.

Table 12: KC Drain

Roadside KC Drainage List					
Design Chainage		Design Length	TCS Detail	Side	Roadside Drain Length (m)
From	To	(m)			
148.610	148.804	0.194	TCS06	LHS	194

Table 13: Load Bearing Drain

Load Bearing Drain						
Sr. No	Design Chainage		Design Length in m	TCS Detail	Side	Total Length
	From	To				
1	170.4	170.73	0.33	TCS09	Both side	330

Table 14: RCC Cover Drain with Footpath

RCC Cover Drain with Footpath						
Sr. No.	Design Chainage		Design Length	TCS Detail	Side	Length
	From	To				
1	150.925	150.98	0.055	TCS02	Both side	110
2	150.98	151.085	0.105	TCS05	Both side	210
3	151.115	151.22	0.105	TCS05	Both side	210
4	151.22	151.279	0.059	TCS02	Both side	118
5	151.592	151.72	0.128	TCS02	Both side	256
6	151.72	152.3	0.58	TCS03	Both side	1160
7	152.3	152.439	0.139	TCS02	Both side	278
8	153.41	153.52	0.11	TCS02	Both side	220
9	153.75	154.05	0.3	TCS03	Both side	600
10	154.05	154.097	0.047	TCS02	Both side	94
11	157.74	157.83	0.09	TCS02	Both side	180
12	158.26	158.651	0.391	TCS03	Both side	782

13	158.8	158.914	0.114	TCS02	Both side	228
14	160.44	160.55	0.11	TCS02	Both side	220
15	160.55	160.73	0.18	TCS04	Both side	360
16	160.73	160.85	0.12	TCS02	Both side	240
17	160.85	160.95	0.1	TCS03	Both side	200
18	160.95	161.114	0.164	TCS02	Both side	328
19	163.74	163.795	0.055	TCS02	Both side	110
20	164.05	164.1	0.05	TCS02	Both side	100
21	164.2	164.393	0.193	TCS03	Both side	386
22	164.836	164.938	0.102	TCS02	Both side	204
23	166.99	167.15	0.16	TCS02	Both side	320
24	167.53	167.601	0.071	TCS02	Both side	142
25	168.63	168.8	0.17	TCS03	Both side	340
26	168.8	169.45	0.65	TCS03	Both side	1300
27	169.79	169.866	0.076	TCS02	Both side	152
28	171.59	171.78	0.19	TCS02	Both side	380
29	171.78	172.25	0.47	TCS04	Both side	940
30	172.25	172.409	0.159	TCS02	Both side	318
31	173.85	173.9	0.05	TCS02	Both side	100
32	174.3	174.6	0.3	TCS03	Both side	600
33	174.6	174.85	0.25	TCS02	Both side	500
34	174.85	175.1	0.25	TCS03	Both side	500
35	175.1	175.21	0.11	TCS02	Both side	220
36	176.38	176.603	0.223	TCS02	Both side	446
37	148.610	148.804	0.194	TCS06	RHS	194
38	153.52	153.75	0.23	TCS15	LHS	230
Total Length						17875

Table 15: Chute Drain

Sr. No.	Design Chainage		Design Length	TCS Detail	Side	Total Length
	From	To				
1	169.45	169.79	0.34	TCS07	RHS	34

Table 16: Lined Surface Drain

Lined Surface Drain					
Design Chainage		Design Length	TCS Detail	Side	Roadside Drain Length (m)
From	To	(m)			
169.45	169.79	0.34	TCS07	LHS	340

0.5.5 Protection Works

Safety barriers have been provided for moving vehicles and as well as pedestrians. Jersey barriers have been provided and pedestrian guard rail has been adopted as per codal provisions (IRC: SP: 73- 2018) in urban areas (as per TCS). The details have been provided below:

Table 16: Pedestrian Railing

Sr. No.	Design Chainage		Design Length	TCS Detail	Side	Length
	From	To				
1	150.925	150.98	0.055	TCS02	Both side	110
2	150.98	151.085	0.105	TCS05	Both side	210
3	151.115	151.22	0.105	TCS05	Both side	210
4	151.22	151.279	0.059	TCS02	Both side	118
5	151.592	151.72	0.128	TCS02	Both side	256
6	151.72	152.3	0.58	TCS03	Both side	1160
7	152.3	152.439	0.139	TCS02	Both side	278
8	153.41	153.52	0.11	TCS02	Both side	220
9	153.75	154.05	0.3	TCS03	Both side	600
10	154.05	154.097	0.047	TCS02	Both side	94
11	157.74	157.83	0.09	TCS02	Both side	180
12	158.26	158.651	0.391	TCS03	Both side	782

13	158.8	158.914	0.114	TCS02	Both side	228
14	160.44	160.55	0.11	TCS02	Both side	220
15	160.55	160.73	0.18	TCS04	Both side	360
16	160.73	160.85	0.12	TCS02	Both side	240
17	160.85	160.95	0.1	TCS03	Both side	200
18	160.95	161.114	0.164	TCS02	Both side	328
19	163.74	163.795	0.055	TCS02	Both side	110
20	164.05	164.1	0.05	TCS02	Both side	100
21	164.2	164.393	0.193	TCS03	Both side	386
22	164.836	164.938	0.102	TCS02	Both side	204
23	166.99	167.15	0.16	TCS02	Both side	320
24	167.53	167.601	0.071	TCS02	Both side	142
25	168.63	168.8	0.17	TCS03	Both side	340
26	168.8	169.45	0.65	TCS03	Both side	1300
27	169.79	169.866	0.076	TCS02	Both side	152
28	171.59	171.78	0.19	TCS02	Both side	380
29	171.78	172.25	0.47	TCS04	Both side	940
30	172.25	172.409	0.159	TCS02	Both side	318
31	173.85	173.9	0.05	TCS02	Both side	100
32	174.3	174.6	0.3	TCS03	Both side	600
33	174.6	174.85	0.25	TCS02	Both side	500
34	174.85	175.1	0.25	TCS03	Both side	500
35	175.1	175.21	0.11	TCS02	Both side	220
36	176.38	176.603	0.223	TCS02	Both side	446
37	148.610	148.804	0.194	TCS06	RHS	194
38	153.52	153.75	0.23	TCS15	LHS	230

Table 17: Jersey barrier Crash Barrier

Sr. No.	Design Chainage		Design Length	TCS Type
	From	To	(m)	
1	148.451	148.547	0.096	TCS16
2	148.547	148.577	0.030	TCS12
3	148.577	148.610	0.033	TCS16
4	148.610	148.804	0.194	TCS06
5	150.925	150.98	0.055	TCS02
6	150.98	151.085	0.105	TCS05
7	151.085	151.115	0.03	TCS10
8	151.115	151.22	0.105	TCS05
9	151.22	151.279	0.059	TCS02
10	151.592	151.72	0.128	TCS02
11	151.72	152.3	0.58	TCS03
12	152.3	152.439	0.139	TCS02
13	153.41	153.52	0.11	TCS02
14	153.52	153.75	0.23	TCS15
15	153.75	154.05	0.3	TCS03
16	154.05	154.097	0.047	TCS02
17	157.74	157.83	0.09	TCS02
18	157.83	157.95	0.12	TCS01
19	157.95	158.05	0.1	TCS13
20	158.05	158.06	0.01	TCS08
21	158.06	158.15	0.09	TCS13
22	158.15	158.26	0.11	TCS14
23	158.26	158.651	0.391	TCS03
24	158.651	158.8	0.149	TCS13
25	158.8	158.914	0.114	TCS02

26	160.44	160.55	0.11	TCS02
27	160.55	160.73	0.18	TCS04
28	160.73	160.85	0.12	TCS02
29	160.85	160.95	0.1	TCS03
30	160.95	161.114	0.164	TCS02
31	163.74	163.795	0.055	TCS02
32	163.795	163.805	0.01	TCS08
33	163.805	163.935	0.13	TCS13
34	163.935	164.05	0.115	TCS11
35	164.05	164.1	0.05	TCS02
36	164.1	164.2	0.1	TCS13
37	164.2	164.393	0.193	TCS03
38	164.393	164.418	0.025	TCS08
39	164.418	164.715	0.297	TCS13
40	164.715	164.755	0.04	TCS08
41	164.755	164.836	0.081	TCS13
42	164.836	164.938	0.102	TCS02
43	166.99	167.15	0.16	TCS02
44	167.15	167.35	0.2	TCS14
45	167.35	167.53	0.18	TCS14
46	167.53	167.601	0.071	TCS02
47	168.63	168.8	0.17	TCS03
48	168.8	169.45	0.65	TCS03
49	169.45	169.79	0.34	TCS07
50	169.79	169.866	0.076	TCS02
51	170.4	170.73	0.33	TCS09
52	171.59	171.78	0.19	TCS02

53	171.78	172.25	0.47	TCS04
54	172.25	172.409	0.159	TCS02
55	173.85	173.9	0.05	TCS02
56	173.9	174.3	0.4	TCS14
57	174.3	174.6	0.3	TCS03
58	174.6	174.85	0.25	TCS02
59	174.85	175.1	0.25	TCS03
60	175.1	175.21	0.11	TCS02
61	176.38	176.603	0.223	TCS02

0.6 Environmental Impact Assessment

A corridor of 10 km on either side from the project road is considered for study of various environmental attributes. The study is carried out as per the requirements stipulated by the Ministry of Environment and Forests, Government of India for Environmental Impact Assessment of Rail / Roads/Highway Projects. Important features from environmental point of view observed along the project road are as mentioned below.

- Project Corridor on both sides has significant amount of tree plantation. Different type of trees is existing along the project road. Trees will be impacted due to road widening. Along the project road which lies in toe line on either side of the road edge shall be made to avoid felling of trees which are not falling under corridor of impact. The removal of these trees and the loss of vegetation cover will have some effect on local ecological balance, such as the disruption of habitat for small birds, mammals, etc., that will be forced to migrate to other areas. With the addition of trees and shrubs, following re-forestation, the short-term impact of construction is expected to be reversed over the long term.
- There are cultural properties, and community properties / facilities exists within the ROW that are likely to be affected due to proposed project.

0.6.1 Social screening

The project road falls within Anantnag district of Jammu and Kashmir. During the initial social screening period, primary consultations were conducted along the project road.

- The consultations were held to build awareness about the project amongst the people, district level administration, and NGOs and to enlist their support in preparation and implementation of the project. Also, it served the purpose of understanding the reaction of the likely affected persons.
- Issues raised by individuals during the consultations were mainly related to land acquisition, loss of livelihood and income restoration, loss of religious structures, community structures, trees, etc.
- A preliminary baseline socio-economic survey identified that structures are likely to be affected due to the project. The remaining includes private and government structures that will be affected due to the proposed project. Most of the structures affected are of kuccha type i.e. temporary in nature.

0.7 Land acquisition Requirement

The existing Right of way (ROW) of the road varies from 28m to 30m however, the proposed widening scheme of project stretch is accumulated with the existing ROW.

0.8 Material investigation

Material investigations were carried out to explore the availability and identify sources of suitable material for the construction of the project.

0.8.1 Borrow pits for soil

Material investigation of borrow area indicates that soil suitable for embankment is available at an average lead of 5 km for the project stretch.

0.8.2 Sand

Sand is available at Sangam River. The location is 24km from project site.

0.8.3 Gravel

Several quarries were identified within the project zone as potential sources of aggregate materials essential for construction activities. After a thorough assessment based on factors such as quality of material, accessibility, and proximity to the project site, the **Ashajipora Quarry** was proposed as the primary source of aggregate for civil construction. Located approximately 17 kilometers from the project site, the Ashajipora Quarry offers a reliable supply of aggregates that meet the required engineering and environmental standards. Its

relatively short haul distance is expected to optimize transportation logistics and reduce associated costs and emissions. The selection of this quarry also considers existing road connectivity and the quarry's operational capacity to meet the demands of the project within the stipulated timeframe.

0.8.4 Bitumen

Bulk bitumen of the VG-10 Grade is available at Panipat, refinery with an average lead of 644 km. For the project road VG-10 of bitumen has been proposed for DBM & BC

0.8.5 Cement

Cement source is taken as from Gurdaspur which is 297 km from project site. The proposed cement grade shall be OPC-55.

0.9 Cost Estimate

Preliminary cost estimate for the project Road is finalized based on the improvement proposed. The preliminary cost estimate is worked out based on the quantities calculated for major items of work to be executed in the project and rates derived after detailed analysis.

SUMMARY OF COST

Abstract of Cost			
Project Length (Km)		9.866	
Bill No.	Item of works and Sub-Heads	Estimated Cost (In Rs.)	Estimated Cost (In Crores)
1	Road Works	393,156,345.84	39.32
	a) <i>Site Clearance and Dismantling</i>	<i>5,289,946.84</i>	<i>0.53</i>
	b) <i>Earthwork up to top of the sub-grade</i>	<i>48,010,278.00</i>	<i>4.80</i>
	c) <i>Granular Sub-base & Base Courses & Shoulders</i>	<i>128,782,645.00</i>	<i>12.88</i>
	d) <i>Bituminous Courses</i>	<i>211,073,476.00</i>	<i>21.11</i>
2	Culvert	25,076,565.06	2.51
3	Bridges	279,787,334.96	27.98
3.1	MNB - New Construction	127,406,155.95	12.74
3.2	MNB- widening	43,389,839.68	4.34
3.3	MJB	108,991,339.32	10.90
4	Protection Work (Breast Wall / Retaining Wall/Toe Wall/New jersey Crash Barrier/RE Wall/Stone Pitching/Crash Barrier/MS Railing)	275,711,612.42	27.57
	a) <i>Breast Wall (3.0 m height)</i>	<i>4,740,156.42</i>	<i>0.47</i>

	b) Retaining Wall (3 m height)	50,115,693.74	5.01
	c) Retaining Wall (2.5 m height)	8,862,556.69	0.89
	d) Retaining Wall (2 m height)	4,164,528.50	0.42
	e) Retaining Wall (1.5 m height)	7,592,921.90	0.76
	f) New Jersey Crash Barrier (Median)	85,613,870.36	8.56
	g) RE Wall (15m Height)	35,472,384.00	3.55
	h) RE Wall (6m Height)	14,342,788.80	1.43
	i) Stone Pitching with Filter Media	5,360,088.02	0.54
	j) W-Metal Beam Crash Barrier	6,400,620.00	0.64
	k) MS Railing	53,046,004.00	5.30
5	Drainage Works	104,648,706.39	10.46
	a) Lined Drain (Rectangular) -RCC Cover Drain	99,781,175.40	9.98
	b) Lined Drain (Triangular) - KC Drain	481,462.41	0.05
	c) Lined Surface Drain	843,800.10	0.08
	d) Chute Drain	687,725.23	0.07
	e) Load Bearing Drain	2,778,561.66	0.28
	f) Unlined Drain	75,981.60	0.01
6	Traffic Signs, Markings, Road Safety Crash Barrier and Other Road Appurtenances	5,923,882.00	0.59
7	Junctions, Temporary Diversion, Bus Bays & Shelter, Truck Laybye other Project Facilities	34,763,406.62	3.48
8	Miscellaneous Works (Lighting Work & Electrical Works)	20,243,917.00	2.02
9	Total Civil Works (Excluding GST)	1,139,311,770.30	113.93
10	Utility Shifting (excluding GST, Contingencies & Supervision Charges)	136,030,426.07	13.60
	a) Electrical Utilities	22,348,811.86	2.23
	b) Public Health Engineering (PHE)	113,681,614.20	11.37
A	Total Civil Works including Utility Shifting (09+10) (Excluding GST)	1,275,342,196.37	127.53
11	GST 18% over Civil Cost (A)	229,561,595.35	22.96
B	Total Cost of Civil Works (including GST @18%)	1,504,903,791.71	150.49
Ç	Centages (As Per RW-NH-33044/10/2019-S&R(P&B) Dated 07/03/2019)	146,239,542.26	14.62
	i) Contingencies @ 1% A (As Per A-12025/1/2020-NHIDCLCell(Pt.) Dated Aug 2021)	12,753,421.96	1.28
	ii) Supervision Consultancy Charges @ 3% of A	38,260,265.89	3.83
	iii) Agency Charges @3% of A	38,260,265.89	3.83

iv)	Escalation @2.5 %	28,482,794.26	2.85
v)	Maintenance Charges @2.5% of @ Sl. No. 9	28,482,794.26	2.85
D)	Total Project Cost without GST (A+C)	1,421,581,738.63	142.16
E)	Total Project Cost with GST (B+C)	1,651,143,333.97	165.11
F)	Total Pre- Construction Charges	151,250,000.00	15.13
a)	Land Acquisition (RoW)	139,000,000.00	13.90
b)	Land Acquisition (PHE Utility (Service Reservoir)	12,250,000.00	1.23
G)	TOTAL CAPITAL COST OF THE PROJECT Without GST (D+F)	1,572,831,738.63	157.28
H)	TOTAL CAPITAL COST OF THE PROJECT With GST (E+F)	1,802,393,333.97	180.24
*The cost of Land is subjected to confirmation from the revenue department			

0.10 Conclusion and Recommendations

Based on the lane capacity analysis results, the project road requires 4 lanes with paved shoulder for capacity augmentation and efficient movement of traffic up to project common concession period of 20 years.

The project road can be improved without causing significant adverse environmental impacts to the natural, social, economic or cultural environments.

The process of land acquisition must be initialized immediately after the approval of the alignment, to expedite construction of widening sections.

The project can be constructed within 12 months period with strategic planning and through one construction package. The construction work may begin from March 2026. The estimated basic cost is given below table

1.0 Introduction

1.1 General

The National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has assigned M/S Technocrat Advisory Services Pvt. Ltd In association with Space Engineers Consortium Pvt. Ltd as Consultants to carry out the "Consultancy Services for Preparation of Detailed Project Report for intermittent Two Lane plus Paved Shoulder stretches to Four Lane in between Design Km 148+589 (Existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir

1.2 Overview of MORT&H, NHDP and Project Financing

1.2.1 Introduction

The road network of India is comprised of (I) National Highways and Expressways -1,01,011 Km. (II) State Highways -1,76,166 Km, (III) Major District Roads-561,940, Rural Roads and Urban Roads 44,45,067 Km (approx.). As National Highways comprise about 1.80% of the total road length in the country and yet carry over 40% of total traffic, there is an immediate need to augment the existing road network.

- About 60% of freight and 85% passenger traffic is carried by the roads.
- National Highways constitute only about 1.80% of the road network but carry about 40% of the total road traffic.
- Number of vehicles has been growing at an average pace of 10.16% per annum over the last five years.

Advantages of having a well-developed network of world class highways are many for a nation like India, poised to surge ahead. These are enlisted below.

- Savings in vehicle operating costs.
- Faster, comfortable journeys.
- Reduced fuel consumption
- Safer travel.

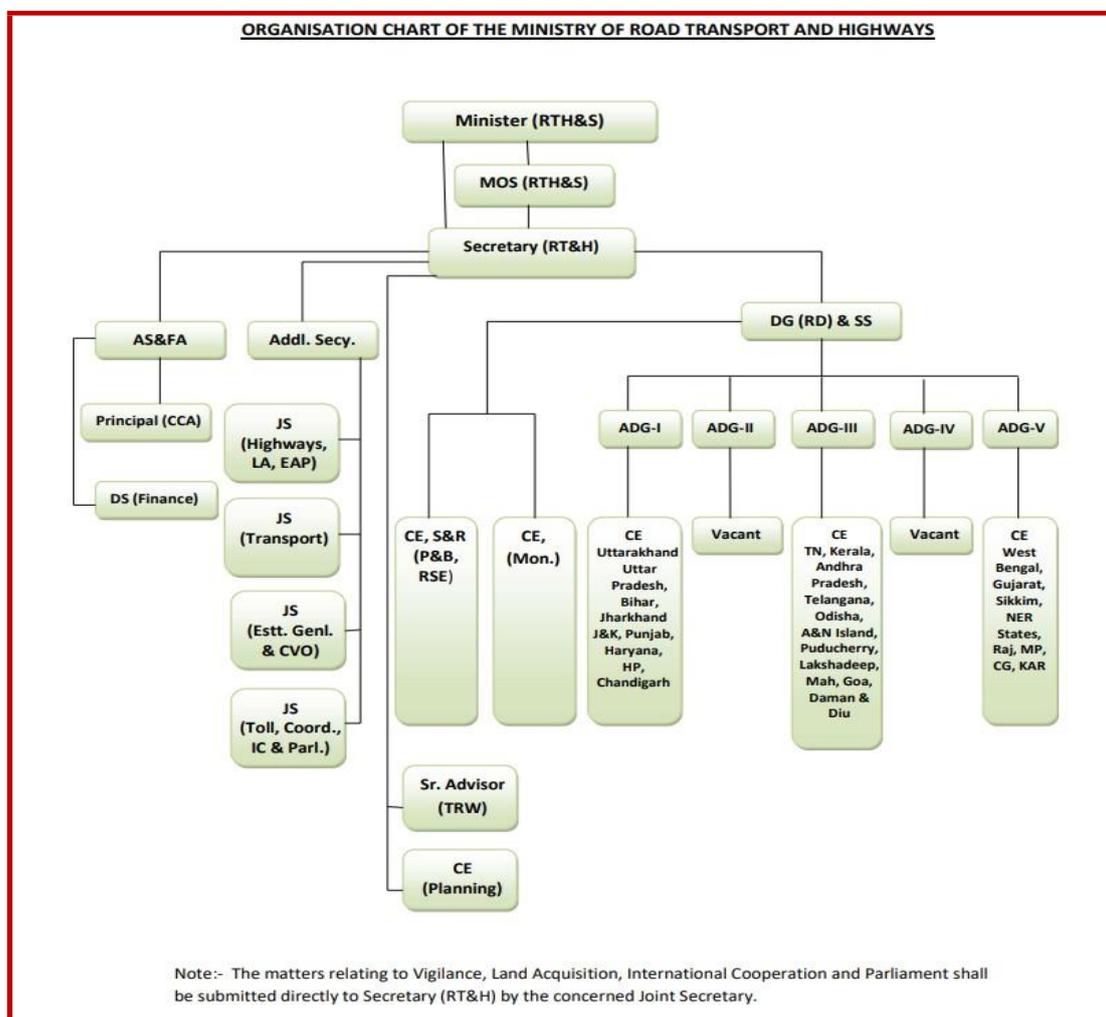
- Induced development in project influence area, and
- Overall boost in country's economy.

1.2.2 Ministry of Road Transport & Highways

This Department is responsible for development and maintenance of National Highways, administration of the Central Road Fund and formulation and implementation of policies relating to road transport. The subjects allocated to the Department of Road Transport & Highways.

1.2.2.1 Organizational Set-up

There are five Wings viz. Administration Wing, Transport Wing, Transport Research Wing, Roads Wing and Finance Wing



1) Administration Wing

The Administration Wing, which is headed by a Joint Secretary, provides administrative and infrastructure support to the officers/employees of the Department. The cadre management of the Central Engineering Services (Roads) Group 'A' and service matters in respect of other categories of posts is dealt with by this Wing. The various cadres are managed as per the instructions and guidelines issued by the Department of Personnel and Training, Ministry of Personnel, Public Grievances and Pensions.

2) Transport Wing

The Transport Wing is headed by a Joint Secretary and is concerned with the formulation of policies relating to regulation of road transport, legislation relating to road transport including aspects of road safety, environmental issues, and automotive norms besides making arrangements for movement of vehicular traffic with neighboring countries. The Motor Vehicles Act, 1988 is the main enactment for regulating motor vehicles in the country.

3) Transport Research Wing

The Transport Research Wing (TRW) headed by Adviser (Transport Research) is also common to both the Departments (the Department of Road Transport & Highways and the Department of Shipping). The TRW is responsible for collection, compilation and dissemination of statistics on road and water transport.

4) Roads Wing

The Roads Wing is headed by a Director General (Road Development), who is assisted by other technical and secretarial staff. The work of Roads Wing has been divided into sixteen zones, each headed by a Chief Engineer. There are ten project zones which look after the work of development and maintenance of National Highways and other centrally sponsored road works. In addition, Chief Engineers also look after Planning, Monitoring, Standards & Research, Project Implementation Cell and Mechanical zones. Roads Wing is concerned mainly with matters relating to (i) advising Government on all policy matters relating to Highways (ii) development and maintenance of roads declared as National Highways (iii) roads other than National Highways in Union Territories (iv) administration of Central Road Fund (CRF) pertaining to State Roads (other than rural roads) (v) evaluation of standards for roads and bridges and formulation of specifications (vi) road research.

5) Finance Wing

The Finance Wing is headed by the Additional Secretary & Financial Adviser (AS&FA) and is common to both the Department of Road Transport & Highways and the Ministry of Shipping; and renders financial advice on various matters. It also assists in planning, budgeting, monitoring and evaluation of schemes/programs.

6) Autonomous Bodies

The following autonomous bodies are under the administrative preview of this Department:

National Highways Authority of India (NHAI)

The National Highways Authority of India (NHAI) was constituted by an Act of Parliament in 1988 under the administrative control of the Ministry of Road Transport and Highways. NHAI has been set up as a Central Authority to develop, maintain and manage the National Highways entrusted to it by the Government of India. The Authority, however, became operational in February 1995. The Authority consists of a full time Chairman, and not more than five full time Members and four part time Members who are appointed by the Central Government. The part time Members are the Secretary (RT&H), Secretary (Expenditure), Secretary (Planning) and DG (RD) & SS. NHAI has Technical, Finance, Administrative and Vigilance Wings at its Headquarters. Project Implementation Units (PIUs) headed by a Project Director and supported by various technical and accounts officers have been set up at various sites to oversee timely completion of the projects.

b) Ministry of Road Transport and Highways (MoRT&H)

The Ministry of Road Transport and Highways is a ministry of the Government of India, that is the apex body for formulation and administration of the rules, regulations and laws relating to road transport, transport research and in also to increase the mobility and efficiency of the road transport system in India. Through its officers of Central Engineering Services (Roads) cadre it is responsible for the development of National Highways of the country. Road transport is a critical infrastructure for economic development of the country. It influences the pace, structure and pattern of development. In India, roads are used to transport over 60 percent of the total goods and 85 percent of the passenger traffic. Hence, development of this sector is of paramount importance for India and accounts for a significant part in the budget.

c) National Highways and Infrastructure Development Corporation Ltd. (NHIDCL)

National Highways and Infrastructure Development Corporation is a fully owned company of the Ministry of Road Transport & Highways, Government of India. The company promotes surveys, establishes, designs, builds, operates, maintains and upgrades National Highways and Strategic Roads including interconnecting roads in parts of the country which share international boundaries with neighboring countries. The regional connectivity so enhanced would promote cross border trade and commerce and help safeguard India's international borders. This would lead to the formation of a more integrated and economically consolidated South and South East Asia. In addition, there would be overall economic benefits for the local population and help integrate the peripheral areas with the mainstream in a more robust manner.

d) Indian Academy of Highway Engineer (IAHE)

Indian Academy of Highway engineer (IAHE) formerly known as the National Institute for Training of Highway Engineers (NITHE) is a registered Society under the administrative control of this Ministry. Hon'ble Minister-in-Charge is the President and the Secretary, Road Transport & Highways is the Vice-President of this Society, which is advised by a Governing Body comprising eminent and distinguished engineers and administrators. The Director General (Road Development) & Special Secretary of this Department is the Chairman of the Body. It was set up as a collaborative body of the Central and State Governments in 1983. This Institute has been shifted in 2001 to its permanent campus at A-5, Institutional Area, Sector-62, Noida, (U.P.). The campus has all facilities for providing training and has a trainees' hostel and staff quarters.

Training is imparted to freshly recruit as also to in-service highway engineers. The areas of training include different aspects of road and bridge engineering, contract management, quality control, etc.

e) Border Roads Organization (BRO)

The BRO was conceptualized initially in 1960, to construct and maintain roads in border areas as per the operational requirements of the Ministry of Defense. The road works so entrusted were classified as General Staff (GS) roads. Besides GS roads, the BRO also executes agency works entrusted by other Ministries of the Central Government. The BRO is under the administrative control of the Ministry of Defense. The Director General Border Roads (DGBR) is the executive head of the BRO.

1.2.3 NHDP

1.2.3.1 General

As National Highways comprises about 2% of the total road length in the country and yet carryover 40% of total traffic, the first and the foremost task mandated to the NHAI is the implementation of NHDP- comprising of the Golden Quadrilateral and North-South & East-West Corridors. In addition to the projects under NHDP, the NHAI is also currently responsible for about 1 000 km of Highways connecting major Ports & also on National Highways 8A, 24, 6, 45 & 27. Highways length with NHAI currently is around 70,000 km.

NHDP's prime focus is on developing roads of international standards with facilities for uninterrupted flow of traffic with:

- Enhanced safety features.
- Better riding surface.
- Better road geometry.
- Better traffic management and noticeable signage.
- Divided carriageways and service roads.
- Grade separators.
- Over bridges and underpasses.
- Bypasses; and
- Wayside amenities

1.2.3.2 Need of NHDP

There has been a major shift in transportation mode from railways towards the road sector since 1980s. Before inception of NHDP, country's road network was having the following bottlenecks.

- Growth
- Rate of primary road network was hovering around 2%-3%. Out of which, only 2.5% was four laned and 15% two laned.

- There was severe capacity constraint and lack of mobility in primary / secondary network.
- Tertiary network was plagued with lack of connectivity to primary / secondary network and nearly 40% habitations were not connected by all-weather roads.
- Above all, main commuting mode remained to be road as depicted in the Table 1.1.

Table 1. 1: Mode of Transport

Type	Road	Railways
Passenger	85%	15%
Freight	60%	40%

1.2.3.3 NHDP Phase:

NHDP Phase-I: Government has approved four/ six/eight laning of 7,498 km of National Highways at an estimated cost of Rs. 30,300 crores. It mainly includes four/ six/eight laning of Golden Quadrilateral connecting four metropolitan cities Le. Delhi, Mumbai, Chennai and Kolkata. Implementation of NHDP-I mainly on Item Rate Construction Contract (IRCC). All the contracts awarded and about 94% of NHDP-1 project has been completed. Around 12% through PPP route on BOT (Toll) [6.0%] and BOT (Annuity) [6.0%] mode.

NHDP Phase-II: Under this Government has approved 6644 km of National Highways to be widened to four/six lane facility at a cost of Rs. 34,339 crores. Under this North South Corridor from Srinagar to Kanyakumari with Cochin Selam Spur and East West Corridor from Silchar to Porbandar are to be developed. Implementation of NHDP-II mainly on IRCC. Though around 24% through PPP on BOT (Toll) [11%] and BOT (Annuity) [13%]. 87.34% of length is awarded out of which around 19.51% completed.

NHDP Phase-III: Under this, Government has approved up gradation of 12109 km of existing National Highways to two lane with paved shoulders/four/six lane having high traffic density, connecting important tourist locations, economically important areas, State capitals etc on build, operate and transfer (BOT) basis with a maximum viability gap funding (VGF) of 40%. The estimated cost for development of these stretches is Rs. 80,626 crores. 17.13% of length awarded, out of which 3.39% length completed. NHDP-III is scheduled for completion by Dec. 2013.

NHDP Phase-IV: There is a proposal under consideration for widening of 20,000 km of existing single /intermediate /two lane highways to two lanes with paved shoulders at an estimated cost of Rs. 27,800 crores through PPP route on BOT (Toll) /BOT (Annuity) basis.

NHDP Phase -V: Under this Government has approved six laning of 6500 km of National Highways at a cost of Rs. 41,210 crores through PPP route on BOT (Toll) mode using Design Build Finance and Operate (DBFO) pattern with a maximum VGF of 10%. In DBFO private parties needs the upfront cost of design, construction and expenditure on annual maintenance and recovers the entire cost along with the interest from toll collection during the concession period. A length of 882 km awarded. NHDP-V is scheduled for completion by Dec. 2012.

NHDP Phase-VI: Under this Government has approved construction of 1000 km of expressways at an estimated cost of Rs. 16,680 crores through PPP route on BOT (Toll) mode following a DBFO pattern with a maximum VGF of 40%. Action is being taken for preparation of feasibility report. NHDP-VI is scheduled for completion by Dec. 2015.

NHDP Phase-VII: Under this Government has approved construction of 700 km of stand-alone ring roads/bypasses as well as grade separators, flyovers, elevated road, tunnels road over bridge, under passes etc at an estimated cost of Rs. 16,680 crores through PPP route on BOT (Toll) mode with a maximum VGF of 40% Action is being taken for preparation of feasibility study. NHDP-VII is scheduled for completion by Dec. 2014.

1.2.3.4 Finance Mechanisms

Government of Jammu and Kashmir proposes to finance its projects by a host of financing mechanisms. Some of them are as follows.

a) Through Budgetary Allocations from the Government of India

b) Cess

In a historic decision, the Government of India introduced a Cess on both Petrol and Diesel. This amount at that time (at 1999 prices) came to a total of approximately Rs. 2,000 crores per annum. Further, Parliament decreed that the fund so collected were to be put aside in a Central Road Fund (CRF) for exclusive utilization for the development of a modern road network. The

developmental work that it could be tapped to fund, and the agencies to which it was available were clearly defined as:

- I) Construction and maintenance of state highways by state governments.
- II) Development of rural roads by state governments
- III) Construction of rail over-bridges by Indian Railways
- IV) Construction and maintenance of national highways by NHDP and Ministry of Road Transport & Highways (MoRTH).

Today, the Cess contributes between Rs. 5 to 6 thousand crores per annum towards NHDP.

c) Loan Assistance from International Funding Agencies

Loan assistance is available from multilateral development agencies like Asian Development Bank and World Bank or Other overseas lending agencies like Japanese Bank of International Co-Operation.

d) Market Borrowing

Government of Jammu and Kashmir proposes to tap the market by securities cess receipts.

e) Private Sector Participation

Major policy initiatives have been taken by the Government to attract foreign as well as domestic private investments. To promote involvement of the private sector in construction and maintenance of National Highways, some projects are offered on Build Operate and Transfer (BOT) basis to private agencies. After the concession period, which can range up to 30 years, the road is to be transferred back by the Concessionaires.

f) Special Purpose Vehicle

Funds are also leveraged by the setting up of Special Purpose Vehicles (SPVs). The SPVs will be borrowing funds and repaying these through toll revenues in the future. This model will also be tried in some other projects. Some more models may emerge in the near future for better leveraging of funds available such as Annuity.

The financial arrangement for the development of NHDP has been made as shown vides

Table 1.2. Total cost of NHDP has been estimated to be Rs. 54,000 Crores or US\$ 13.2 billions whose components are as below.

Table1.2: Financing of NHDP

Total Cost	Rs.54,000 Crores	US\$ 13.2 Billion
Likely sources	Rs.cr. (On 1999 prices)	US\$ Billions (on 1999 prices)
Cess on petrol	20,000	4.90
External assistance	20,000	4.90
Market borrowings	10,000	2.40
Private sector participation	4,000	1.00

1.2.3.5 Policy Initiatives for Attracting Private Investment

- Government will carry out all preparatory work including land acquisition and utility removal. Right of way (ROW) to be made available to concessionaires free from all encumbrances.
- Government of India to provide capital grant up to 40% of project cost to enhance viability on a case to case basis.
- 100% tax exemption for 5 years and 30% relief for next 5 years, which may be availed of in 20 years.
- Concession period allowed up to 20 years.
- Arbitration and Conciliation Act 1996 based on UNICITRAL provisions.
- In BOT projects entrepreneurs can collect and retain toll.

1.3 The Consultant

"Consultancy Services for Preparation of Detailed Project Report for intermittent Two Lane plus Paved Shoulder stretches to Four Lane in between Design Km 148+589 (Existing Km

235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir

1.4 Objectives of Consultancy

- The main objective of the consultancy service is to establish the technical, economical, and financial viability of the project and prepare detailed project reports for rehabilitation and upgrading of the existing road to 4 lanes with paved shoulder configuration.
- The viability of the project shall be established considering the requirements with regard to rehabilitation, upgrading and improvement based on highway design, pavement design, provision of service roads wherever necessary, type of intersections, rehabilitation and widening of existing and/or construction of new bridges and structures, road safety features, quantities of various items of works and cost estimates and economic analysis within the given time frame.
- The Detailed Project Report (DPR) would inter-alia include detailed highway design, design of pavement and overlay with options for flexible or rigid pavements, design of bridges and cross drainage structures and grade separated structures, design of service roads, quantities of various items, detailed working drawings, detailed cost estimates, economic and financial Viability analyses, environmental and social feasibility, social and environmental action plans as appropriate and documents required for tendering the project on commercial basis for international / local competitive bidding
- The DPR consultant should ensure detailed project preparation incorporating aspects of value engineering, quality audit and safety audit requirement in design and implementation.
- The consultant should, along with Feasibility Report, clearly bring out through financial analysis the preferred mode of implementation on which the Civil Works for the stretches are to be taken up. The consultant should also give cost estimates along with feasibility report/detailed Project Report.

1.5 Scope of Services

The general scope of services is given in the sections that follow. However, the entire scope of services would, inter-alia, include the items mentioned in the Letter of Invitation, terms of reference, general contract and any supplements and appendices to these documents.

1.5.1 ROW and Land related aspects

- The land for any Expressway will be acquired with a ROW of 100 m.
- As for the four-lane/six-lane Highway Road Projects, experience shows that all the existing two-lane Roads requiring up gradation to 4/6-lane involve acquisition of land, shifting of utilities, felling of trees and other statutory clearances etc. As such, keeping in view a futuristic approach, it has been decided that the land for any 4/6 lane Highway Road will be acquired with a Row of 60 m irrespective of the width of the carriageway. Further, efforts shall be made to design the road for up gradation from 2 lane to 4 lanes in such a way that the existing 2 lanes shall be retained for one-way traffic and separate one way 2 lane Greenfield shall be provided at an appropriate distance from existing 2 lane road with interlinking in between, to avoid higher LA cost, avoiding shifting of utilities and felling of trees depending upon specific site conditions and economic considerations.
- All efforts shall be made to avoid any road alignment through National Parks and Wildlife Sanctuaries, even if it requires taking a longer route/bypass. However, where it becomes unavoidable and necessary to keep the alignment through such reserve forest/restricted areas, land would be acquired with Row of not more than 30 meters. The cross-section in such areas may be kept as 3.25m, (shoulder/Utility Corridor) 10.5m (three-lane one side carriageway) 2.5m (Median) 10.5m (2nd three-lane carriageway) 3.25m (shoulder/Utility Corridor).
- Similarly, though it may be difficult, while determining the alignment for any bypass, efforts are made to see if these could be along the revenue boundaries of two revenue Estates thereby minimizing the compulsions of land owners/farmers for cross-over's to the other side. In case such an alignment is not found feasible, it should be ensured that access to common facilities for the local people (eg, schools, Healthcare facilities etc.) is maintained only on one side of the alignment, thereby minimizing the need for cross-over for day-to-day life.

- Protection of the acquired ROW against any possible encroachments is extremely important. Boundary stones be provided at the end of the ROW as per Clause 9.8 of IRC SP: 84-2019 and supplemented as per Circular dated 08.12.2015 issued by NHIDCL. The boundary pillars alone, which are subject to removal with passage of time, may not be enough to save against encroachments. As such, the typical cross-section of a Highway Road is being re-visited separately with the intention of providing permanent features in this behalf. For a typical ROW of 60 meters, starting from one end, these will require the following
- a) Use barricading of the ROW with plantation of hedge-like species (Ficus/Poplars) within a 3m wide strip area, dug up to 0.6 to 0.9 meters, of which 2.0 meters to serve as a Utility Corridor.
 - b) Provision of a Service Road (along the inhabited area) with its drainage slope towards the drain/area reserved for Strip Plantation, for a width of 9.0 meters.
 - c) Earmark width of 1.5 meters for construction of a drain so as to be able to capture the rainwater flow from the Service Road (wherever provided) and the main carriageway.
 - d) Three lanes with paved shoulders: Main carriageway-10.5 meters, paved shoulder-1.5 meters and earthen shoulder-2.0 meters (Total 14 meters).
 - e) Median-5.0 meters (effective width 4.5 m), and
 - f) A Mirror Image on the other end.

Provisions of short bypasses, service roads, alignment corrections, improvement of intersections shall be made wherever considered necessary, practicable and cost effective. However, bypasses proposals should also be considered, wherever in urban areas, improvement to 4/6/8-lane, as the case may be, of the existing road is not possible.

The Consultant shall furnish land acquisition details as per revenue records/maps for further processing of land acquisition. Consultant shall also submit 3a, 3A and 3D draft notification for acquisition of land.

Support in land Acquisition process till the receipt of land possession certificate from CALA

- a) The Consultant shall identify all land parcels needing to be acquired as part of project ROW and shall furnish land acquisition details as per revenue records/maps for further processing of land acquisition.
- b) Assist CALA in preparation and verification of draft 3A/3D/3G/3H notifications, collecting information/documents, claims hearing etc.
- c) Liaison with state departments like land revenue department and registrar's office for collection and verification of revenue records, surveys, sale deeds, circle rates and for valuation of land related assets.
- d) Conduct all required surveys/valuation including joint measurement survey and valuation of land assets.
- e) Support CALA by providing technical manpower (like Amin's) clerical manpower and other resources (like vehicles, printers)
- f) Assist PIU in verification of 3A/3D/3G/3H drafts from CALA, drafting of documents (to be forwarded to RO/HQ), receipt of land possession certificate and in related activities till award of civil work
- g) Assist PIU in all official communications with CALA and other State department.

Approach to the provision and specifications for Structures:

- a) The structures on roads viz. Bridges, ROB's (Road Over Bridges, and Flyovers), RUBs (Road under Bridges) etc. are designed for more than 50 years. It is difficult to increase the width of the structures later which may also have larger financial implications apart from construction related issues in running traffic. Therefore, it has been decided to keep provision for all the structures including approaches comprising of retaining structures as 6-lane (length of such approaches shall, in no case, be less than 30m on either side) on all the four-lane highways except in the following cases (i) Reserve Forest (ii) Wild life Areas (iii) Hilly Areas (iv) Urban Areas where site condition do not permit this. Wherever elevated sections are designed through any inhabited areas, these should be six-lane structures supported on single piers so that the road underneath serves as effective service roads on both sides.
- b) Highway projects shall be designed for separation of local traffic especially for Vulnerable Road Users (VRUs), for longitudinal movements and crossing facilities through viaduct(s) located at convenient walking distance. Provision of PUPs and CUPs with size of 7.0m x 3.0m, as specified in para 2.10 of the IRC specifications, has proved to be insufficient keeping in view the increased use of mechanization in agriculture practices. These structures do not support the

easy passage/crossing for the tractors with trolleys so often used for agricultural operations. As traffic on cross roads is increasing day-by-day, it has been decided to substitute the provision of Pedestrian Underpass (PUP)/Cattle Underpass (CUP) [for para 2.10 of IRC specifies the dimensions of 7.0m x 3.0m] with a VUP Grade-II with a minimum size of 12m (lateral clearance) x 4m (vertical clearance). Out of 12m lateral width, 2.5m width on one side shall be raised for pedestrian sidewalks with grills to make pedestrian movement convenient and safe. These structures shall be located at the most preferred place of pedestrian / cattle / day-to-day crossings. Depending on the site conditions, feasibility of clubbing the crossing facilities through service roads shall also be explored. Further, the bed level of these crossings shall not be depressed as any such depression, in the absence of proper drainage facilities becomes water-logged rendering the same unusable. Ideally, the bed level of the crossings should be a bit higher with proper connectivity to a drain, which could serve the drainage requirements of the main carriageway, the underpass and the service road as well.

- c) Wherever the alignment of 4-lane Highway road project is retained in-situ while passing through inhabited areas (e.g. villages), it should be ensured that Service Roads are provided on both sides of the carriageway, connected underneath with a cross-over structure (VUP/PUP/CUP). Thus, each habitation should preferably have crossing facility at the highways with a vertical clearance of 4 m.
- d) To ensure that bypass once constructed serves the intended purpose during its life, all the bypasses shall be well designed, and access controlled. The entry / exit from/ to side roads shall be controlled such that they are grade separated at major roads or at spacing not less than 5 km. Side roads at closer spacing shall be connected to the service roads on either side and taken to major roads for provision of grade separated interchange.
- the provision of embankments shall be kept minimum so as to save land as well as earth which are scarce resources. This can be decided on case to case basis with due deliberations. However, economic considerations may also be given due weight age before deciding the issue.
 - The Consultant shall study the possible locations and design of toll plaza if applicable to the project. Wayside amenities Land (minimum 5 acres, length and depth preferably in the ratio of 3:2) shall also be acquired for establishment of Way-side amenities at suitable locations at distances varying between 30 to 50 km on both sides of the

Highway. The local and slow traffic may need segregation from the main traffic and provision of service roads and fencing may be considered, wherever necessary to improve efficiency and safety.

- The Consultant will also make suitable proposals for widening/improvement of the existing road and strengthening of the carriageways, as required at the appropriate time to maintain the level of service over the design period. The Consultants shall prepare documents for EPC/PPP contracts for each DPR assignment.
- Already to implement "good for construction" drawings shall be prepared incorporating all the details.
- Environmental Impact Assessment, Environmental Management Plan and Rehabilitation and Resettlement Studies shall be carried out by the Consultant meeting the requirements of the lending agencies like ADB/World Bank/JICA, etc.
- Wherever required, consultant will liaise with concerned authorities and arrange all clarifications. Approval of all drawings including GAD and detail engineering drawings will be got done by the consultant from the Railways. However, if Railways require proof checking of the drawings prepared by the consultants, the same will be got done by NHIDCL and payment to the proof consultant shall be made by NHIDCL directly. Consultant will also obtain final approval from Ministry of Environment and Forest for all applicable clearances. Consultant will also obtain approval for estimates for shifting of utilities of all types from the concerned authorities and NHIDCL. Consultant is also required to prepare all Land Acquisition papers (ie. all necessary schedule and draft 3a, 3A, and 3D, 3G notification as per L.A. act) for acquisition of land either under NH Act or State Act.
- The DPR consultant may be required to prepare the Bid Documents, based on the feasibility report, due to exigency of the project for execution if desired by NHIDCL..
- Consultant shall obtain all types of necessary clearances required for implementation of the project on the ground from the concerned agencies. The client shall provide the necessary supporting letters and any official fees as per the demand note issued by such

concerned agencies from whom the clearances are being sought to enable implementation.

- Consultant shall obtain all types of necessary clearances required for implementation of the project on the ground from the concerned agencies. The client shall provide the necessary supporting letters and any official fees as per the demand note issued by such concerned agencies from whom the clearances are being sought to enable implementation.
- The consultant shall prepare separate documents for BOT as well as EPC contracts at Feasibility stage / DPR stage. The studies for financing options like BOT, Annuity, EPC will be undertaken in feasibility study stage.
- The consultant shall be guided in its assignment by the Model Concession/Contract Agreements for PPP/EPC projects, as applicable and the Manual of Specifications and Standards for four/six laning of highways published by IRC (IRC: SP:84 or IRC: SP:87, as applicable) along with relevant IRC codes for design of long bridges.
- The consultant shall prepare the bid documents including required schedules (as mentioned above) as per EPC/ PPP documents. For that it is suggested that consultant should also go through the EPC/PPP documents of ministry before bidding the project. The Consultant shall assist the NHIDCL and the Legal Adviser by furnishing clarifications as required for the financial appraisal and legal scrutiny of the Project Highway and Bid Documents.
- Consultant shall be responsible for sharing the findings from the preparation stages during the bid process. During the bid process for a project, the consultant shall support the authority in responding to all technical queries, and shall ensure participation of senior team members of the consultant during all interaction with potential bidders including pre-bid conference, meetings, and site visits etc. In addition, the consultant shall also support preparation of detailed responses to the written queries raised by the bidders.

1.5.2 General

Primary Tasks

- General Scope of Services shall cover but be not limited to the following major tasks (additional requirements for Preparation of Detailed Project Report for Hill Roads and Major Bridges are given in Supplement I and II respectively):
 - Review of all available reports and published information about the project road and the project influence area;
 - Environmental and social impact assessment, including such as related to cultural properties, natural habitats, involuntary resettlement etc.
 - Public consultation, including consultation with Communities located along the road, NGOs working in the area, other stakeholders and relevant Government departments at all the different stages of assignment (such as inception stage, feasibility stage, preliminary design stage and once final designs are concretized).
 - Detailed Reconnaissance.
 - identification of possible improvements in the existing alignment and bypassing congested locations with alternatives, evaluation of different alternatives comparison on techno-economic and other considerations and recommendations regarding most appropriate option;
 - traffic studies including traffic surveys and Axle load survey and demand forecasting for next thirty years;
 - Inventory and condition surveys for road;
 - Inventory and condition surveys for bridges, cross-drainage structures, other Structures, river Bank training/Protection works and drainage provisions;
 - Detailed topographic surveys using LiDAR equipped with minimum engineering grade system or any other better technology having output accuracy not less than

(a) Specified in IRC SP 84 2019

b) Total Station

(c) GPS/DGPS.

The use of conventional high precision instruments ie. Total Station or equivalent can be used at locations such as major bypasses, water bodies etc. where it may not be possible to survey using LiDAR. Use of mobile / Aerial LiDAR survey is preferable.

Pavement investigations.

Sub-grade characteristics and strength: investigation of required sub-grade and sub-soil characteristics and strength for road and embankment design and sub soil investigation.

Identification of sources of construction materials.

Detailed design of road, its x-sections, horizontal and vertical alignment and design of AD and construction drawings and cross drainage structures and underpasses etc.

Identification of the type and the design of intersections.

Design of complete drainage system and disposal point for storm water

Value analysis/value engineering and project costing.

Economic and financial analysis.

Contract packaging and implementation schedule.

Strip plan indicating the scheme for carriageway widening, location of all existing utility services (both over- and underground) and the scheme for their relocation, trees to be felled, transplanted and planted and land acquisition requirements including schedule for LA: reports documents and drawings arrangement of estimates for cutting/ transplanting of trees and shifting of utilities from the concerned department;

Develop 3D engineered models of terrain and elevation, as-is project highway, proposed and project highway along with all features, current and proposed structures, current and proposed utilities and land acquisition plans.

To find out financial viability of project for implementation and suggest the preferred mode on which the project is to be taken up.

Preparation of detailed project report, cost estimate, approved for construction Drawings, rate analysis, detailed bill of quantities, bid documents for execution of civil works through budgeting resources.

Design of toll plaza and identification of their numbers and location and office cum residential complex including working drawings

Design of weighing stations, parking areas and rest areas.

Any other user-oriented facility en-route toll facility.

Tie-in of on-going/sanctioned works of MORT&H/NHIDCL/other agencies.

Preparation of social plans for the project affected people as per policy of the lending agencies/Govt. of India R&R Policy.

- While carrying out the field studies, investigations and design, the development plans being implemented or proposed for future implementation by the local bodies, should be considered. Such aspect should be clearly brought out in the reports and drawings.
- the consultant shall study the possible locations and design of toll plaza, wayside amenities required and arboriculture along the highway shall also be planned.
- the local and slow traffic may need segregation from the main traffic and provision of service roads and physical barrier including fencing may be considered, wherever necessary to improve efficiency and safety.

Standards and Codes of Practices

- 1) All activities related to field studies, design and documentation shall be done as per the latest guidelines/ circulars of MoRT&H and relevant publications of the Indian Roads Congress (IRC) and Bureau of Indian Standards (BIS). For aspects not covered by IRC and BIS, international standards practices, may be adopted. The Consultants, upon award of the Contract, may finalize this in consultation with NHIDCL and reflect the same in the inception report.
- 2) All notations, abbreviations and symbols used in the reports, documents and drawings shall be as per IRC: SP 84-2019

1.6 Project Stages

The Project must be completed in eight stages as described herein below:

No	Stage	Key activities	Report/deliverable submitted
1	Inception	Project planning and mobilization	Inception Report and QAP
2	Feasibility	Alignment finalization, preliminary surveys	Alignment Options Report and Feasibility Report
3	LA and Clearances I	LA, utilities identification; creation of draft notifications and proposals	Strip Plan, LA Report (3a, 3A), Clearances and Utility Shifting proposals

4	DPR	Detailed design of highway, preparation of detailed project report with drawings,	Draft DPR Report, Final DPR Report, documents and drawings
5	Technical Schedules	Preparation of bid documents and technical schedules	Civil Works Contract Agreement and Schedules
6	(i) LA II (ii) Project Clearances	Land acquisition process, obtaining final utilities estimates and required clearances	JMS and 3D Report, Final Project Clearances and Utilities Report
7	LA III- Award Determination	Land acquisition award determination	3G Report
8	LA IV- Possession	Obtaining possession of land	Land Possession Report

1.7 The Draft Detailed Project Report

The Final Detailed Project Report consists total of 12 volumes as following details.

Volume-I	Main Report
Volume-I (A)	Annexure to Main Report
Volume-I (B)	Hydrology Report
Volume-II (A)	Design Report Highways
Volume-II (B)	Design Report Structures
Volume-III	Material Report
Volume-IV	EIA & EMP
Volume-V	Technical Specification
Volume-VI	Rate Analysis
Volume-VII	Cost Estimate
Volume-VIII	Bill of Quantities
Volume-IX	Drawings

Table 1.3: Volume-I Main Report of Draft Detailed Project Report consists of following chapters.

Chapter No.	Name
0	Executive Summary
1	Introduction
2	Socio- Economic Profile
3	Traffic Surveys and Analysis

4	Engineering Surveys, Investigations and Analysis
5	Traffic Forecast
6	Social Screening Report
7	Environmental screening Report
8	Improvement Proposal and Design
9	Cost Estimate (Road & Structures)
10	Economic Analysis
11	Financial Analysis
12	Conclusion and Recommendations

2.0 Socio-Economic Profile of the Project Influence Area

2.1 Background

The entire proposed project road is in the union territory of Jammu and Kashmir. The UT occupies a total area of 42,241 square kilometers. Jammu and Kashmir borders with the states of Himachal Pradesh and Punjab to the south, Ladakh to the east, Jammu and Kashmir has an international border with Pakistan on the east. Jammu and Kashmir consist of two divisions: Jammu and Kashmir and is further divided into 20 districts.

The Vailoo-Donipawa road section situated in west part of Jammu and Kashmir is having total existing length of about 27.943 Kilometers. The consultants have proposed intermediate road stretch from Vailoo to Donipawa having total design length of 8.643 km. The project road has significant influence on Jammu and Kashmir, specifically on the Anantnag district since it lies entirely in that district. Jammu and Kashmir is located around 33.7782° N, 76.5762° E.

2.2 Delineation of the Project Influence Area (PIA)

The entire project road is passing within the Anantnag district. Hence, for analyzing the immediate influence area of the project road Anantnag District in Jammu and Kashmir Union Territory have been considered.

2.3 Demographic Profile of PIA: UT and Districts

2.3.1 Jammu and Kashmir (Union Territory)

2.3.1.1 Location and Geography

The Union Territory of Jammu and Kashmir covers an area of 42,241 sq.km. The state is very rich in natural heritage since it is located mostly in Himalayan Mountains. Jammu and Kashmir borders with the states of Himachal Pradesh and Punjab to the south. Jammu and Kashmir has an international border Pakistan on the east, the Line of Control separates it from the Pakistan. Jammu and Kashmir consist of two divisions: Jammu and Kashmir and is further divided into 20 districts. Jammu and Kashmir is home to several valleys such as the Kashmir Valley, Tawi Valley, Chenab Valley, Poonch Valley, Sind Valley and Lidder Valley. The main Kashmir Valley is 100 km. The Indus, Tawi, Ravi and Chenab are the major rivers flowing through the state. Jammu and Kashmir is home to several Himalayan glaciers. With an average altitude of 5,753 metres (18,875 ft) above sea-level, the Siachen Glacier is 76 km (47 mi) long making it the longest Himalayan glacier. In the south around Jammu, the climate is typically monsoonal. In the hot season, Jammu city is very hot and can reach up to 40 °C whilst in July and August, very heavy though erratic rainfall occurs with monthly extremes of up to 650 millimeters.

2.3.1.2 Administrative Setup

Jammu and Kashmir consist of three divisions: Jammu, Kashmir Valley and is further divided into 20 districts. The major cities in Jammu and Kashmir are:

Table 2.1: Population Census of Jammu and Kashmir

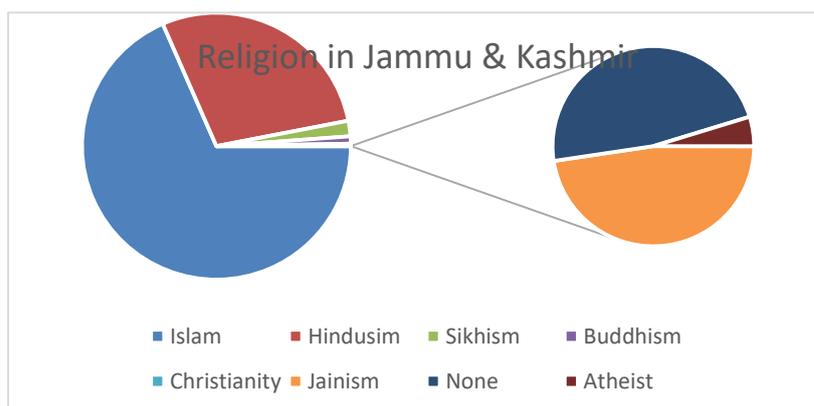
Division	Districts	Area (Square-Km)	Population	Headquarters
Jammu	Kathua District	2651	616,435	Kathua
	Jammu District	2336	1,529,958	Jammu
	Samba District	1002	3,18,898	Samba
	Udhampur District	5550	554,985	Udhampur
	Reasi District	1719	314,667	Reasi
	Rajouri District	2630	642,415	Rajouri
	Poonch District	1674	476,835	Poonch
	Doda District	2625	409,936	Doda
	Ramban District	1329	283,713	Ramban

	Kishtwar District	7737	230,696	Kishtwar
	Total for division	29253	5059640	Jammu
Kashmir	Anantnag District	3574	1,078,692	Anantnag
	Kulgam District	1067	424,483	Kulgam
	Pulwama District	1398	560,440	Pulwama
	Shopian District	612.9	266,215	Shopian
	Budgam District	1370	753,745	Budgam
	Srinagar District	1979	1,236,829	Srinagar
	Ganderbal District	1979	297,446	Ganderbal
	Bandipora District	345	392,232	Bandipora
	Baramulla District	3353	1,008,039	Baramulla
	Kupwara District	2379	870,354	Kupwara
	Total for division	18056.9	6,888,475	

2.3.1.3 Demographic Features

The major ethnic groups living in Jammu & Kashmir include Kashmiris, Gujjar's /Bakarwals, Paharis, and Dogras. The Kashmiris live mostly in the main valley of Kashmir and Chenab valley of Jammu division with a minority living in the Pir Panjal region. The Pahari-speaking people mostly live in and around the Pir Panjal regions. The Dogra's are ethnically, linguistically and culturally related to the neighboring punjabi people and mostly live in the udhampur and Jammu districts of the state.

Jammu and Kashmir is one of India's two administrative divisions (the other being the Union territory of Lakshadweep which is overwhelmingly Muslim) with a Muslim majority population. According to the 2011 census, Islam is practised by about 68.3% of the state small minorities and Hinduism follow 28.4% population, follow Sikhism (1.9%), Buddhism (0.9%) and Christianity (0.3%). About 96.4% of the populations of the Kashmir valley are Muslim followed by Hindus (2.45%) and Sikhs (0.98%) and others (0.17%).



According to the 2011 census of India, the total population of Jammu and Kashmir is 42241 Km sq. The official language of the state is Urdu. Among other languages Kashmiri, Dogri, Hindi, Punjabi, Pahari, Balti, Gojri, Shina and Pashto are also spoken in other parts of Jammu and Kashmir. Jammu and Kashmir have a rich literary heritage with roots that lie deep in the sociological and historical movements of the region. Its literature reflects the regional consciousness and the evolution of an identity distinct from others in Northern India. The literacy is about 68.74%.

Table 2.2: Demographic Profile of Jammu and Kashmir

Division	% Muslim	%Hindu	% Sikh	% Buddhist & others
Kashmir	96.40%	2.45%	0.98%	0.17%
Jammu	33.45%	62.55%	3.30%	0.70%

2.3.2 Anantnag District

2.3.2.1 Location and Geography

The project bypass stretches lies in the Anantnag district. Anantnag is a district in the newly formed Union Territory of Jammu and Kashmir. It is one of ten districts which make up the

Kashmir Valley. The district headquarters is Anantnag city. As of 2011, it was the third most populous district of Jammu and Kashmir (out of 20), after Jammu and Srinagar.

Anantnag is located about 54 Km from Srinagar and about 254 Km from Jammu. The district is well connected with other districts and National Highway NH-1A (44) and NH-1B (244) pass through the district. The district has a good road network. District Anantnag is called the Gateway of Kashmir Valley. The nearest airport is located at Srinagar, which is about 65 Km away and the nearest Railhead is located at Jammu. The general approach to the whole of the District is through road and one can avail the transport facilities like Taxi, Deluxe Buses etc. both from Jammu and Srinagar. The ambitious project of bringing the Kashmir Valley on the railway network map has been started. Geographically the district lies between 33-20' to 34 - 15' north latitude and 74-30 to 75 -35 East Longitude bounded by north west by Srinagar and Pulwama districts and in the north east by Kargil district, in the southeast by district Doda, Kishtwar and in the south and south west by Ramban and Kulgam districts respectively.

2.3.2.2 Geological

Here are four informative maps related to the geology and seismicity of the Kashmir region, including the Anantnag area in Jammu & Kashmir:

Geological Map of Jammu & Kashmir – illustrates rock types and formations across the region.

Simplified Geology & Structural Map of the Kashmir Basin, highlighting major tectonic thrusts and faults such as the Main Central Thrust (MCT), Main Boundary Thrust (MBT), and Central Kashmir Fault (CKF).

Isoseismic Map of Major Earthquakes in the Kashmir Basin (last ~500 years) – shows contours of shaking intensity from historic earthquakes, including events of 1555, 1885, 1953, 1967, and 2005.

Topographic Map with Active Faults around the Kashmir Basin – provides context for major thrust and strike-slip fault systems in the vicinity.

Geological Context for Anantnag & Surrounding Area

The **Kashmir Valley** (including Anantnag) contains a mix of sedimentary, metamorphic, and igneous rock units ranging from Precambrian to recent epochs. The neighboring **Outer Hills Region** (Jammu side) features Siwaliks, Murree formations, and Dogra slates.

Structural complexity includes major fault lines such as the **MCT**, **MBT**, and the **Central Kashmir Fault (CKF)**, which overlie or traverse the valley and significantly influence regional geology.

Seismic Hazard & Earthquake Patterns

Anantnag falls within **Seismic Zone IV**, bordering **Zone V**, which denotes high seismic risk. The broader **Kashmir Valley** lies in **Zone V**, reflecting very high seismic hazard levels based on the BIS zoning system.

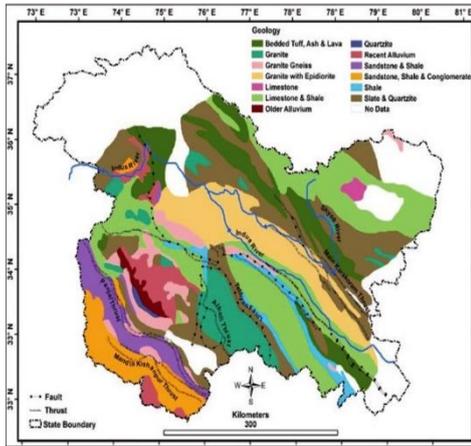
Historical seismicity analysis reflects substantial activity: Kashmir Valley's probability of experiencing an earthquake of magnitude ≥ 7.7 in 50 years is approximately **88%**, while magnitude ≤ 7.5 has a **97%** probability; recurrence periods are estimated as ~ 47 years and ~ 27 years, respectively. Smaller events ($M \leq 6.5$) are almost certain within 4 years.

Recent Seismic Activity in Anantnag

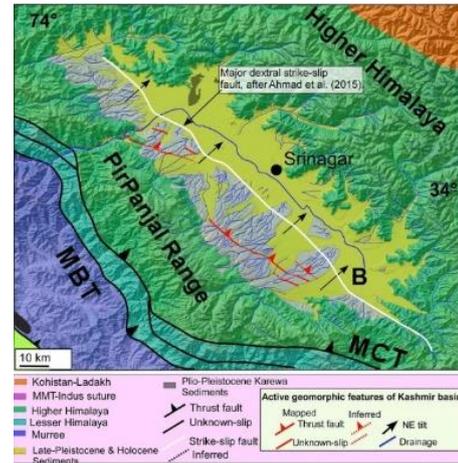
Recent recorded tremors include:

Magnitude 2.7 on 18 September 2024, shallow (~ 5 km depth).

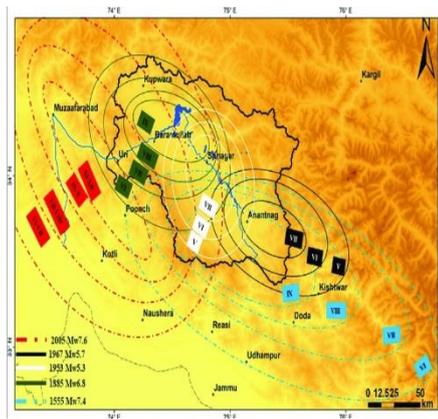
Magnitude 3.4 on 9 October 2024, depth ~ 10 km.



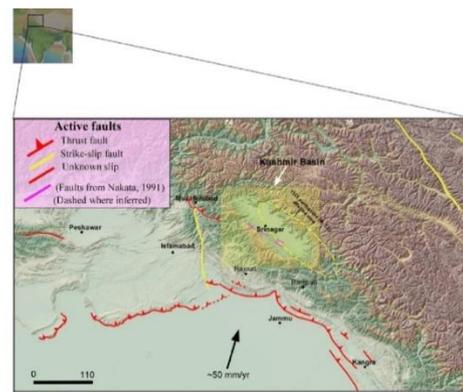
Geological Map



Structural Map



Isoseismic I Map



Active Faults Map

2.3.2.3 Temperature in Anantnag

Anantnag experiences a moderate, temperate climate with distinct seasonal contrasts. According to climate classification sources, summers are generally mild and humid, while winters are cold and often frosty. The hottest month is July, with mean maximum temperatures reaching around 32 °C and night-time minimums near 6 °C, and the coldest months—December to January—can plummet to mean minimums of -15 °C and highs near 0 °C.

Detailed monthly data reinforces this pattern: January’s average highs reach just 2.3 °C and lows plunge to -9.5 °C; by July, highs climb to about 23 °C, with lows near 13.5 °C Historical averages from weather APIs show January averaging around 0 °C, rising to about 22 °C in July and August.

Rainfall (Precipitation)

Anantnag receives significant annual precipitation, though rainfall (and snowfall) is fairly distributed across the year rather than concentrated in a single monsoon season.

Annual rainfall ranges from approximately 721 mm to 916 mm, depending on the data source. Rainfall occurs over around 70 days annually.

Monthly breakdowns show March often being one of the wettest months (~159 mm on average), followed by August (~155 mm).

Summers bring moderate rain, but winters and springs also see consistent precipitation—notably due to snow during the colder months

In summary, Anantnag's precipitation is spread throughout the year, with spring and late summer being especially wet.

Wind Patterns

Wind in Anantnag is generally light to moderate, with some seasonal variation:

Average wind speeds range from about 3.7 km/h in October to around 6.4 km/h in January, making winter slightly windier than more tranquil autumn months.

In September, average hourly wind speeds are around 4.7 mph (~7.5 km/h), with predominant winds coming from the west.

Wind tends to be gentle throughout the year, with no extreme gusts—keeping the climate relatively calm but cool, especially during the winter season.

2.3.2.4 Administrative Setup

Anantnag district comprises Kokernag, Shangus, Anantnag (town), Bijbehara, Doru Shahabad, Pahalgam and Qazigund tehsils. The district consists of seven blocks: Breng, Shangus, Achabal, Dachnipora, Qazigund, Khoveripora and Shahabad. Each block consists of a number of panchayats such as Akingam, Dialgam, and Vailoo etc.

Table 2.3-Tehsil and Blocks in Anantnag District

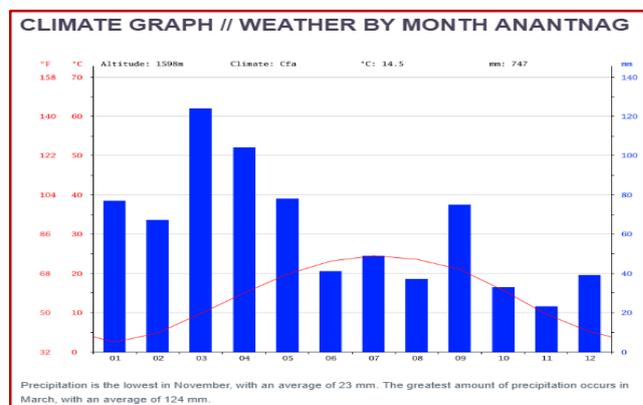
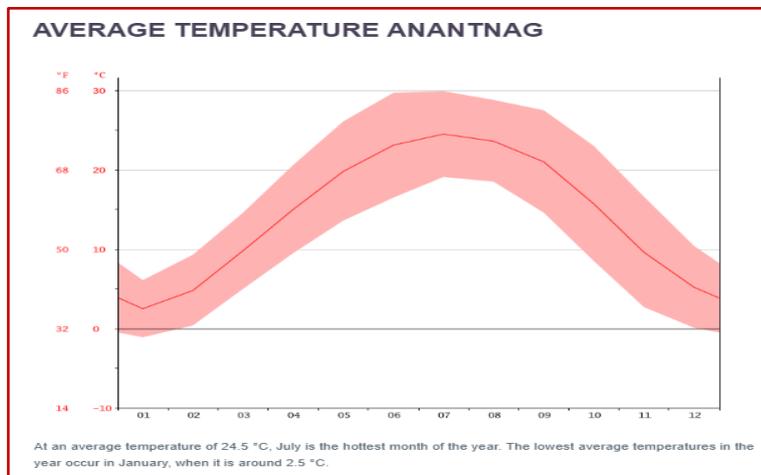
District	Tehsil	Block
ANANTNAG	1. Bijbehara	1. Khveripora
	2. Doru	2. Shanabad
	3. Kokernag	3. Achabal
	4. Shangus	4. Breng
	5. Qazigund	5. Shangus
	6. Pahalgam	6. Qazigund
	-	7. Dachipora

Table 2.4: Demographic Profile of Anantnag District

Category	No
Area	2917 Sq. Kms.
No. of Revenue Villages	387
No. of Sub-Divisions	04
No. of CD Blocks	16
No. of Tehsils	12
No. of Gram Panchayats	303
No. of Municipalities	10
No. of Municipal Corporations	2
No. of Patwar Halqas	99
Literacy Rate	62.69%
Total Population	1078692

2.3.2.5 Climate

The existing project road starts at Vailoo Village and terminates at Khanabal of NH-244 having total project length of 34 km. This project road lies entirely in Anantnag District of Jammu and Kashmir. Anantnag features a moderate climate (Köppen climate classification). The climate of Anantnag is largely defined by its geographic location, with the towering Karakoram to its east and the Pir-panjal range to the south. It can be generally described as cool in the spring and autumn, mild in the summer, and cold in the winter. As a large city with a significant difference in Geo location among various districts, the weather is often cooler in the hilly Areas of east as compared to the flat northern part of Anantnag. Weather conditions are unpredictable. The record high temperature is 33 °C and the record low is -18 °C. On 5-6 January 2012, after years of relatively little snow, a wave of heavy snow and low temperatures shocked the city covering it in a thick layer of snow and ice, forcing them to officially declare a state of emergency and calling the following two days (6 and 7 January) off for the whole valley.



2.4 Employment Pattern and Economy

This micro level study, conducted in Union Territory of Jammu and Kashmir to examine the income and employment pattern, has revealed that Due to limited job opportunities available for job seeker youth in the region, the number of job seeker youth has been increasing with every passing year. The number of job seeker youth registered in various District Employment & Counselling Centers of the J&K region is 6.01 lakhs ending September 2011. The given table provides the combined data of J&K and Ladakh region.

Table 2.5: Qualification-wise job seekers in 2011 of Jammu and Kashmir

Qualification	Kashmir Division	Jammu Division	Total
Illiterate	2771	432	3203
Middle	21211	55876	77087
Matric	78991	86217	165208
PUC	18774	656	19430
TDC	102621	83846	186467
Graduate			
Arts	26585	11977	38562
Science	15181	6620	21801
Commerce	3798	1565	5363
Others	13191	6105	19296
Total	58755	26267	85022
Post Graduate			
Arts	5432	4575	10007
Science	3227	2143	5370
Commerce	913	573	1486
Others	2690	1217	3907

Total	12262	8508	20700
Diploma Holders			
Civil	554	464	1018
Elect.	447	695	1142
T/Com	291	466	757
Mechanical	428	506	934

In India estimates of the rates of unemployment are provided by the NSSO and use three different criterions of unemployment:

- (i) Number of persons unemployed based on Usual Principle Status
- (ii) Number of persons unemployed based on the Current Weekly Status and
- (iii) Number of person-days unemployed based on the Current Daily Status.

Table 2.6: Unemployment of Jammu and Kashmir

Area	J&K (%)			All India (%)		
	Male	Female	Persons	Male	Female	Persons
Rural						
UPS	2.7	16.6	3.9	2.1	2.9	2.3
CWS	3	6.3	3.8	3.3	3.5	3.4
CDS	5	11.8	6.1	5.5	6.2	5.7

Urban						
UPS	4.7	25.6	7.8	3.2	6.6	3.8
CWS	4.5	21.8	7.6	3.8	6.7	4.4
CDS	5.3	24.2	8.4	4.9	8	5.5
Combined (Rural + Urban)						
UPS	3.7	21.1	5.85	2.65	4.75	3.05
CWS	3.75	14.05	5.7	3.55	5.1	3.9
CDS	5.15	18	7.25	5.2	7.1	5.6

The economy of Jammu and Kashmir has suffered from disturbed conditions. It would be therefore necessary to put the economy back to the rails to enable an average person get employment opportunities. In this direction, the following 8 sectors of economy have been identified for generation of gainful employment opportunities in the region on sustainable basis:

1. Agriculture (including Horticulture, Floriculture, Food Processing and Animal Husbandry)
2. Industries (including Small Scale industries and rural industries)
3. Handlooms and Handicrafts
4. Tourism & travels,
5. Education & health
6. Large infrastructure projects (Roads & Railways)
7. Information Technology & Telecommunication

8. Construction Sector

Jammu and Kashmir's economy is predominantly dependent on agriculture and allied activities. The Kashmir Valley is known for its sericulture and cold-water fisheries. Wood from Kashmir is used to make high-quality cricket bats, popularly known as Kashmir Willow. Kashmiri saffron is very famous and brings the UT a handsome amount of foreign exchange. Agricultural

exports from Jammu and Kashmir include apples, barley, cherries, corn, millet, oranges, rice, peaches, pears, saffron, sorghum, vegetables, and wheat, while manufactured exports include handicrafts, rugs, and shawls.

Horticulture plays a vital role in the economic development of the area. With an annual turnover of over 3 billion. Apart from foreign exchange of over 800 million, this sector is the next biggest source of income in the UT's economy. The region of Kashmir is known for its horticulture industry and is the wealthiest region in the Union Territory. The table provide the combined data of J&K and Ladakh Region.

Table 2.7: Economy of Jammu and Kashmir

Year	State's Gross Domestic Product (in million INR)
1980	11,860
1985	22,560
1990	36,140
1995	80,970
2000	147,500
2006	539,850 million (US\$8.4 billion)
2016	132,307 crores (US\$21 billion)

2.4.1 Agriculture and Irrigation

Jammu and Kashmir is essentially a mountainous region. Only about 30 per cent of the combined area of J&K and Ladakh region is under cultivation. Agriculture is the mainstay of the people as it provides employment, directly or indirectly to about 70 per cent of the workforce. It contributes about 65 per cent of the state revenue which explains the overdependence of the state on agriculture. Land is, however, limited and therefore, its judicious utilization is necessary to meet the growing need of the tremendously increasing population and for the sustainability of soils, ecosystems and environment. The general picture of land-use and the proportion of area under different categories have been given below.

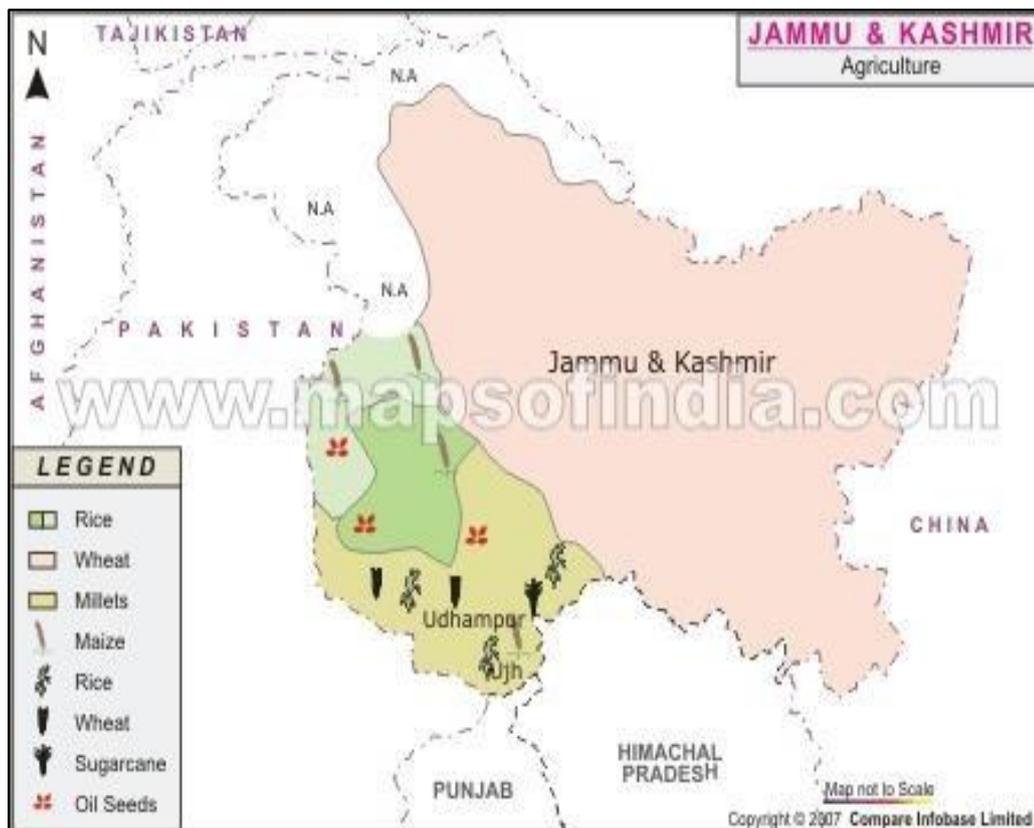
Table 2.8: Land Pattern of Jammu and Kashmir

Jammu and Kashmir General Land use, 1995-96			
Sr.No	Use of Land	Total Reporting Area in (Hect.)	Percentage
1	Forest	658	27.24
2	Net area shown	730	30.22
3	Land out to non-agricultural uses	291	12.04
4	Barren Land	293	12.13
5	Permanent pastures and other grazing grounds	125	5.17
6	Land under miscellaneous trees and other groves	72	2.98
7	Cultivable waste	141	5.84
8	Fallow other than current fallow	7	0.29
9	Current fallow	99	4.00
	Total	2416.00	100.00

Being, hilly, mountainous and snow covered, it is only the gentle slopes (below 15°) which may be developed as orchards and pastures after heavy investment. The proportion of old fallow and current fallow is 0.29 and 4.0 per cent respectively. About 12 per cent of the total reporting area is put to non-agricultural uses, e.g., settlement, roads, cemetery, guls (canals) and water bodies. In general, the Jammu plain has a high concentration of wheat, rice, maize, pulses, fodder and oilseeds, while the Valley of Kashmir is well known for its paddy, maize, orchards (apples, almond, walnut, peach, cherry, etc.) and saffron cultivation. In Ladakh, barley, wheat, maize, vegetables, berseem and fodder are the main crops. The Kashmir Valley

has a large capacity of fruit production. Apples, walnuts, almonds, cherries and pears are imported by many foreign countries.

Over 70 percent of the Net Sown Area is under food crops and the area under fruits is a little over 13 percent. Viability of agriculture as a profession is presently affected capital inadequacy, lack of infrastructural support and controls on movement, storage and sale etc of agricultural produce. Dwindling water resources too is a major challenge as only 42 percent of the cultivated area is under irrigation.



Irrigation Dwindling water resources too is a major challenge as only 42 percent of the cultivated area is under irrigation. Hilly terrain puts limits to mechanical farming and transportation of products, especially horticulture produce. Fragile soil in hilly areas is susceptible to soil erosion and a single cropping season is available in temperate and high-altitude areas. Net irrigated area in the region is just 24 percent and double and multiple cropping is followed on a larger scale in the intermediate and warmer plain sub-tropical areas. Wheat, maize and rice crops grown in about 250, 000 hectares 210,000 hectares and 110,000 hectares

S.No	Year	Net Area Irrigated by				Total
		Canals	Tanks	Wells	Other Sources	
1)	1950-51	244.00	3.00	3.00	11.00	261.00
2)	1955-56	277.00	1.00	3.00	9.00	290.00
3)	1960-61	256.00	-	5.00	13.00	274.00
4)	1965-66	270.00	Neg	1.00	7.00	278.00
5)	1968-69	252.00	Neg	1.00	11.00	264.00
6)	1974-75	279.00	Neg	3.00	13.00	295.00
7)	1980-81	285.00	2.00	4.00	13.00	304.00
8)	1985-86	288.69	2.67	4.12	14.13	309.61
9)	1990-91	278.58	1.98	1.33	16.20	298.09
10)	1995-96	284.86	2.57	1.42	17.73	306.58
11)	1998-99	283.81	2.60	1.32	21.42	309.15
12)	1999-00	278.35	2.57	1.37	20.80	303.09
13)	2000-01	284.15	2.71	1.53	22.48	310.37
14)	2001-02	284.42	2.79	1.61	21.35	310.17
15)	2002-03	274.50	2.66	1.57	20.49	299.67
16)	2003-04	282.41	3.87	1.06	19.19	306.53
17)	2004-05	286.28	3.93	1.08	19.60	310.89
18)	2005-06	289.28	4.21	1.05	17.57	312.11
19)	2006-07	286.64	4.24	1.04	17.52	309.44
20)	2007-08	285.78	4.22	0.99	17.05	308.04
21)	2008-09	287.77	4.84	3.80	17.32	313.73
22)	2009-10	287.80	5.11	4.33	20.03	317.27
23)	2010-11	288.48	6.22	11.65	14.28	320.63
24)	2011-12	285.40	7.11	7.42	19.33	319.26
25)	2012-13	285.35	8.03	10.42	21.29	325.09

area respectively are the major cereal crops of Jammu division. Basmati rice and rajmaah (pulses) are valuable cash crops of the region. Vegetables, oil seeds, spices and condiments, aromatic and medicinal plants and fodder are also grown in specific areas of the region.

2.4.2 Industrialization and Minerals

Main industrial activity is concentrated in the Jammu and Kathua districts of Jammu division. This is mainly because Jammu is the only railhead, where loading and unloading of raw material becomes easy and less cumbersome as compared to Kashmir region where transportation cost is higher. The Industry sector has been declared as the main vehicle for accelerating economic activity besides providing employment opportunities to the unemployed educated youth in the State. To attract investment, the government has come up with a new eco-friendly industrial policy in 2004, which is valid until 2015. The industrial policy is designated to promote rapid industrialization and has evoked a great deal of interest in the

private investment. The policy has slew of incentives in the form of subsidies for all sorts of industries, especially for small-scale industries to make them capable of competing in the present market. The policy also lays emphasis on promoting industries based on local raw materials and skills. The State has set up two industrial growth centers - one in Samba, Jammu and other in Lassipora, Pulwama with the assistance of Central Govt. under the centrally sponsored schemes.

The key industrial activity in J&K includes:

- **Horticulture**
- **Floriculture**
- **Handloom & Handicraft**
- **Tourism.**
- **Mineral based Industries.**
- **Gem & Jewellery**
- **Sericulture**
- **Information Technology**
- **Pharmaceuticals**
- **Insecticides**
- **Pesticides**
- **Electronics**
- **Hardware**

Infrastructure

Housing

As per the census 2001 there were 155768 households in the state. Census 2001 has revealed that 55% of the households occupy permanent house whereas 32.16% resided in semi-permanent houses and 12.68% of household in temporary and unclassifiable houses.

Geology and Mining Activities

The UT of J&K and Ladakh is endowed with tremendous mineral resources covering an area of 13334 Sq. Kms., out of which 60% are reported to be commercially viable for mining of various minerals. The Department of Geology and Mining, Jammu & Kashmir was established in 1960 to identify/ locate minerals like Limestone, Gypsum, Marble, Lignite, Granite, Bauxite, Coal, Magnesite, Slates, Sapphire, Dolomite, Borax, Graphite, Quartzite etc. in a big way, the quality and quantity of which are estimated for establishment of mineral based industries. A

number of cement-based industries as well as units for manufacture of plaster of Paris, Marble and Granite cutting units have been established in the state.

S.No	Period	Drilling (000 Mts)	Exploratory Mining (000 Mts)	Geological Mapping (detailed) (Million Sq.Mts)	Geological Mapping (Reconnaissance) (Million Sq.Kms)	Samples		Royalty Realised (rs. In Lakhs)
						Collected (000 Nos)	Analysed (000 Nos)	
1)	1969-70	4.60	1.30	4.80	NA	260	1.00	NA
2)	1973-74	2.00	1.10	5.90	962.00	4.00	0.40	2.60
3)	1975-76	1.70	NA	2.11	225.00	3.20	0.60	NA
4)	1977-78	3.80	0.20	4.78	1734.00	2.70	1.70	8.20
5)	1978-79	5.30	0.04	4.25	1384.00	3.30	1.40	11.90
6)	1979-80	7.40	0.01	0.03	1353.00	3.30	1.00	13.30
7)	1980-81	5.92	0.36	3.78	1995.00	4.32	0.50	14.60
8)	1981-82	5.30	0.10	3.38	1022.00	2.59	0.44	19.62
9)	1985-86	5.50	0.36	3.38	2771.00	3.14	0.46	20.10
10)	1986-87	4.23	0.20	2.17	663.37	3.15	0.40	20.36
11)	1987-88	10.20	0.12	2.47	1995.00	2.76	0.53	27.61
12)	1988-89	9.89	0.12	3.13	3091.50	3.09	0.54	49.64
13)	1989-90	10.17	0.14	3.49	3152.30	3.32	0.60	63.73
14)	1990-91	5.23	0.12	1.68	1049.00	0.78	NA	16.83
15)	1995-96	1.45	0.08	1.81	2093.50	0.50	NA	1.80
16)	1996-97	0.79	0.17	2.44	803.00	0.63	NA	64.56
17)	1998-99	0.59	-	2.81	1762.50	0.69	NA	85.25
18)	2000-01	0.61	-	0.96	776.00	0.32	0.30	296.01
19)	2001-02	0.68	-	0.79	965.00	0.40	-	328.18
20)	2002-03	1.46	-	0.82	197.50	1.04	0.36	304.51

Tourism

Jammu & Kashmir with its vast potential and growing economy has immense potential for the sustenance of the tourism industry. Tourism has historically remained an instrument of economic growth in the State of Jammu & Kashmir and has contributed a lot in developing the economy, particularly in Kashmir Valley and Ladakh. This sector has given jobs to many people and generated economic activities especially in the tertiary sectors. Its impact is visible in-service industry sectors of the State such as transport, hospitality, horticulture and small scale industry. The tourism activities at a particular place are directly related to the arrival of tourists at that place. The more the arrival, the more economic activities get generated and

make impact on the related sectors accordingly. Tourist expenditure generates multiple effects on the service sector such as agriculture, horticulture, poultry and handicrafts.

Jammu & Kashmir is an important tourist destination and has been a place of attraction for tourists since centuries. The lush green forests, sweet springs, perennial rivers, picturesque alpine scenery and pleasant climate of Kashmir valley has remained an internationally acclaimed tourist destination, whereas Jammu region is attracting a large number of pilgrim tourists and the important destination has been Shri Mata Vaishno Devi Shrine at Katra.



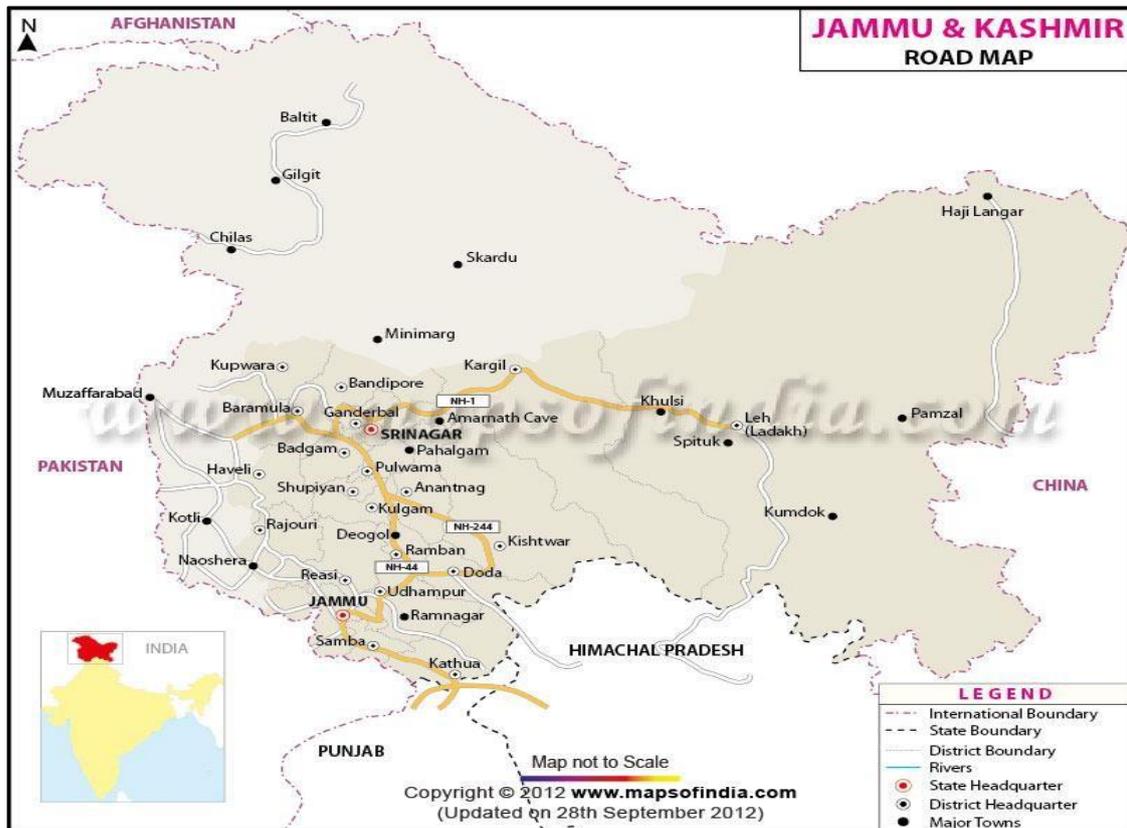
2.5 Transport system Network

2.5.1 Roads

An effective communication network is essential not only to cater to the needs of travel and transport but also for Socio-economic development of a region and the country. In case of J&K, the same is more important for promotion of tourism as well. Revival of Tourism and restoration of damaged infrastructure, which had become the target during the period of disturbance in the State has been a priority of the State Government.

The Government, with the supplementation of Central resources, made concerted efforts in rebuilding of destroyed infrastructure in the shape of roads, bridges, school buildings and the social infrastructure, etc. With this objective in view, special schemes were launched, besides giving a boost to the ongoing schemes of the Department. Many new roads are under construction and many existing roads are under improvements.

Jammu and Kashmir have a wide range of road network that connects all the cities. The major highways in Jammu and Kashmir are NH 1, NH 3, NH 44, NH 144, NH 244, NH 144-A, NH 301, NH 444, NH 501, NH 701, NH 701-A, Srinagar-Jammu National Highway, Udhampur - Jammu Highway and Skardu Kargil Road

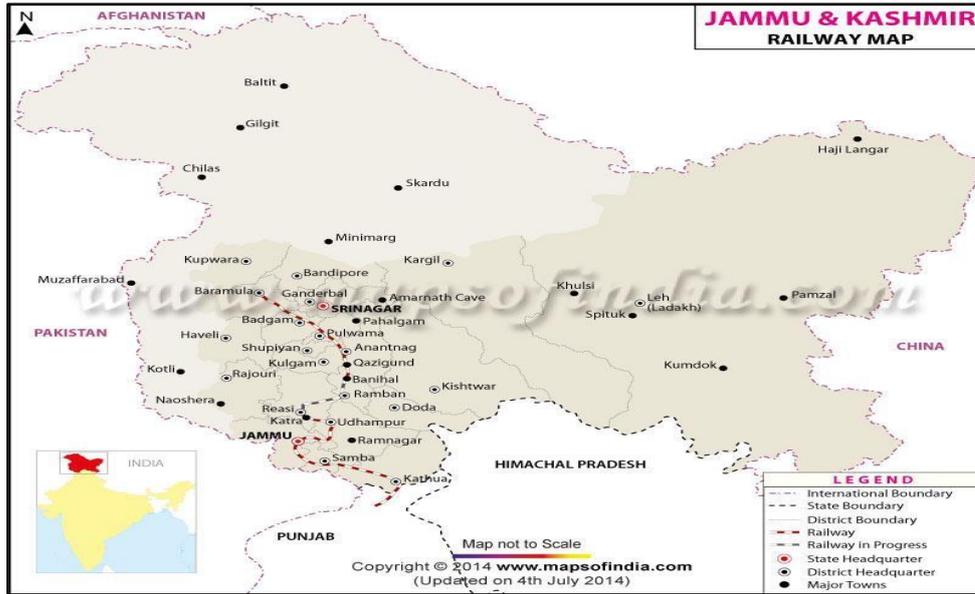


2.5.2 Railways

Jammu & Kashmir have railway network of only 238.77 km. The state government has recognised the crucial role of railways in the process of economic development and in response to that the government of India has also extended full cooperation in all respects by providing technical and financial support for developing railways links in the state at a very fast speed. The Jammu-Srinagar-Baramulla railway line is a railway track being laid to connect the Kashmir Valley in the Indian state of Jammu and Kashmir with Jammu railway station and hence to the rest of the country. This railway line will connect the state with mainstream of country and will lead to boost in trade, economy and tourism in the state.

The list of railway stations in J&K and Ladakh region can be divided into 2 parts: -

- **Railway stations in Jammu region,**
- **Railway stations in Kashmir region**



2.6 Economic Perspective

The future traffic growth will thus depend on the future economic development in the newly formed Union Territory. The economic perspective for the state is based on the past performance of the economy and the economic growth.

2.6.1 past performance

The data available is the combined data of J&K and Ladakh Region hence same is illustrated below. The details of **GSDP** are given in Table below.

Table 2.12: Gross state domestic product (GSDP) estimates (REVISED) by economic Activity at constant (2004-05) prices

Sr.No	Sector	2011-12 (Q)	2012-13 (Q)	2013-14 (A)
1	Agriculture including Livestock	743878	745110	756742
2	Forestry and Logging	130261	130059	131083
3	Fishing	18071	18160	18347
A	Agriculture & Allied (1+2+3)	892209	893330	906171
4	Mining and Quarrying	10446	44768	313638
a	Sub-total Primary (A+4)	902655	938098	50300
5	Manufacturing	290872	305100	956471
5.1	Manufacturing (Registered)	134062	138905	313638
5.2	Manufacturing (Un-registered)	163740	166195	142740
6	Construction	476989	489583	170898
7	Electricity, Gas, Water Supply	185792	188497	508922
b	Sub-total Secondary (5-7)	690583	983180	194022
B	Industry (b+4)	971029	1027949	1016582
8	Transport, Storage & Communication	326981	349799	233485
9	Trade, Hotels & Restaurants	290376	299924	379532
10	Banking & Insurance	232571	256991	286321
11	Real Estates, Ownership of Dwelling, Legal & Business Services	228437	238825	249603
12	Public Administration	684436	747025	823423
13	Other Services	519803	554075	594528
C	Sub-total Tertiary (Services Sector)	2200827	2366546	2566892
	Total GSDP (a+b+c)	4364065	4287825	4539945
	Population in Lakhs	118.06	119.52	120.96
	Per Capita GSDP (Rs.)	34424	35875	37533
	Growth Rate	6.19	5.51	5.88

Table 2.13: Net State Domestic Product (NSDP) and per Capita Income

Sr. no	Year	NSDP (IN Crore)		Per capita income (Rs)	
		At current price	At Constant (1980-81) Prices	At current price	At Constant (1980-81) Prices
1	1980-81	1049.5	1049.5	1776	1776
2	1985-86	1929.23	1229.84	2874	1832
3	1986-87	2134.01	1245.82	3108	1809
4	1987-88	2086.26	1109.63	2954	1571
5	1989-90	2688.38	1285.35	3618	1730
6	1990-91	2908.26	1359.89	3816	1784
7	1991-92	3249.87	1390.48	4157	1779
8	1992-93	3564.56	1452.27	4457	1816
9	1993-94	5500.2	5500.2	6543	6543
10	1994-95	6001.44	5744.99	6915	6619
11	1995-96	6973.05	6031.48	7783	6732
12	1996-97	7850.89	6320.65	8667	6978
13	1997-98	8857.86	6652.24	9491	7128
14	1998-99	11128.21	7005.33	11591	7296
15	1999-00	13532.97	13532.97	13816	13816
16	2000-01	14328	13917.48	14268	13859
17	2001-02	15456.42	14184.9	15019	13784
18	2002-03	17399.87	14907.16	16739	14341
19	2004-05	23292.21	23292.21	21734	21734
20	2005-06	25278.1	24371.09	23240	22406
21	2006-07	27652.09	25794.32	25059	23375
22	2007-08	30720.05	27387.31	27448	24470
23	2008-09	34290.32	29102.03	30212	30212
24	2009-10	38718.2	30513.15	33650	26519
25	2010-11	4674012	3225589	40089	27666
26	2011-12 (Q)	5336075	3431596	45198	29067
27	2012-13 (Q)	6154429	3625604	51493	30335
28	2013-14 (A)	7087432	3843266	58593	31773

3.0 Traffic Surveys and Analysis

3.1 General

Traffic surveys, analysis and demand forecast are an important element of any feasibility/detailed project report preparation. Traffic analysis and demand forecasting are directly related to several important aspects of project road planning and design i.e. capacity augmentation proposals, geometric design features, planning and design of toll plaza, pavement design, economic and financial analysis etc. Towards this the consultant has undertaken detailed traffic surveys, analysis, forecasting and carry out laning requirements. Various steps followed in this regard are described in the subsequent paragraphs.

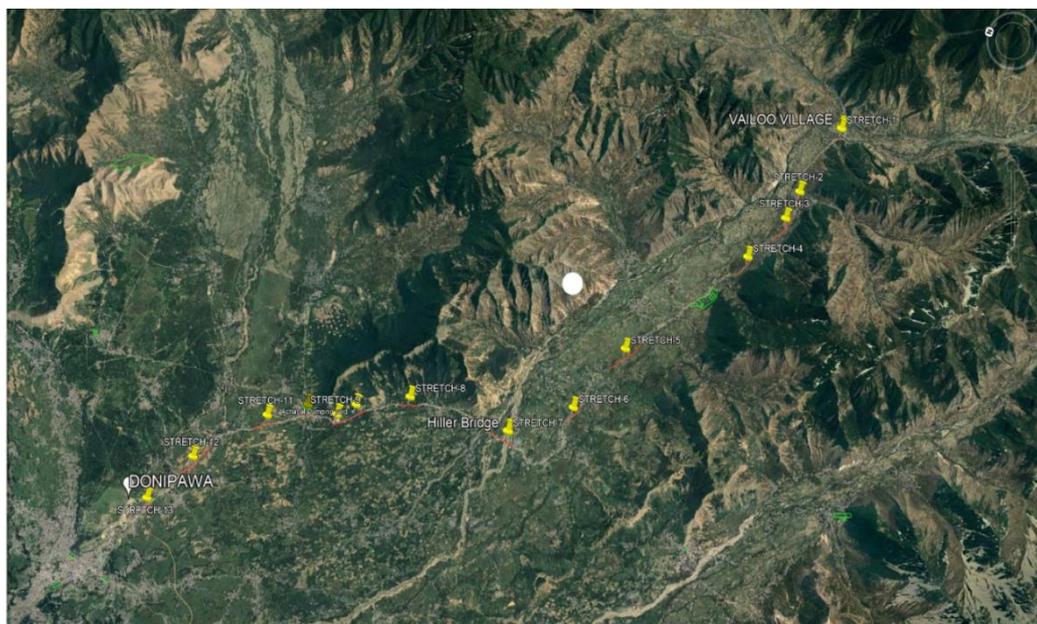
3.2 Objectives

- To carry out traffic surveys and estimation of base year traffic demand
- Identification of travel pattern and influence area of project road
- Traffic demand forecasting up to project life
- Assess capacity requirement of project road, to estimate tollable traffic & to identify toll plaza locations.

3.3 Project Road

The project road deals with the section of Vailoo-Donipawa Km 148+589 (Existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa. The total existing length of the project road is 27.943 Km. The consultants have proposed road stretch from Vailoo to Donipawa with design chainage km 148+589 to 176+532 km having total design length of 9.725 km.

The Project Road falls entirely in the Anantnag district in the newly formed Union Territory of Jammu & Kashmir and traverses through many built-up areas and agricultural lands. The Project Road starts from Existing Km 235+070 in Vailoo Village and passes through Gad Wali, Wandevalgum, Zalangam, Bindoo, Bidder, Hangalgund, Dan Veth Pora, Sagam, Takia Ahamad Shah, Buchoo, Peertakia, Hiller, Hillar Arhama, Akingam, Badoora, Achabal, Koleh Garh, Thajiwara, Barakpora, Donipawa at Existing Km. 263+070. The total Length of the existing road is 34.0 Km. The location of the Project Road has been shown in the **Fig. 3.1 - Key Plan.**



3.4 Traffic Homogeneous Section

The traffic homogeneous sections have been identified based on the major traffic generators and diversion locations along the project corridor. The passenger traffic has been observed to vary with respect to the influence of village/towns falling along the project corridor. The major traffic generators settlements and its connections (diversion) points are:

Vailoo to Donipawa

Traffic surveys locations were selected to capture representative traffic volume on the homogeneous sections with a view to capture section wise traffic flow characteristics, the total stretch has been segmented in to one homogeneous section, based upon the major intersections that act as main collectors or distributors (diversion) of traffic along the project road. The traffic homogeneous section in the road section is as follows:

Table 3.1: Traffic Homogenous Section

Sr.no	Homogenous Section	Existing chainage	
		From (Km)	To (Km)
1	Vailoo to Donipawa	148+589	176+532

Traffic Survey Planning and Selection of Survey Location

A comprehensive traffic survey plan has been prepared for the project road after considering traffic intensity on homogeneous sections and travel characteristics. Detailed site visit of project road and its influence/alternative transport network has been carried out between on 10th April 2025 to 24th April 2025. Traffic survey locations were finalized by consultation

with client officials. Reasoning with detailed justification for selection of each traffic survey location is given in **table 3.2**

Table 3.2 traffic survey locations justification/rational

Sr.No	Existing Chainage	Justification/Rational
Classified volume count surveys (CVC) & Origin and Destination		
1	Km176+532, Donipawa	Has been selected to get the idea of traffic
2	Km 170+423, Achabal	Has been selected to get the idea of traffic
3	Km 148+589, Vailoo	Has been selected to get the idea of traffic

3.5 Traffic Surveys Schedule

It is very important, that the existing information on traffic flow, commodity movement and traffic pattern is required to assess the traffic behavior on a project road. To collect such information to satisfy the Terms of Reference (TOR) and project requirements, following various types of traffic surveys were carried out:

- 1) Classified Volume Count (CVC) Survey
- 2) Axle Load Spectrum Survey
- 3) Origin-Destination and Commodity Movement Surveys
- 4) Intersection Volume Count Survey

5) Speed and Delay surveys

Traffic survey locations were selected after detailed reconnaissance survey and in line with the TOR. All the traffic surveys were carried out as per the IRC guidelines given in IRC: SP 19-2001, IRC 37:2018, TRC: 108-2015, IRC SP: 41-1994, IRC 102-1988, IRC 103-2012 and IRC: 09-1972 etc.

All the above surveys were carried out manually by employing sufficient number of trained enumerators recording information in the pre-designed formats. The enumerators were selected from locally available educated people familiar with traffic characteristics and condition of the project road. They were properly briefed and trained about the survey work before putting them on actual survey work in field. An experienced supervisor was kept in-charge for all the locations

The locations for the various surveys were so selected that all vehicles can be viewed and interpreted easily without endangering the safety of enumerators and drivers.

The most important part of all traffic survey was to exercise adequate quality control.

The quality assurance was achieved through:

- Proper briefing and demonstration to enumerators before the start of work;
- Continuous independent checking by Traffic engineers / supervisor in the field during the survey work;
- Checking of filled in survey formats by Traffic engineer, and
- Validation of computer data entry with raw surveyed data

The survey data were recorded in the pre-designated approved formats for each type of survey. All the above traffic surveys were carried out as per the schedule finalized after considering requirements of TOR and project requirements as presented below.

Table 3.3 Traffic survey schedule

Type of survey	Location	Survey date		Duration
		From	to	
Classified traffic volume count survey	Km176+532, Donipawa Km 170+423, Achabal Km 148+589, Vailoo	10-04-2025	17-04-2025	7 days (24 Hrs)
Turning movement survey	Km176+532, Donipawa Km 170+423, Achabal Km 148+589, Vailoo	18-04-2025		12 Hrs
O-D survey	Km 148+589	19-04-2025		24 Hrs
Speed & delay surveys	Entire Project Road			
Axle loads survey	Km 148+589 Vailoo, Km 176+532 Donipawa	19-04-2025		24 Hrs

3.6 Traffic Surveys Methodology

3.6.1 Classified Volume Count Survey

The objective of classified traffic volume count survey is to estimate traffic intensity on the project road. The classified volume count surveys at one strategic location has been carried out for 7 days, @ 24 hours/day. The traffic is counted in number of vehicles by vehicle category-wise in each direction in a 60-minutes interval over 24 hrs a day for 7 days. The counts were recorded in the approved formats as per IRC specifications.

3.6.2 Axle Load Spectrum Survey

Axle load survey is carried out to estimate vehicle loading spectrum on project road, and to determine vehicle damage factor for the commercial vehicles. The data collected from the Axle Load Survey is further used to calculate MSA for the design of pavement

3.6.3 Origin-Destination and Commodity Movement Survey

In a transportation study, it is necessary to estimate the number of trips with respect to origin and destination. These calculations help in studying travel trends of passenger and commercial vehicles. The trend pattern determines the basis for adopting techniques for estimating traffic growth projections. O-D survey was carried out at one location to get travel and loading patterns.

The Origin-Destination survey was carried out to study the travel pattern of goods and passenger traffic along the project road. O-D surveys shall help calculate future diverted traffic on project roads once a better transportation facility is made available. The location of origin and destination zones has been determined in relation to each individual station and the possibility of traffic diversion to the project road from/to other routes including bypasses.

Roadside Interview Method was adopted for conducting the survey. A sample proportion of vehicles were interviewed from the total traffic. Randomly picked vehicles were stopped and interviewed. Designated trained enumerators interviewed the drivers. Variable sampling flow requires a classified hourly count of all vehicles that pass in the direction being studied while interview is in progress. A volume count survey was carried out simultaneously to get the number of vehicles passing in both the directions. The O-D survey was limited to cars/Jeeps, bus, LCV, and 2 axles/3 axles, Multi Axle. The following information on travel was collected during the O-D and commodity movement survey

- Origin and destination of trips;
- Trip Purpose
- Travel Route
- Trip length;
- Vehicle Occupancy;
- Type of commodity and loading in case of the goods vehicles; and
- Frequency of trips etc.

Appropriate zoning system was adopted, and coding was done for zones and type of vehicle & commodity being carried.

3.6.4 Intersection Volume Count Survey

The objective of turning movement count survey is to estimate the traffic contribution and diversion to and from the project road. The Intersection Turning Movement count was carried out with primary objective for identifying the type of control measures required for the junction improvement. Intersection Volume Count Survey has been carried out at one major intersection in hiller along the project road. Each turning movement at the intersection was recorded by deploying sufficient trained enumerators on each arm traffic intensity.

3.6.5 Speed and Delay Survey

The purpose of the travel time and delay study is to evaluate the quality of traffic movement along a route and to determine the locations, types and extents of traffic delays. The efficiency of flow is measured by travel and running speeds. In the actual study, total travel and running times are observed and then converted into speed measures.

Before starting the test runs, major intersections or suitable control points were selected along the study route as reference/control locations. The project road was divided into one homogenous section based on the traffic characteristics and pavement condition of the corridor. Time readings are taken at these locations to permit the development of travel speeds by sections along the travelled route.

A test vehicle is driven along the study route in accordance with moving car technique, in which, a safe level of vehicular operation is maintained by observing proper following and passing distances and by changing speed at reasonable rates of acceleration and decelerations. Delay information is recorded when the traffic flow is stopped or greatly impeded. The duration of traffic delay is measured in units of time along with notations of the corresponding location, cause and frequency of delay to travel. Following information was collected during the survey:

- Number of vehicles in the opposite direction of test car;
- Number of vehicles overtaken by the test car,
- Number of vehicles overtaking the test car;
- Amount of delay occurred; and
- Reasons for the delay etc.

3.7 Analysis of Traffic Surveys - Base Year Traffic Estimation

3.7.1 General

The base year traffic pattern is the primary input for checking existing level of service and determination of future traffic demand of project influence area. The consultant has conducted Classified Volume Count Surveys, Intersection Volume Count, O-D and commodity, Axle load and speed & delay surveys to examine the base year traffic intensity, travel characteristics, loading patterns and travel speed on project road. For traffic estimation and projection, the year 2019 has been taken as base year.

The following section provides detailed traffic analysis and important observations about traffic pattern along the project corridor. The data collected during traffic surveys were entered into the computer for further analysis and to obtain information about traffic characteristics and travel pattern along the project road. The results of the analysis can be further used for designing the pavement crust, road cross-section, planning and way side amenities, and for economic and financial analysis. The traffic analysis was carried out as per the guidelines given in IRC: SP 19-2001, IRC: 108-2015, IRC: 64-1990, IRC SP: 41-1994.

3.7.2 Classification of Vehicles and PCU Values

To convert recorded vehicles into a common scale, the Passenger Car Units (PCU) equivalent factor as per IRC: 64-1990 has been adopted. The PCU equivalent factors adopted are as given in **Table 3.4**.

Table 3.4: Classification of Vehicles Recommended PCU Equivalent Factors

Sr. No.	Vehicle Type	PCU Value
Fast Moving Vehicles		
1	Cars/Utility Vehicles/Jeeps/Vans & 3 Wheelers	1.0
2	2 Wheelers	0.5
3	LCV Passenger/LCV Goods/Minibus	1.5
4	Standard Bus	3.0
5	Two and 3 Axle Truck	3.0
6	Multi Axle Truck/Heavy Construction Machinery/Trailer	4.5
7	Agricultural Tractor (with Trailer)	4.5
8	Agricultural Tractor (without Trailer)	1.5
Slow Moving Vehicles		
1	Bicycle	0.5
2	Cycle Rickshaw	2.0
3	Animal Drawn Vehicle (Bullock cart)	8.0
4	Animal Drawn Vehicle (Horse drive)	4.0
5	Hand cart	3.0

3.8 Analysis of Classified Volume Count Survey

3.8.1 Average Daily Traffic (ADT)

7-Day, 24 hrs. Continuous volume counts were undertaken to obtain a realistic picture of the current volume and composition of the traffic. The analysis of traffic counts provided an estimate of the Average Daily Traffic (ADT) and the analysis has been carried out in terms of total number of vehicles as well as in respect to Passenger Car Unit (PCU). Location wise results of traffic analysis are discussed below:

a) At Donipawa Km 176+532

Classified Volume count survey was carried out at Km 176+532 at Donipawa.

Total ADT at this station were recorded as 8599 in terms of number and 8856 in terms of PCU. Fast moving vehicles were recorded as 99% of the total traffic (in No.). Peak hour traffic flow of 1020 nos. formed around 11% of the total traffic. Peak hour is identified during 17:00-18:00 hours. The directional distribution for all vehicles. observed is 48 percent flow towards up

direction and 52 percent towards down direction. Summary of classified traffic volume count survey results is shown in Table 3.5.

Table 3.5: Summary of Classified Volume Count Survey at all count stations

Sr. No.	Location	Fast Moving AADT Vehicles (PCU)	Slow Moving AADT Vehicles (PCU)	Total AADT (PCU)	ADT (PCU)	Directional Distribution (%)		Peak Traffic (vol)	Peak Hour	Peak Traffic (%)
						Up	Down			
1	At Brakpora	10385	93	10477	11513	52.11	47.88	1326	17:00-18:00	11.20

Location wise Average daily traffic (ADT) and Annual Average Daily Traffic is shown in **Annexure 3.1 and 3.2 respectively**. Survey has been carried out for seven days 24 hours continuously; the traffic flow on all the days in the week will not be same. There will be variation of traffic for each day.

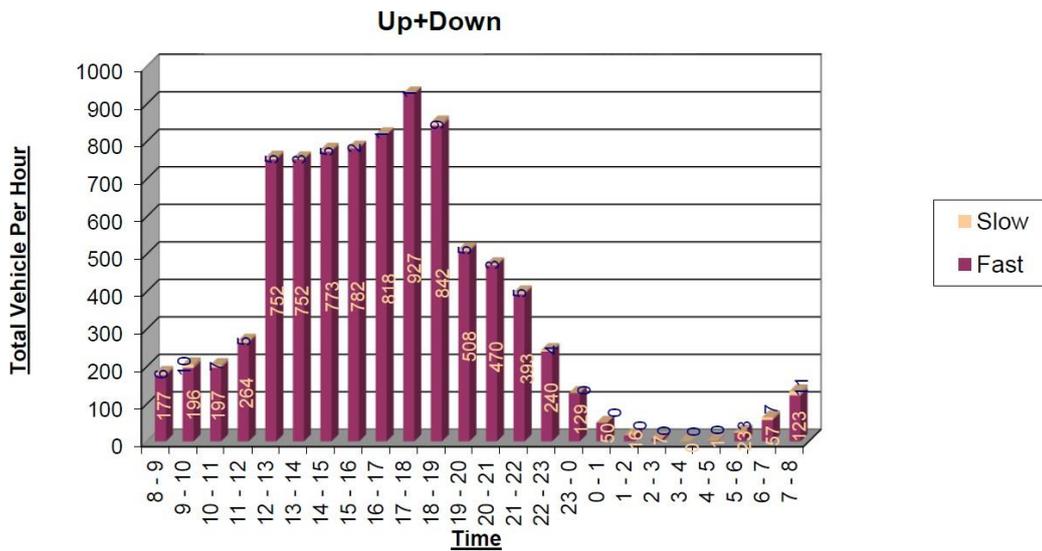


Figure 3.2: Daily Variation of Total traffic at Brakpora

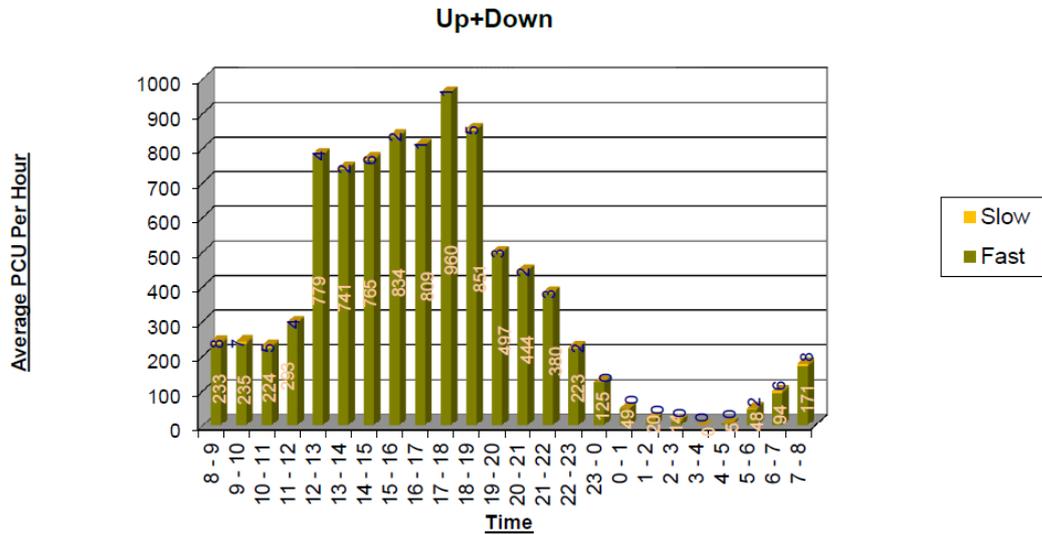


Figure 3.3: Hourly Variation of Traffic at Brakpora

3.8.2 Traffic Composition

The traffic compositions observed in survey locations are presented graphically At location Brakpora (Km 263+550) vehicle's compositions by type and percentage of volume are 2-wheelers (27.08%), Auto Rickshaw (5.43%), Car/Jeep/Van (55.24%), Mini Bus (0.17%), Bus (1.63%), LCV (4.28%), 2-Axle Truck (4.24%), Multi Axle (0.06%) and Agriculture Tractor (0.53%).

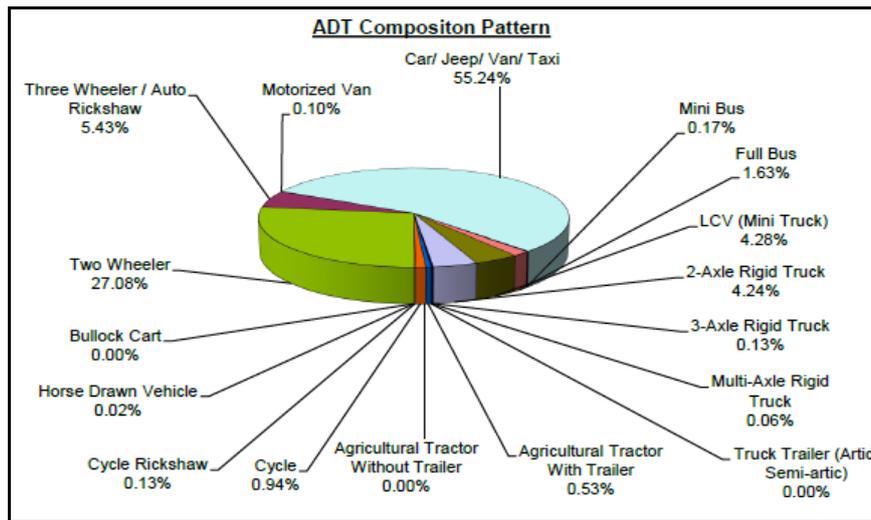


Figure 3.4: Composition of Traffic by Volume at Brakpora

3.9 Estimation Seasonal Correction factors

Seasonal Correction factors by vehicle types are required to account for variations in the pattern of traffic volume on the project road sections over different seasons of the year. Seasonal correction trends were assessed based on the sale of automobile fuels ie. petrol and diesel data along the project road.

Seasonal correction factors were worked out to arrive at Annual Average Daily Traffic (AADT). The monthly petrol and diesel sales data were collected from fuel station on the project road. The SCF was calculated separately for petrol and diesel driven vehicles. The calculated SCF based on monthly fuel consumption are presented in the following Table 3.6.

Table 3.6: Seasonal Correction Factors (SCF) Based on Fuel Consumption

	Petrol	Diesel
For Whole Section	1	1

Since traffic volume count surveys were carried out in the month of July 2019, the computed seasonal variation factors of 0.89 for Diesel driven and 0.92 for Petrol driven vehicles have been adopted for estimation of AADT.

3.10 Annual Average Daily Traffic (AADT)

The seasonal correction factors presented above are used to convert Average Daily Traffic (ADT) to Annual Average Daily Traffic (AADT). Location wise Annual Average daily traffic is shown in Annexure 3.2 and in Table 3.7 below

Table 3.7: Annual Average Daily Traffic

Type of Vehicle		ADT (Up+Dn)		Annual Average Daily Traffic (AADT)		
		No.	PCU	No.	PCU	
Fast / Motorised Vehicles	Two Wheeler	2329	1165	2096	1049	
	Three Wheeler / Auto Rickshaw	467	467	430	430	
	Motorized Van	9	9	8	8	
	Car/ Jeep/ Van/ Taxi	4750	4750	4370	4370	
	Bus	Mini	15	45	13	40
		Full	140	420	125	374
	LCV (Mini Truck)		368	553	328	492
	Truck	2-Axle Rigid Truck	365	1095	325	975
		3-Axle Rigid Truck	11	50	10	45
		Multi-Axle Rigid Truck	5	23	4	20
		Truck Trailer (Artic/ Semi-artic)	0	0	0	0
	Tractor With Trailer		46	208	41	185
	Tractor Without Trailer		0	0	0	0
Slow / Non-motorised Vehicles	Cycle	81	41	81	41	
	Cycle Rickshaw	11	22	11	22	
	Bullock Cart	0	0	0	0	
	Horse Drawn Vehicle	2	8	2	8	

3.11 Axle Load Survey

To estimate vehicle loading spectrum on project road, and to determine vehicle damage factor for the commercial vehicles, the axle load surveys have been carried out at Km 263+550 at Brakpora. The data collected from the Axle Load Survey has been compiled and analysed through "Fourth power" pavement damage rule to arrive at the vehicles damage factor (VDF). The survey is analysed to obtain Vehicle Damage Factor (VDF) and is presented below:

Table 3.8: Adopted VDF by Homogeneous Sections

VDF Summary at Barakpora		
Sr.no	Vehicle type	VDF
1	LCV	0.80
2	2 axle	2.68
3	3 axle	1.74
4	MAV	2.74
5	Bus	0.61
Adopted VDF		1.7

The equivalent single axle loads (ESALs) have been calculated assuming that the project road will be opened to traffic in the of year 2026. VDF Details are provided in **Annexure 3.5**.

3.12 Analysis of Origin-Destination (O-D) & Commodity Movement Survey

3.12.1 General

Origin and Destination survey was conducted by roadside interview method at one location at Km 263+550 at Brakpora. This survey has been used to obtain the travel characteristics of goods and passenger vehicles and to determine the through and local traffic.

The purpose of the OD survey is to determine the existing travel pattern of the road user on the corridor & the project influence area. The road users were asked questions to determine their flow path along the project corridor, trip purpose, trip length, commodity type. Axle load survey was also carried along with the OD survey to analyse the loading pattern and Vehicle Damage Factor, VDF.

The survey has been carried out by deploying a group of enumerators under the supervision of engineers. The questionnaire prepared for the O-D survey was filled up by the enumerators by stopping the vehicles and interviewing the road users. Resentment to answer the questions was observed at both the locations.

3.12.2 Zoning System

To analyse O-D Data the entire study corridor has been divided into local traffic zones and rest of the locations had been divided into external zones. The number of trips originating from and destined to any zone represents the influence of that zone in traffic generation/attraction. Based on the study of collected O-D data, project corridor was divided into 10 zones. Table below

represents O-D Zoning system used for the analysis. Table 3.10 and Table 3.11 represent the zone influence factor for the goods and passengers.

Table 3.9: Traffic area zoning

Zone code	Zone Name
1	Achabal
2	Anantnag
3	Vailoo
4	Kokernag
5	Rest of Anantnag District
6	Srinagar
7	Pulwama District
8	Ganderbal District
9	Kishtwar District
10	Rest of J&k state

Table 3.10: Zone Influence Factor for Goods Vehicles

Zone Code	Name of Zone	Trip Production	Trip Attraction	ZIF (%)
1	Achabal	51	31	21.8
2	Anantnag	57	33	23.9
3	Vailoo	18	29	12.5
4	Kokernag	13	6	5.1
5	Rest of Anantnag District	35	56	24.2
6	Srinagar	8	6	3.7
7	Pulwama District	4	8	3.2
8	Ganderbal District	0	2	0.5
9	Kishtwar District	0	17	4.5
10	Rest of J&k state	2	0	0.5

Table 3.11: Zone Influence Factor for Passenger Vehicles

Zone Code	Name of Zone	Trip Production	Trip Attraction	ZIF (%)
1	Achabal	294	343	30.5
2	Anantnag	245	168	19.8
3	Vailoo	126	147	13.1
4	Kokernag	84	49	6.4
5	Rest of Anantnag District	98	252	16.8
6	Srinagar	98	42	6.7
7	Pulwama District	49	42	4.4
8	Ganderbal District	49	0	2.3
9	Kishtwar District	0	0	0.0
10	Rest of J&k state	0	0	0.0

3.12.2.1 Discussion

Internal to internal zones means trips origin and destination within the project corridor and immediate surroundings. Internal to External zones means trips. Originating from project corridor and destined to beyond the project corridor. External to Internal zones means trips originating from outside the project corridor and destined to within the project corridor, and External to External zones means trips originating and destined form outside the project corridor.

3.12.2.2 Development of Origin-Destination Matrices and travel Characteristics

It is important to analyse the trip characteristics with respect to the project road and its surroundings by development of vehicle category wise trip matrices and desire lines.

After coding of Origin and Destination from the raw data, expansion factors were calculated by comparing sample size of each vehicle type with the traffic classified volume count data of the same day at the same location of O-D Survey. These expansion factors were applied to O-D Data and vehicle wise O-D matrices were developed.

O-D matrices for different vehicle types for each survey station on the project road are presented in Annexure 3.4. Based on O-D matrices, travel pattern of the vehicles moving on the project road is discussed below.

3.13 Analysis of Intersection Volume Count Survey

The intersection volume count survey at major intersection has been carried out during identified peak periods for 24 hours. The category-wise traffic is counted for all direction in a 60 minutes interval. The counts were recorded in the specified survey formats.

The survey data have been analysed to obtain the peak hours with flow of vehicles in each direction. The peak hour traffic flow diagrams are provided in **Annexure 3.3**. The summary of peak hour traffic flow through intersections is given in **Table 3.12**

Table 3.12: Peak hour Traffic at Intersection

Sr.no	Location	Peak Hour	Traffic (in No)	Traffic (PCU)
1	Donipawa	8:00 to 9:00	3159	3323

3.14 Analysis of Speed & Delay Survey

The vehicle operation cost and the time taken for a trip will depend mainly upon the journey speed and the type of surface on the road. Hence the journey speed data is needed to estimate the road user cost on the existing road and to compare the same with the road user cost on the improved facility. Speed and delay surveys by Moving car surveys were conducted to find the journey speeds on the existing project. Round trip was made on entire project road during identified peak period using new technology vehicle. The survey vehicle was kept maintaining the speed of existing traffic flow. Start time, delay occurred, distance covered, and end time were recorded on the specified survey format. The data thus obtained is analyzed and presented below **Table 3.14**.

Table 3.14 Summary of Speed-Delay Survey

Sr. No.	Section		Distance (Km)	Average travel Time during off-peak (minutes)	Average speed during off-peak (km/hr)	Travel Time during peak (minutes)	Average speed during peak hours (km/hr)	Delay (minutes)	Reason for delay
	From	To							
1	Vailoo	Khanabal	34	60	34	80	25.5	20	Delay due to local traffic

The dominant reason for delay in Vailoo Khanabal section is vehicular movements during peak hours along the project road. In the built-sup area like Achabal, Anantnag and others, it was observed during speed delay study that traffic was slow due to movement of vehicles. Also, due to absurd geometric condition of existing project road, traffic movement was found to be slower

4.0 Engineering Survey, Material Investigation & Pavement Design

4.1 General

A sound engineering approach has been developed based on the requirement enumerated in Terms of Reference for conducting the required field surveys. Following data were collected from site and detailed desk study has been carried out to formulate a systematic and meticulous approach towards the present assignment. Following primary field surveys and investigations have been carried out on the project road:

- Inventory
 - Road
 - Bridge and Cross Drainage Structures
- Condition Surveys
 - Pavement condition and Roughness survey
 - Bridges and Cross Drainage Structures
- Topographic Survey

- Longitudinal alignment
- Cross sections at 50m interval
- Cross section of Bridges & Cross Drainage Structures
- Pavement Investigations
 - Trial Pit Investigation
 - Sub-grade Investigation
 - Axle load Survey
- Material Survey
 - Sand Sources
 - Source of Aggregates
 - Other construction Material like Cement, Bitumen etc.

4.2 Inventory and Condition Survey of Road and Pavement

The scope of improvement measures and economic justification thereon depend on the condition of the existing road and its associated inventory. To collect the inventory of the existing road and allied features of road and structure, inventory surveys were carried out.

4.2.1 Road Inventory Survey

While conducting Inventory Survey of Road the existing physical features and surrounding condition of the project road was ascertained. The details collected are discussed in **Annexure 4.1**. Road Inventory of this report. Some of the salient features of the existing road has been described under following paragraphs.

The information collected, analyzed and cross-checked, constitute the core database for formulating improvement proposals for further validation and finalization considering results of detailed topographical survey and investigations. The information has been utilized to decide the following:

- Decision on the widening of the carriageway is concentric for through the project road.

- Formulate the best-fit cross section with due consideration to terrain conditions, available land width and roadside features.
- Treatment to be given to congested built-up stretches. Number of trees to be affected by road improvement/construction works, the anticipated environmental impacts and extent of rehabilitation and resettlement.
- Provision of wayside amenities.
- Existing utility lines by type, location and extent that would require relocation.

4.2.1.1 Existing Carriageway

Project stretch is generally two-lane Carriageway and, in some portion, it encounters four lane having 7.0-8.0 m width throughout the project road. The existing road has earthen shoulder of about 1.0 m to 2.0 m on either side of the project road. Median is not present for the major portion of the stretch, however in the end of the road stretch in the city region, median of varying width from 0.5m is found.

4.2.1.2 Alignment and Geometry

The horizontal alignment of the existing road has stretches with sub-standard horizontal curves. The horizontal curves for most of the stretches allow a negotiable speed of 40-50 km/h but also at some stretches in built up areas such as Achabal. where the vehicle speed is as low as 20-30 km/h requires geometric improvements.

The vertical geometry appears to be substandard at many places resulting in slow down of vehicle movement and inadequate sight distance. This would require improvement of vertical curves

4.2.1.3 Terrain and Land use

Project road passes mainly through plain and rolling terrain but a very small portion encounters the land-use pattern for the major part of the project road is habitational area.

4.2.1.4 Existing Major intersections

The existing project stretch starts from Vailoo village at the junction of the road which heads towards proposed Vailoo tunnel and ends at the junction of Donipawa. The project road passes through many minor junctions along the project stretch. There are 5 major intersections and 09

minor intersections sighted on the road. List of minor and major intersections is given in **Table 4.2(a)** and **Table 4.2(b)** respectively below.

Table 4.2(a): Existing Minor Intersections

S. No	Existing Chainage	Link		Type of junction	Type
		LHS	RHS		
1	148+589	Heliora		T JUNCTION	MAJOR
2	170+700	To Dailgam	-	T JUNCTION	MAJOR
3	170+700	-	To shangus	T JUNCTION	MAJOR

Table 4.2(b): Existing Major Intersections

S. No	Existing Chainage (Km)	Link		Type	Types
		LHS	RHS		
1	163+770	-	To Hillar	Y Junction	Minor
2	164+100	To Dailgam	-	T Junction	Minor
3	164+640	Arhama	-	T Junction	Minor
4	167+480	-	To Ziyarat	T Junction	Minor
5	168+705	-	-	Y Junction	Minor
6	169+150	To Dailgam	-	Y Junction	Minor
7	175+100	To Hajipora	-	Y Junction	Minor

4.2.1.5 Embankment and Surface Drainage

The embankment height varies from 0.0 m to 2.0 m. The facilities such as roadside drainage are generally available at built-up locations.

4.2.1.6 Embankment Height Details with Chainages

Retaining Wall Locations						
S.no	Chainage		Length (Km)	Height of Slope (approx. rise) (m)	Side	Remarks
	From	To				
1	148.589	148.68	0.091	11.4 to 5.4	LHS	
2	148.785	148.807	0.022	5	LHS	
3	151.12	151.17	0.1	4	B/S	
4	157.8	157.95	0.15	4	LHS	
5	158.1	158.23	0.13	3	RHS	
6	158.35	158.47	0.12	3	RHS	
7	158.912	158.96	0.048	4	RHS	
8	160.73	160.85	0.12	3	RHS	
9	163.8	163.95	0.15	3	RHS	
10	164.42	164.45	0.03	3	LHS	
11	164.6	164.7	0.1	3	RHS	
12	164.78	164.95	0.17	3	RHS	
13	167	167.22	0.22	4	LHS	
14	167.3	167.36	0.06	4	LHS	
15	168.7	168.83	0.13	4	LHS	
16	169.54	169.6	0.06	4	LHS	
17	169.55	169.8	0.5	10 to 25	BHS	
18	170.68	170.73	0.05	4	RHS	
19	173.93	174.1	0.17	4	RHS	
20	174.5	174.6	0.1	3	RHS	
Total			2.521			

Breast Wall Locations						
S.no	Chainage		Length (Km)	Height (M)	Side	Remarks
	From	To				
3	151.9	151.915	0.015	3	RHS	

4.2.1.6 Existing Railway Crossings/ROB

There are no existing Railway Level crossings in the project road.

4.2.2 Pavement Condition Survey

4.2.2.1 Condition Survey of Pavement

It is the most important data needed for deciding upon the maintenance. The basic measurement of pavement condition is existing distresses. The information required is on the type, severity and amount of distress. The most commonly occurring distress forms are:

Sl. No.	Details	Sl. No.	Details
1	Bleeding	6	Patch deterioration
2	Block cracking	7	Polishing of aggregate
3	Corrugation	8	Raveling
4	Depressions	9	Rutting
5	Pot-hole		

Pavement condition survey consists of observing and recording the various distresses like cracks, pothole, rutting, raveling etc. of the existing carriageway, pavement shoulders and embankment. The details collected from pavement condition survey form the basis to decide strategy for adequate strengthening /rehabilitation measure of Existing pavement.

4.2.2.2 Pavement Condition Survey by Visual Inspection

a) General observation

Pavement condition of the Project stretch can be summarized as given below. The detail is given in **Annexure 4.2**.

Table 4.3: Percentage wise distribution of Good Fair and Poor Road

Sr. No.	Condition	Length (Km)	% Condition
1	Good	9.725	100

4.3 Topographic Survey

Topographical surveys have been carried out as per IRC: SP 19-2001, "Manual for Survey, Investigation and Preparation of Road Project" and as per TOR, for the preparation of alignment plans, strip plans, longitudinal sections, cross sections and other details like drainage works, earth retaining structures, control points and reference pillars required in view of consideration of vertical and horizontal alignments. The DGPS and TBM points are enclosed as **Annexure 4.10**.

a) Plan metric Control

The co-ordinates of basic plan control points were established by GPS in interval of 5km on RCC pillars as primary control station. Between two control points, benchmarks were fixed in interval of 250m on RCC pillars, which serve the purpose of starting and closing bearings for Total Station Traverse

b) Height Control

Double tertiary levelling was done along the entire stretch with precision automatic level connecting benchmarks and reference control points established near the project road. The misclosures were all seen to be below the tolerance limit of $0.12\text{mm } k$, where k is the length of the levelling line in km in between the starting and closing benchmarks. The misclosures were adjusted and height available at, given to all benchmarks was connected to BMs established by contracting GTS Benchmark available near the project road.

c) Detailed Survey

The detail of project influence area is up to minimum (building line) in case of urban area and 60m in case of realignments. The limit was extended further in case of anticipated junction improvement along the finalized center line which were surveyed by running Total Station Traverse X, Y and Z coordinates of relevant points of survey to establish ground profile captured by this Total Station Traverse besides other details like electric/telephone poles, tree, building, well, visible property line etc.

d) Creation of DTM

Data collected through topographical survey clubbed with the findings of inventory surveys have been used to develop a Digital Terrain Model (DTM) in Mx Roads Software. Supplemented with the silting of important cross drainage structures along with their desired

deck levels, horizontal and vertical profile of each road has been finalized after the careful application of the relevant design standard.

Traverse and LS/CS surveys were fed into computer to carry out the followings:

- (i) Sort out the geometric (horizontal) deficiencies in the existing alignment.
- (ii) Design the best fit center line of the existing alignment considering all obligatory/nodal points with relevant design standards.
- (iii) Examine the feasibility of proposed laning requirement within existing available ROW or proposal of bypass if any.
- (iv) As far as possible obviate existing buildings, functional infrastructure facilities within the proposed ROW to minimize utility relocation.
- (v) Examine each existing junction for its usefulness and determine the improvement measures.

4.4 Pavement Investigation

4.4.1 General

Pavement Investigation comprise of carrying out Sub grade characteristics and strength, investigation of required Sub-grade and sub soil characteristics, Pavement composition by excavating trial pits, evaluate Sub-grade strength, Pavement condition Surveys.

4.4.2 Roughness Survey

Roughness survey has been carried out with “Towed Fifth Wheel Bump Integrator”. The equipment was run on the entire road stretch under study for all the 2 lanes for each wheel path and the average value of Unevenness Index (UI) is expressed in terms of mm/ Km. The survey was conducted, in such a way that, vehicle runs along both lanes of the carriageway. Bump Integrator was towed at a constant speed of 32+/-0.5 Kmph. Readings are taken at every 200m interval. The values obtained were corrected by using the calibration equation.

Equipment used and Calibration: -

The survey was carried out by using bump integrator (Automatic Road Unevenness Recorder) No. STECO-320, duly calibrated by CRRI, New Delhi vide certificate dated March 2016 – March 2018.

The calibration equation for Automatic Road Unevenness Recorder (ARUR) given by CRRI, New Delhi:

$$Y = 1.061X + 636.6$$

$$R^2 \text{ (Regression Coefficient)} = 0.992$$

Where, Y = Calibrated roughness value, mm/km

X = Observed roughness value by ARUR, mm/km

Recommended Standard for Roughness Values:

The maximum permissible value of surface roughness measured with bump integrator for different surfaces are given in Table-1 as per IRC- SP: 16:2004

Newly constructed surface is expected to give roughness value corresponding to 'Good' category while the values under 'Average' and 'Poor' category indicate level of service and intervention level for maintenance. Surfaces with very low roughness values loose skid resistance and are not desirable from safety considerations. Such surfacing should prompt attention for restoring frictional resistance.

Maximum Permissible Values of roughness (mm/km) for Road Surface

S. No.	Type of surface	Condition of Road Surface		
		Good	Average	Poor
1	Surface dressing	<3500	3500-4500	>4500
2	Open graded premix carpet	<3000	3000-4000	>4000
3	Mix seal surfacing	<3000	3000-4000	>4000
4	Semi-dense bituminous concrete	<2500	2500-3500	>3500
5	Bituminous concrete	<2000	2000-3000	>3000
6	Cement concrete	< 2200	2200-3000	>3000

Table 4.6: Roughness Index Values for Vailoo to Khanabal Section

Chainage, Km		Roughness Index (mm/Km)		Pavement Condition	
From	To	Left	Right	Left	Right
148+589	149+589	2389	2115	Fair	Fair
149+589	150+589	2386	2673	Fair	Fair
150+589	151+589	1529	1554	Good	Good

151+589	152+589	1763	1961	Good	Fair
152+589	153+589	1525	1914	Fair	Good
153+589	154+589	2147	2815	Fair	Fair
154+589	155+589	2679	2991	Fair	Fair
155+589	156+589	1847	1946	Good	Good
156+589	157+589	1933	1933	Good	Fair
157+589	158+589	2856	2636	Fair	Fair
158+589	159+589	1924	1869	Good	Good
159+589	160+589	2183	2128	Fair	Fair
160+589	161+589	2870	2895	Fair	Fair
161+589	162+589	1932	1729	Good	Good
162+589	163+589	2182	2330	Good	Fair
163+589	164+589	2247	2885	Fair	Fair
164+589	165+589	2147	2087	Fair	Fair
165+589	166+589	2171	2059	Fair	Fair
166+589	167+589	2241	2350	Fair	Fair
167+589	168+589	2348	2097	Fair	Fair
168+589	169+589	1842	1875	Good	Good
169+589	170+589	2915	2438	Fair	Fair
170+589	171+589	2663	2017	Fair	Fair
171+589	172+589	2556	2073	Fair	Fair
172+589	173+589	2881	2163	Fair	Fair
173+589	174+589	2388	2332	Fair	Fair
174+589	175+589	1811	1928	Fair	Good
175+589	176+589	1500	1964	Good	Good

4.5 Sub grade Investigations

The sub grade conditions of existing pavement structure have been investigated by means of test pits excavated at every intermittent stretch of the road. They have been carefully dug from the pavement surface up to sub-grade level. Samples of natural ground have also been collected and tested in lab for its properties. Pavement structural composition of existing pavement at the Chainage of every test pit is noted. Representative samples of subgrade soil have also been collected in bulk, in gunny bag for laboratory testing listed above. The laboratory test results for the existing subgrade are provided later in this chapter. The key observations are however given below:

The predominant soil used in existing sub grade construction is sand and silty sand with some pockets of clay at some discrete locations

Free swelling Index varies from 10.0 to 20.0.

4 days soaked CBR varies from 9.22 to 10.60 (%)

The following laboratory tests were conducted on the soil samples collected from each pit and borrow areas.

Grain Size Distribution (%age)

Maximum dry density (MDD) (gm/cc)

Optimum moisture content (DMC) (%age)

Atterberg's Limit (LL. and PL) (%age)

Free swelling index (%age)

4 days soaked CBR (%age)

4.5.1 Existing Pavement Composition

A total of 6 pits were dug all along the road and crust noted along with other field tests. Crust composition found at these pits is tabulated below. It can be seen from data that bituminous thickness varies from 40mm to 80mm with average of around 60 mm. Granular thickness varies from 280mm to 320mm and averaging around 300mm. Existing pavement composition data is presented in Annexure 4.5. Summary of crust thickness is given in **Table 4.7**.

Table 4.7: Summary of Existing Pavement Crust Thickness

Location	Granular in mm	BT in mm	Total thickness in mm
148.589	310	50	360
150.94	290	40	330
151.69	305	60	365
153.49	280	50	330
157.74	285	70	355
160.44	320	60	380

4.5.1.1 Field Density of Existing Sub grade

Bulk filed density was found out at site by sand replacement method on soils of each pit and finally dry filed density was calculated by using field moisture content. Results are tabulated in **Annexure 4.4**.

The soil Lab Test Reports are also tabulated in **Annexure 4.6**.

4.5.1.2 Borrow Areas and its Evaluation

In initial assessment, it is found that there will be the need of additional borrows areas which can fulfilled by borrowing earth from local area.

4.5.1.3 Aggregates (coarse and fine)

4 samples (coarse aggregates) and 2 crushed sand sample (fine aggregates) sample were collected and tested for following tests in laboratory. AIV, water absorption and specific gravity were carried out on coarse aggregates samples whereas grain size analysis, fineness modulus, water absorption and specific gravity were conducted on sand sample. The results obtained are tabulated below.

Table 4.8: Test results Coarse Aggregates

Coarse Aggregate				
Sample ID	AIV	Water absorption	Specific gravity	Combined FI & EI
CA-40-01	26.36	0.78	2.66	25.38
CA-40-02	23.63	0.75	2.73	30.79
CA-40-03	29.05	0.57	2.68	24.47
CA-20-01	23.56	0.60	2.74	28.37
CA-20-02	22.28	0.47	2.73	27.30
CA-20-03	20.97	0.54	2.73	29.25
CA-10-01	23.97	0.48	2.76	30.18
CA-10-02	22.57	0.61	2.69	35.39
CA-10-03	21.08	0.47	2.7	32.41

Table 4.9: Test Results for Fine Aggregates

Sample ID	Is sieve size in mm (For Sand Gradation %age passing)							Water absorption (%)	Specific gravity
	4.75	2.36	1.18	0.6	0.3	0.15	0.75		
Sand -01	100	95.44	89.54	75.88	33.27	3.85	1.00	1.13	2.65
Sand-02	100	97.45	92.39	73.86	38.47	4.95	2.08	1.19	2.64

4.6 Source of Material

4.6.1 Type of Materials

The various construction materials are listed below.

- Aggregate
- Sand
- Bitumen
- Steel
- Cement

4.7 Inventory and condition survey of bridges and culverts

It is observed that the land along the existing alignment is open land passing through many built up areas and terrain is mostly hilly and rolling

4.7.1 Minor and Major Bridges

There are **1 major bridge & 9 minor bridges** which crosses either River, Nalla or small streams. Photographic representations of some of minor bridges are described as below.

S. No.	Design Chainage	Type of Structure	Existing Span Arrangement	Carriageway Width (m)	Overall Width (m)	Direction Of Water Flow	Remarks
1	148+570	Vailoo Bridge	1 x 23	3.5	5.5	L-R	
2	151+096	Minor Bridge	1 x 30	7	12.5	L-R	
3	158+061	Minor Bridge	1 x 10	8.3	12.4	L-R	
4	163+790	Minor Bridge	1 x 10	8.7	12.9	R - L	

5	164+090	Major Bridge hiller	3 x 35	7	12.3	R - L	
6	164 + 132	Minor Bridge	1 x 10	7	12.5	R - L	
7	164+400	Minor Bridge	1 x 24.23	7	12	R - L	
8	164+769	Minor Bridge Arhama	1 x 40	7	12.4	R - L	
9	164+840	Minor Bridge	1 x 10	7.3	12.6	R - L	
10	170+467	Minor Bridge	1 x 13	10.9	12.5	R - L	Merging zone

4.7.2 Inventory of Culverts

There are 35 slab culverts & 1 pipe culvert on project road. detailed inventory and condition survey of culverts are presented below

Patc h No	Section Name	Design Chainage	Type of Structure	Existing Span Arrange ment	Existing Carriagewa y Width (m)	Existing Overall Width (m)	Remarks
1	Vailoo	0	0	0	0	0	
2	Wanigam	0	0	0	0	0	
3	Wandeval gam to Soiyan	151+951	Box	1x2	6.8	12.15	
		152+280	Box	1X2	8.3	12.2	Merging zone
4	Zalangam to Bindoo	153+569	Box	1X2	7	12.1	Merging zone
		153+810	Box	1x2	7	12.1	Merging zone
5	Danveth to Mirpora sagam	158+667	Box	1x2	7.1	12.1	
		158+392	Box	1x2	6.9	11.7	
		158+121	Box	1x2	7.5	12.3	
6	Tengpawa to Buchoo	160+440	Box	2x2	7	20	Culverts have been constructed as per 4lane
		160+701	Box	2x2	7	20	
		160+830	Box	1x4x3	7	20	
		160+897	Box	1x2	11.4	20	
7	Hiller to Arhama	163+817	Box	4x3	7.4	12.4	
		164+190	Box	1x2	7	12.35	

		164+259	Box	1x2	7	12	
		164+334	Box	1x2	7.1	12.2	
		165+525	Box	1x2	7	11.9	
		164+620	Box	1x2	7	13.2	
		164+902	Box	1x2	16.6	20	Culverts have been constructed as per 4lane
8	Akingam to Tulbagh	167+312	Box	1x2	7	12.1	
		167+599	Box	1x2	7	12	
9	Badoora to Achabal	168+797	Box	1x4x3	7	12.1	
		169+269	Box	1x2	7	12.1	
		169+639	Box	1x2	6.8	13.3	
10	Achabal to Kulgadh	172+230	Box	1x2	7	12,8	
		171+967	Box	1x2	6.9	15.8	
		171+582	Box	1x2	7	20	Culverts have been constructed as per 4lane
11	Thajwara to Brakpora	174+980	Box	1x2	7	12.3	
		174+860	Box	1x2	7	12	
		174+396	Box	1x2	7	12.3	
		173+990	Box	1x2	7	11.9	
12	Brakpora to Donipawa	176+382	Box	1x2	11.9	14	
		176+550	Box	1x2	7	10.5	
		176+550	Pipe	1200mm	7	18	
	Achabal main market	170+423	Box	1x2	14.5	18.3	
		170+545	Box	1x2	10	13.8	
		170+601	Box	1x2	9.4	12.5	

4.8 Manufactured Materials

Following are the manufactured materials use for the construction purpose listed below.

4.8.1 Cement The Cement will be getting from Gurdaspur or Bathinda District of Punjab. Ordinary Portland Cement and with various grade of cement like 33, 43 & 53 type of Cement in various brand like Birla, Ambuja, J K etc. are available.

4.9.2 Bitumen

Nearest source of Bitumen is Panipat Refinery. Different Viscosity grade of bitumen from above mentioned Refinery is available. As per study, BC and DBM layer with use of VG 10 grade bitumen resist rutting and top down cracking on high volume roads at low temperature, thus VG 10 Bitumen serve better. Hence use of VG 10 Bitumen is recommended. VG 10 Bitumen is equivalent to penetration grade of 89/100. Bitumen Emulsion can be made available from Jammu.

4.9.3 Bitumen Type and Grade:

Viscosity Grade Bitumen of grade VG-10 has been identified as the optimum bituminous binder for the conventional flexible pavement given the freeze-thaw prone climate of the region and traffic loading surveyed during the feasibility stage, and, has already been proposed in the DPR vide document Volume III- Material Report. Owing to the sustenance in the variation of temperature from -12°C to $+36^{\circ}\text{C}$, as has been observed in the region since decades, VG-10 has been chosen as the optimum grade of bitumen binder due to its lower absolute and kinematic viscosity of 800 Poise and 250 CST respectively, minimum softening point being above 40°C (Ring and Ball method as per IS: 1205:2022), which makes it more suitable to colder regions than other viscosity grade bitumen binders.

It is pertinent to mention that the same type and grade of bitumen has already been utilised by NHIDCL in the widening of the original pavement between Vailoo and Donipawa, and for the purpose of uniformity in the finished pavement, it is crucial to use the same bitumen binder as the rest of the already widened stretches.

VG-10 of sufficient quality as per the norms laid out in IRC: 37 “Guidelines for the Design of Flexible Pavements” and IS:73 “Paving Bitumen Specification” shall be procured from ‘Panipat Refinery’, Haryana, India. Manufacturer’s Test Certificate (MTC) will be provided along with the details as mentioned in the MoRT&H circulars dated 23-08-2023 & 19-04-2024. The sources for bituminous binder (VG-10) and bitumen emulsion have already been included and submitted with the DPR vide document Volume III- Material Report.

4.9.4 Steel

The required type of Steel is to be procured from the (SAIL) Steel Plant in Srinagar.

4.9.5 Water for Construction

The water tests as per IS : 456 have been conducted on water samples from the sources mentioned in the DPR document vide Volume-III Material Report. The water quality has been found to be of adequate quality as per the requirements for concrete works as laid out in the said Indian Standard. The same reports shall be incorporated in the final DPR.

5.0 Traffic Demand Forecast

5.1 Approach

For evaluating the benefits as well as costs incurred by the project roads, it is obvious that a certain period must be considered for the overall project. Though project once implemented has a long life, if a proper maintenance is carried out from time to time, it is also understood that the project will continue to benefit the society even after the expiry of the project period. For the present project, as mentioned in the TOR, period of 30 years has been considered for traffic demand forecasting.

Traffic demand forecast was carried out up to horizon year 2049. To calculate the growth rate for traffic projections, comparative analysis has carried out for all the methods. The methods used for growth rate calculation are as follows:

1. Past trends in traffic growth (Vehicle registration Method)
2. Econometric Model Method: IRC-108:2015

5.2 Past Trends in Traffic growth

There is no permanent count station along the project road.

5.3 Past trend in growth of registered vehicle

The vehicle registration growth also gives an indication of the traffic growth. Vehicle Registration data of Jammu and Kashmir has been taken for period 2004 - 2016 as available. A growth rate for the same has been derived and the same has been shown in the Table 5.1 below.

Table 5.1: Growth Rate based on Vehicle Registration Method (Based on Road Transport Yearbook)

S.No	Year	Cars / Jeeps			Trucks			2 Wheelers			LCV & Mini LCV			Buses		
		Number	Growth	Gr.rate (%)	Number	Growth	Gr.rate (%)	Number	Growth	Gr.rate (%)	Number	Growth	Gr.rate (%)	Number	Growth	Gr.rate (%)
1	2004-05	96590			31515			273265			13949			20735		
2	2005-06	109367	12777	13.23	33172	1657	5.26	297656	24391	8.93	16843	2894	20.75	21435	700	3.38
3	2006-07	123357	13990	12.79	35697	2525	7.61	320754	23098	7.76	20004	3161	18.77	22161	726	3.39
4	2007-08	139693	16336	13.24	38977	3280	9.19	341834	21080	6.57	22674	2670	13.35	23149	988	4.46
5	2008-09	156462	16769	12.00	41696	2719	6.98	363029	21195	6.20	24768	2094	9.24	24051	902	3.90
6	2009-10	183672	27210	17.39	35109	-6587	-15.80	407928	44899	12.37	43238	18470	74.57	23480	-571	-2.37
7	2010-11	316539	132867	72.34	35414	305	0.87	446791	38863	9.53	46792	3554	8.22	25858	2378	10.13
8	2011-12	255248	-61291	-19.36	38482	3068	8.66	480815	34024	7.62	51412	4620	9.87	25765	-93	-0.36
9	2012-13	290025	34777	13.62	40751	2269	5.90	530594	49779	10.35	56230	4818	9.37	26888	1123	4.36
10	2013-14	326990	36965	12.75	43132	2381	5.84	588207	57613	10.86	62047	5817	10.35	27947	1059	3.94
11	2014-15	364763	37773	11.55	45802	2670	6.19	644458	56251	9.56	67077	5030	8.11	29695	1748	6.25
12	2015-16	407236	42473	11.64	48124	2322	5.07	706746	62288	9.67	74598	7521	11.21	30646	951	3.20
Average yearly growth rate (%)				15.56			4.16			9.04			17.62			3.66

5.4 Econometric Model Method (IRC-108:2015)

The traffic forecast by vehicle type has been carried out by adopting the transport demand elasticity method, which is a well-established and proven technique and is referred in India. Elasticity of traffic demand is defined as the rate at which traffic intensity varies due to change in the corresponding indicator selected. Hence, to estimate the elasticity of traffic demand, it is necessary to establish the relationship between the growth in number of a given category of vehicle with one of the economic variables considered, such as NSDP, per capita income and population growth. Then the data can yield econometric model and the form of equation for estimation of traffic demand elasticity as recommended in IRC: 108- 1996 of the following type:

$$\text{Log (P)} = \text{Ao} + \text{A1Log (EI)}$$

Where,

P=Number of vehicles

EI= Economic indicator

Ao-Constant

A1= a coefficient (elasticity value)

5.5 Past Trends in Economy and Population

The economic indicators of Jammu and Kashmir, which are used for the regression analysis, are summed up in Table 5.2 below:

Table 5.2: Net State Domestic Products and Growth for Jammu and Kashmir (2004-16)

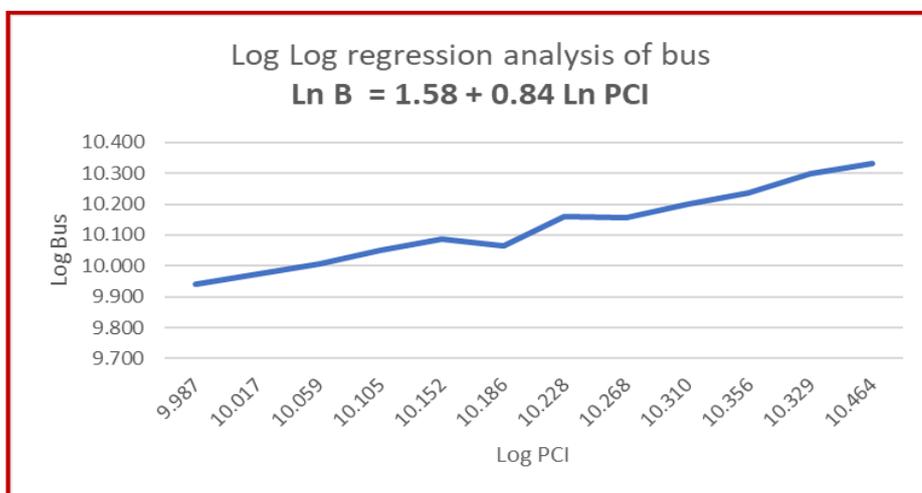
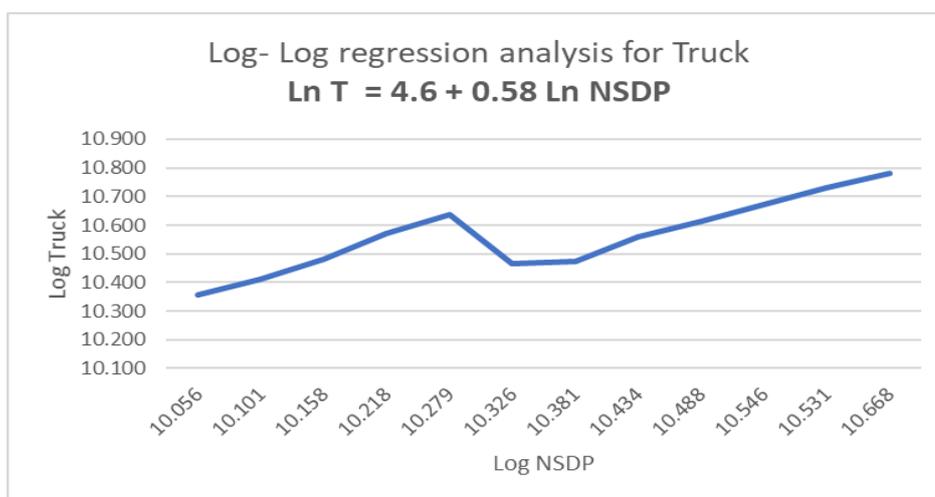
Sr. No	Year	Per Capita Income (PCI)			Population			NSDP			GSDP		
		Rs.	Growth	Gr. rate (%)	In 000's	Growth	Gr. rate (%)	Rs. (In crores)	Growth	Gr. rate (%)	Rs. (In crores)	Growth	Gr. rate (%)
1	2004-05	21734			10717			23292			27305		
2	2005-06	22406	672	3.09	10877	160	1.49	24371	1079	4.63	28883	1578	5.78
3	2006-07	23375	969	4.32	11035	158	1.45	25794	1423	5.84	30602	1719	5.95
4	2007-08	24470	1095	4.68	11192	157	1.42	27387	1593	6.18	32561	1959	6.40
5	2008-09	25641	1171	4.79	11350	158	1.41	29102	1715	6.26	34664	2103	6.46
6	2009-10	26518	877	3.42	11506	156	1.38	30512	1410	4.85	36225	1561	4.50
7	2010-11	27666	1148	4.33	11659	153	1.33	32256	1744	5.72	38270	2045	5.65
8	2011-12	28790	1124	4.06	11806	147	1.26	33990	1734	5.38	41203	2933	7.66
9	2012-13	30035	1245	4.32	11952	146	1.24	35898	1908	5.61	43402	2199	5.34
10	2013-14	31448	1413	4.70	12096	144	1.20	38039	2141	5.96	45847	2445	5.63
11	2014-15	30612	-836	-2.66	12235	139	1.15	37453	-586	-1.54	45126	-721	-1.57
12	2015-16	35034	4422	14.45	12261	26	0.21	42955	5502	14.69	51757	6631	14.69
Average yearly growth rate (%)				4.50			1.23			5.78			6.05

As mentioned above, to establish elasticity of traffic growth, we have regressed past vehicle a registration data with past economic indicators of the Union Territory. The 'e' values for the selected economic variables with respect to different vehicle types are shown in the Table 5.3 and are found with good fit, as reflected in their R2 values.

Table 5.3: Transport Demand Elasticity's

Vehicle Type	Independent variable	Elasticity Coefficient (e)	R2
2-Wheelers	Per Capita Income	2.10	.97
LSV & Mini LSV	NSDP	2.98	.95
Car/Jeep /Van/Taxi	Per Capita Income	3.32	.93
Bus	Population	2.69	.98
Trucks /Trailer	NSDP	0.58	.73

The relationship between different vehicle types and selected Per capita income (PCI) are presented in **Figure 5.1**.



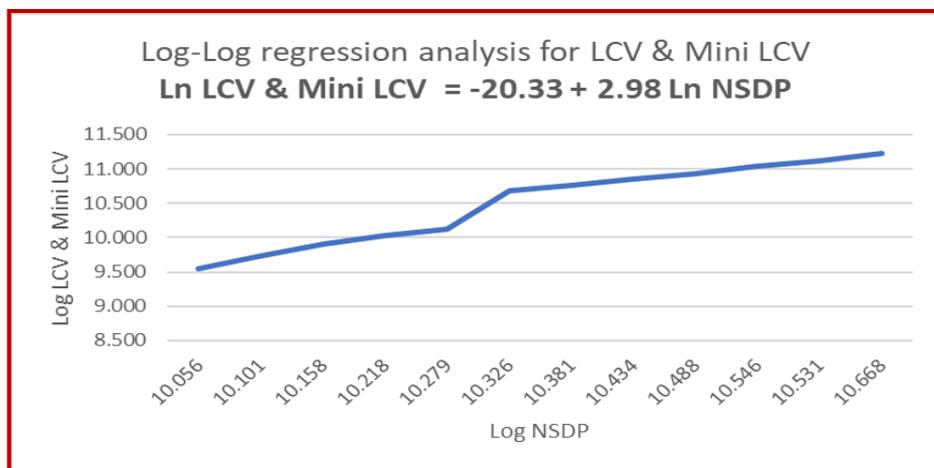
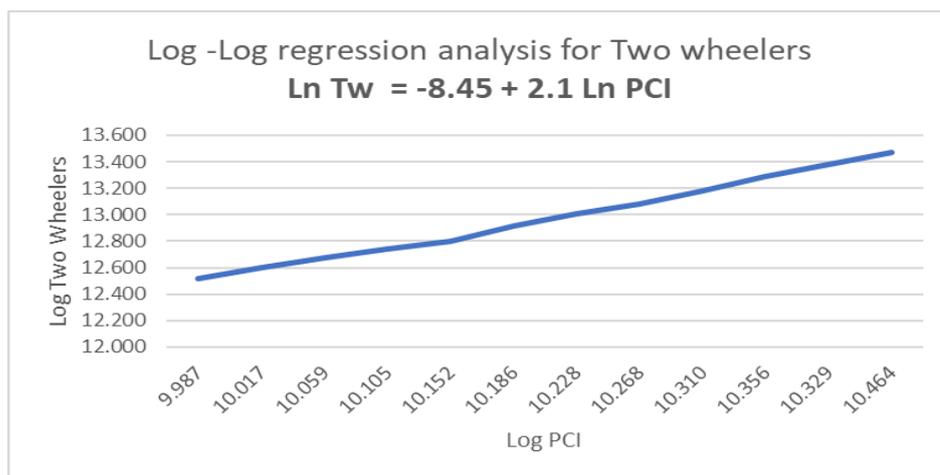
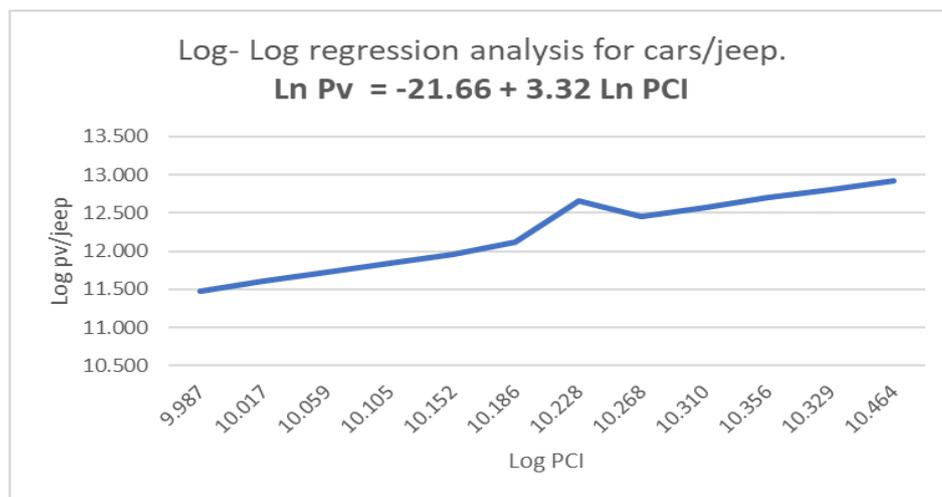


Figure 5.1: Relationship between Vehicle Types and Per capita Income (PCI)

The comparison of vehicle growth rates by vehicle registration and econometric model is as shown in Table 5.4(a) and Table 5.4(b). It is appropriate to use the growth pattern that has emerged out of the economic model, which relates the economic growth with the growth in vehicle registration data.

Table 5.4(a) - Growth Rates of Vehicular Traffic for the state of Jammu and Kashmir

Sr. no	Description	2 Wheelers	Cars/ jeeps	Buses	Trucks	LCV and Mini LCV
1	Trend Growth of vehicles	9.04	15.56	3.66	4.16	17.62
2	Growth from regression	9.45	14.95	3.31	3.33	17.21
3	Considered for Revenue/ Capacity	9.24	15.26	3.49	3.75	17.42

Table 5.4(b) - Adopted Growth Rates for Vehicular Traffic

S. No.	Period	2 wheelers	Car/ jeeps	Buses	Trucks			LCV and mini LCV
					2 Axle	3 Axle	M Axle	
1	Up to 2025	10.0	10.0	5.0	5.0	5.0	5.0	5.0
2	2026-2030	9.0	9.0	5.0	5.0	5.0	5.0	5.0
3	2031-2035	8.0	8.0	5.0	5.0	5.0	5.0	5.0
4	Beyond 2035	7.0	7.0	5.0	5.0	5.0	5.0	5.0

5.6 Estimation of Corridor Traffic and Projection

Consultant has adopted growth rate of 5% for buses, trucks and LCVs and for 2-wheelers, Cars it has adopted growth rate of 10% up to the year 2020, 9% from 2021-2025, 8% from 2026-2030, 7% from 2031-2035 and 6% beyond 2035 as per the analysis. Provided that annual rate of growth of commercial vehicles shall not be less than 5% for traffic projection and pavement design.

Traffic demand projections for the horizon year 2049 on homogeneous sections are shown in Annexure 5. The following Table 5.5 shows the summary of projected traffic volume for homogeneous sections as per adopted realistic growth rates.

Table 5.5: Summary of Projected Total AADT Traffic PCU Volume/ day

Homogeneous Section	Year 2025	Year 2029	Year 2039	Year 2049
Vailoo To Khanabal	10158	16810	30923	55249

5.7 Capacity Analysis and Level of Services

Capacity analysis is fundamental to the planning, design and operation of roads. It is a valuable tool for evaluation of the investment needed for the future improvements. The capacity figures used for determining the desired carriageway width in differing terrain w.r.t. traffic volume and composition are as per IRC: 64-1990. As per IRC 64:1990, it is recommended that on major arterial routes LOS-B should be adopted for the design purpose. On other roads under exceptional circumstances, LOS C could also be adopted for design. For LOS C, Design service volume can be taken as 40 % higher than those for LOS B. For two lane highway, as per IRC: SP:73-2018 and MORT&H circular dated 26th May 2016, the traffic at which the upgradation from two lane to four lanes will trigger is shown in **Table 5.6.** 1`

For four lane highway, as per IRC: SP:84-2019, the project highway shall be widened to six lane when total traffic including the traffic of service road, if any, reaches the design service volume corresponding to Level of Service 'C' of 4-lane highway shown in **Table 5.6.**

Table 5.6: Design Service Volume for Different Lane Configurations

Lane Configuration	Terrain	Design Service Volume (PCUs per day)
4-Lane	Plain	10000
	Rolling	8500
	Mountainous / Steep	6000

Lane Configuration	Terrain	Design Service Volume (PCUS per day)	
Lane Configuration	Terrain	Design Service Volume (PCUs per day)	Design Service Volume (PCUs per day)
4-Lane Plus Paved Shoulder		Level of Service B	Level of Service C
	Plain/Rolling	40000	60000
	Mountainous/Steep	20000	30000

5.8 Lane Requirements

Based on the assessment of the traffic demand on the various homogeneous sections of the Project Highway, the Consultant have carried out detailed option analysis for Four- laning.

It is revealed from the capacity analysis results and considering future traffic growth, the project road in homogeneous section, will require four lane configurations since it reaches 14139 AADT Vehicles and 16533 AADT PCU.

5.9 Lane Improvement Proposals

Capacity analysis and laning requirements have been carried out separately for the homogeneous section as per the traffic demand and travel characteristics.

For the project stretch, Lane capacity will exhaust for 4 lanes as per Design Service Volume (PCUS per day) for 4-lane.

As per traffic data, the maximum generated traffics are locally between Achabal to Anantnag/Srinagar during April to September at peak season of the tourist. Since, there are two major tourist places on the existing alignment i.e. Kokernag & Achabal. The Kokernag place is known for its gardens, pristine freshwater springs and rainbow trout farms. It is known for its trout streams and the largest freshwater spring in Kashmir, Trout hatchery department which has constructed pools in series where in trout is reared. The state's first rural mart has been set up in Kokernag, to promote and market the handicraft products manufactured by the local women self-help groups, by NABARD. Achabal is an important tourist place for an ancient spring surrounded by a garden terraced and developed by the Mughals.

The existing right of way are varying from 26m to 28m. as per above, we have proposed the 4-lane divide carriageway with 0.6m wide median & RCC covered drain at built-up area as per IRC: SP:84-2019 with in the existing right way based on current traffic scenario and local connectivity, which also discussed with NHIDCL, official HQ.

5.10 Intersection Improvement Proposals

Intersections are an important part of the highway because it controls the efficiency, the safety and the capacity. All intersections falling on the project corridor have been studied for the improvement to allow a safe connection to the corridor and minimum interference to the through traffic.

The traffic on the connected road for major intersections have been studied and projections have been made for its future development. Before recommending the improvement, all available options in order of their importance as enumerated ahead have been considered:

- At grade Intersections
- Grade separated Intersections
- Major junction with acceleration and deceleration lanes;
- Major junction with channelization of traffic or Rotary;
- Minor Junction as 'Left In & Left Out'

The intersection volume count survey at one major intersection has been carried out during identified peak periods. As per traffic projection for intersections will require at grade improvements. However as per latest Manual Table 5.8.

Table 5.8: Traffic Movement and Improvement Proposals at Major Intersection

S. No.	Location	Time	Peak Hour Volume	Peak Hour PCU	Total Volume	Total PCU
1	Donipawa	9:00-10:00	3159	3323	27067	28451

With the increased traffic flow, it is anticipated that the saturation capacity of few intersections along the project road is going to impede smooth traffic flow.

As per IRC: SP 84-2019 and 4 laning manual, grade separation should be provided at intersection of junction with all the NH and SH.

5.11 Pedestrians Crossing Facilities

Pedestrian movement along any road is always expected near built up areas, bus bays and intersections. Safe crossing facilities for pedestrians are proposed at major intersections and bus bays. These facilities are planned in accordance with the relevant provisions contained in IRC-11, IRC-17 and IRC-103. At intersections, controlled form of crossing is achieved through provision of 3 m wide zebra crossing, accompanied by STOP line. Pedestrian guard rail has also been proposed at locations to safeguard the pedestrian movement at urban locations.

6.0 Social Impact Assessment of the Project Influence Area

6.1 Introduction

The National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has assigned M/S Technocrat Advisory Services Pvt. Ltd In association with Space Engineers Consortium Pvt. Ltd as Consultants to carry out the "Consultancy Services for Preparation of Detailed Project Report for intermittent Two Lane plus Paved Shoulder stretches to Four Lane in between Design Km 148+589 (Existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir.

The project road lies on NH-244 (previously NH-18) and connects Batote with Khanabal, passing through the Union territory of Jammu & Kashmir. The proposed project alignment passes through Vailoo town. Achabal, Kokernag, Donipawa for a total length of 8.643 km.

6.2 Objectives

The main objectives of Social Analysis and Design are to improve decision making and to ensure that the highway improvement options under consideration are socially sound, sustainable and contribute to the development of social development goals. The main objectives of the Resettlement Action Plan are to provide for resettlement policy framework and includes comprehensive mitigation measures to ensure that the affected and displaced persons are appropriately resettled and rehabilitated i.e. to improve their livelihoods and standards of living or at least to restore them, in real terms. The Social Impact Assessment involves undertaking full baseline information, in such a manner as to ensure compliance with State, Govt. of Indian guidelines and regulations.

6.2.1 Scope of Work

The scope of work comprises the following main tasks, comprising main elements:

- Carry out a preliminary social screening in coordination with other screening exercise (environment and Social) - desk review and field visit- of the highway to determine the magnitude of actual and potential impact and ensure that social considerations are given adequate weight in the selection and design of proposed highway improvements.

- Collect information - desk review and field visit - on existing baseline conditions (include all within the proposed width or Right of Way) and undertake a preliminary evaluation of the highway selected for improvement to define, the zone of impact of such component or activities, design and management studies.
- Explore viable alternative project designs and alignments to avoid, where feasible, or minimize displacement and carry out public consultations on alternate alignments.
- Identify major and minor social impact issues and estimate the economic and social negative impacts on people and land of upgrading the highway and propose cost-effective measures to avoid and/or mitigate negative impacts.
- Carry out public consultation with the likely affected groups, NGOs, district administration and other stakeholders and document the outcomes.
- Provide a preliminary cost estimate for land acquisition, transfer and resettlement and rehabilitation and ensure inclusion in the overall project cost.
- Assets both within and outside of the right of way such structures and land will be recorded on strip maps; and
- Pre-testing of socio-economic questionnaires, checklist for focus group consultations on R&R with different social groups, administrative level and other stakeholders.

6.2.2 Project Road Appreciation

6.2.2.1 Introduction

National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has been assigned the work of preparation of feasibility study / DPR and providing pre-construction services of road stretches/ corridors for up-gradation to four laning with paved shoulder according to NH Act.

The National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has assigned M/S Technocrat Advisory Services Pvt. Ltd In association with Space Engineers Consortium Pvt. Ltd as Consultants to carry out the "Consultancy Services for Preparation of Detailed Project Report for intermittent Two Lane plus Paved Shoulder stretches to Four Lane in between Design Km 148+589 (Existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070)

Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir.

The project road lies on NH-244 (previously NH-18) and connects Batote with Khanabal, passing through the Union territory of Jammu & Kashmir. The proposed project alignment passes through Vailoo town. Achabal, Kokernag, Donipawa for a total length of 8.643 km.

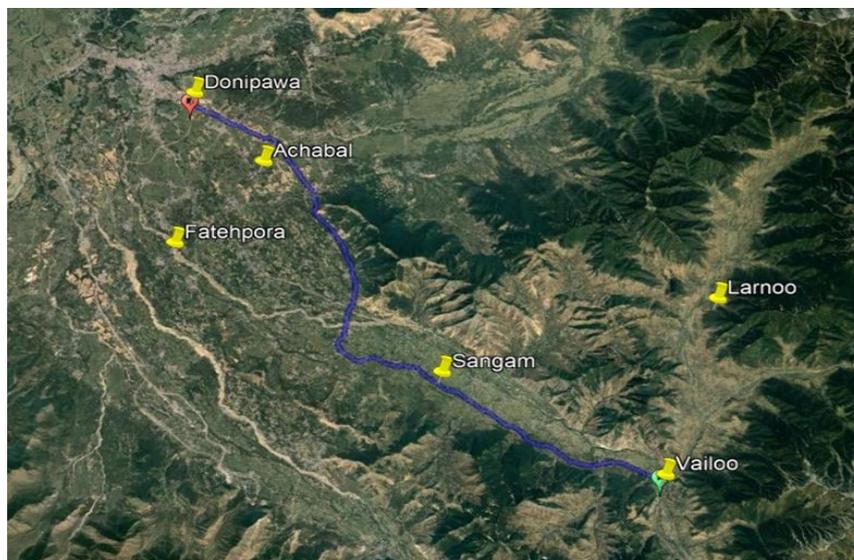


Fig 6.1: Key map of the project road

6.2.2.2 Villages and Districts under the project Road

The project road passing through some major settlements like Vailoo, Kokernag, Bindoo, Sagam, Buchoo, Hillar, Akingam, Achabal, Brakpora, Donipawa.

Table 6.1: Major Villages and Tehsils under the Project Road

Cala	Street (NH 244)	U.T	District	Taluk/ Mandal	Name Of Village
Deputy Commissioner, Anantnag	(KM 148+589 to KM 148+790, KM 150+940 to KM 151+240,	Jammu & Kashmir	ANANTNAG	KOKERNAG	DEVALGAM
				KOKERNAG	BINDOO ZALANGAM
	KM 151+690 to KM 152+290,			KOKERNAG	DANWATPORA
	KM 153+490 to KM 154+090,			KOKERNAG	SAGAM
	KM 157+740 to KM 158+910,			KOKERNAG	BUCHOO
	KM 160+440 to KM 161+140,			KOKERNAG	HILLER ARHAMA
	KM 163+740 to KM 164+890,			KOKERNAG	AKINGAM
	KM 168+690 to KM 169+790,			KOKERNAG	BADOORA
	KM 170+420 to KM 170+730,			ANANTNAG	SAHIBABAD
				ANANTNAG	KULGADH
	KM 171+590 to KM 172+410,			ANANTNAG	THAJIWARA
	KM 173+890 to KM 175+090,			ANANTNAG	BRAKPORA
KM 176+390 to KM 176+532)			ANANTNAG	DONIPAWA	

All major utilities follow the road alignment as the project road connects villages/Towns like:
Bindoo, Bidder, Sagam, Buchoo,, Hillar Arhama, Akingam, Achabal,, Thajiwara,, Donipawa.

Chainage		Terrain	Village Name	Road Way Width	Carriageway		Median	Shoulder							
From	To				Surface type	Width (m)		Width (m)	Type	Width	Type	Width	Type	Width	Type
							Left		Right		Left		Right		
148+589	148+639	Plain and Rolling	Vailoo	11	Flexible	7	0	ER	0	ER	1	Paved	1.5	Paved	1.5
148+639	148+689	Plain and Rolling	Vailoo	9.5	Flexible	7	0	ER	0	ER	1	Paved	1.5	Paved	0
148+689	148+739	Plain and Rolling	Vailoo	9.5	Flexible	7	0	ER	0	ER	1	Paved	1.5	Paved	0
148+739	148+790	Plain and Rolling	Vailoo	9.5	Flexible	7	0	ER	0	ER	1	Paved	1.5	Paved	0
150+940	150+990	Plain and Rolling	Devalgam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
150+990	151+040	Plain and Rolling	Devalgam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
151+040	151+090	Plain and Rolling	Devalgam	10.5	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	0
151+090	151+140	Plain and Rolling	Devalgam	10.5	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	0
151+140	151+190	Plain and Rolling	Devalgam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
151+190	151+240	Plain and Rolling	Devalgam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
151+690	151+740	Plain and Rolling	Wanigam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
151+740	151+790	Plain and Rolling	Wanigam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5

151+790	151+840	Plain and Rolling	Wanigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
151+840	151+890	Plain and Rolling	Wanigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
151+890	151+940	Plain and Rolling	Wanigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
151+940	151+990	Plain and Rolling	Wanigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
151+990	152+040	Plain and Rolling	Wanigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
152+040	152+090	Plain and Rolling	Wanigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
152+090	152+140	Plain and Rolling	Wanigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
152+140	152+190	Plain and Rolling	Wanigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
152+190	152+240	Plain and Rolling	Wanigam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
152+240	152+290	Plain and Rolling	Wanigam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
153+490	153+540	Plain and Rolling	Bindoo	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
153+540	153+590	Plain and Rolling	Bindoo	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
153+590	153+640	Plain and Rolling	Bindoo	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
153+640	153+690	Plain and Rolling	Bindoo	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

153+690	153+740	Plain and Rolling	Bindoo	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
153+740	153+790	Plain and Rolling	Bindoo	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
153+790	153+840	Plain and Rolling	Bindoo	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
153+840	153+890	Plain and Rolling	Bindoo	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
153+890	153+940	Plain and Rolling	Bindoo	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
153+940	153+990	Plain and Rolling	Bindoo	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
153+990	154+040	Plain and Rolling	Bindoo	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
154+040	154+090	Plain and Rolling	Bindoo	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
157+740	157+790	Plain and Rolling	Sagam To Kokernag	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
157+790	157+840	Plain and Rolling	Sagam To Kokernag	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
157+840	157+890	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
157+890	157+940	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

157+940	157+990	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
157+990	158+040	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+040	158+090	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+090	158+140	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+140	158+190	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+190	158+240	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+240	158+290	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+290	158+340	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+340	158+390	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+390	158+440	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

158+440	158+490	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+490	158+540	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+540	158+590	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+590	158+640	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+640	158+690	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+690	158+740	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+740	158+790	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+790	158+840	Plain and Rolling	Sagam To Kokernag	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+840	158+890	Plain and Rolling	Sagam To Kokernag	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
158+890	158+910	Plain and Rolling	Sagam To Kokernag	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5

160+440	160+490	Plain and Rolling	Buchoo To Tangpawa	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
160+490	160+540	Plain and Rolling	Buchoo To Tangpawa	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
160+540	160+590	Plain and Rolling	Buchoo To Tangpawa	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
160+590	160+640	Plain and Rolling	Buchoo To Tangpawa	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
160+640	160+690	Plain and Rolling	Buchoo To Tangpawa	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
160+690	160+740	Plain and Rolling	Buchoo To Tangpawa	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
160+740	160+790	Plain and Rolling	Buchoo To Tangpawa	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
160+790	160+840	Plain and Rolling	Buchoo To Tangpawa	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
160+840	160+890	Plain and Rolling	Buchoo To Tangpawa	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
160+890	160+940	Plain and Rolling	Buchoo To Tangpawa	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

160+940	160+990	Plain and Rolling	Buchoo To Tangpawa	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
160+990	161+040	Plain and Rolling	Buchoo To Tangpawa	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
161+040	161+090	Plain and Rolling	Buchoo To Tangpawa	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
161+090	161+140	Plain and Rolling	Buchoo To Tangpawa	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
163+740	163+790	Plain and Rolling	Arhama To Hiller	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
163+790	163+840	Plain and Rolling	Arhama To Hiller	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
163+840	163+890	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
163+890	163+940	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

163+940	163+990	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
163+990	164+040	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+040	164+090	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+090	164+140	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+140	164+190	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+190	164+240	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+240	164+290	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+290	164+340	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+340	164+390	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

164+390	164+440	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+440	164+490	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+490	164+540	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+540	164+590	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+590	164+640	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+640	164+690	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+690	164+740	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+740	164+790	Plain and Rolling	Arhama To Hiller	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

164+790	164+840	Plain and Rolling	Arhama To Hiller	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
164+840	164+890	Plain and Rolling	Arhama To Hiller	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
166+990	167+040	Plain and Rolling	Azigam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
167+040	167+090	Plain and Rolling	Azigam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
167+090	167+140	Plain and Rolling	Azigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
167+190	167+240	Plain and Rolling	Azigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
167+290	167+340	Plain and Rolling	Azigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
167+340	167+390	Plain and Rolling	Azigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
167+390	167+440	Plain and Rolling	Azigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
167+440	167+490	Plain and Rolling	Azigam	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
167+490	167+540	Plain and Rolling	Azigam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
167+540	167+590	Plain and Rolling	Azigam	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5

168+690	168+740	Plain and Rolling	Kalanag To Achabal	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
168+740	168+790	Plain and Rolling	Kalanag To Achabal	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
168+790	168+840	Plain and Rolling	Kalanag To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
168+840	168+890	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
168+890	168+940	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
168+940	168+990	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
168+990	169+040	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+040	169+090	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+090	169+140	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

169+140	169+190	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+190	169+240	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+240	169+290	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+290	169+340	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+340	169+390	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+390	169+440	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+440	169+490	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+490	169+540	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

169+540	169+590	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+590	169+640	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+640	169+690	Plain and Rolling	Kalanag To Achabal Badoora	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+690	169+740	Plain and Rolling	Kalanag To Achabal Badoora	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
169+740	169+790	Plain and Rolling	Kalanag To Achabal Badoora	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
171+590	171+640	Plain and Rolling	Kulgarah To Achabal	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
171+640	171+690	Plain and Rolling	Kulgarah To Achabal	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
171+690	171+740	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

171+740	171+790	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
171+790	171+840	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
171+840	171+890	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
171+890	171+940	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
171+940	171+990	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
171+990	172+040	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
172+040	172+090	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
172+090	172+140	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
172+140	172+190	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
172+190	172+240	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

172+240	172+290	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
172+290	172+340	Plain and Rolling	Kulgarah To Achabal	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
172+340	172+390	Plain and Rolling	Kulgarah To Achabal	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
172+390	172+410	Plain and Rolling	Kulgarah To Achabal	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
173+890	173+940	Plain and Rolling	Bulbul Nowgam To Thajiwara	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
173+940	173+990	Plain and Rolling	Bulbul Nowgam To Thajiwara	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
173+990	174+040	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+040	174+090	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+090	174+140	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

174+140	174+190	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+190	174+240	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+240	174+290	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+290	174+340	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+340	174+390	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+390	174+440	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+440	174+490	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+490	174+540	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

174+540	174+590	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+590	174+640	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+640	174+690	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+690	174+740	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+740	174+790	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+790	174+840	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+840	174+890	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+890	174+940	Plain and Rolling	Bulbul Nowgam To	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

174+940	174+990	Plain and Rolling	Bulbul Nowgam To Thajiwara	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
174+990	175+040	Plain and Rolling	Bulbul Nowgam To Thajiwara	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
175+040	175+090	Plain and Rolling	Bulbul Nowgam To Thajiwara	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
176+390	176+440	Plain and Rolling	Dunipawa	12.5	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1
176+440	176+490	Plain and Rolling	Dunipawa	11.5	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1
176+490	176+532	Plain and Rolling	Dunipawa	12.5	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1
170+423	170+473	Plain and Rolling	Achabal Main Market	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
170+473	170+523	Plain and Rolling	Achabal Main Market	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5
170+523	170+573	Plain and Rolling	Achabal Main Market	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5
170+573	170+623	Plain and Rolling	Achabal Main	12	Flexible	7	0	ER	1	ER	1	Paved	1.5	Paved	1.5

170+623	170+673	Plain and Rolling	Achabal Main Market	14.48	Flexible	9.48	0	ER	1	ER	1	Paved	1.5	Paved	1.5
170+673	170+730	Plain and Rolling	Achabal Main Market	13	Flexible	8	0	ER	1	ER	1	Paved	1.5	Paved	1.5

6.2.3 Benefits envisaged from the project road:

Following are the expected benefits due to the improvement in the project road:

1. Better level of service in terms of improved riding quality and smooth traffic flow.
2. Faster transportation will ultimately lead to massive savings in the form of reduced wear and tear of vehicles, reduced vehicle operating costs (VOCs) and total reduction in transportation costs etc.
3. With the improvement of road surface, the traffic congestion due to obstructed movement of vehicles will be minimized and thus wastage of fuel emissions from the vehicles will be reduced.
4. Increased road landscaping and safety features.
5. Enhanced connectivity between rural & urban population which will benefit the all sections of the society like general population, small-medium-large scale industries, farmers, businessmen etc.
6. Improved access to higher education facilities & modern health facilities. Strengthening of both rural & urban economies which in turn will improve economic scenario of the region and country.
7. Improved road connectivity helps in better implementation and management of government schemes.
8. With improvement in economy, more generation of employment opportunities.
9. Overall improvement of the region.

6.2.4 Homogeneous Section

The traffic homogeneous sections have been identified based on the major traffic generators and diversion locations along the project corridor. The passenger traffic has been observed to vary with respect to the influence of village/towns falling along the project corridor. The major traffic generators settlements and its connections (diversion) points are:

Vailoo to Donipawa

Traffic surveys locations were selected to capture representative traffic volume on the homogeneous sections with a view to capture section wise traffic flow characteristics, the total stretch has been segmented in to two homogeneous sections, based upon the major intersections that act as main collectors or distributors (diversion) of traffic along the project road.

Table 6.4: Traffic Homogenous Section

S. No	Homogeneous Section	Existing Chainage	
		From (Km)	To (Km)
1	Vailoo - Donipawa	148+589	176+532

6.3 About the Project Influence Area

The entire project road is passing within the Anantnag district. Hence, for analyzing the immediate influence area of the project road Anantnag District in Jammu and Kashmir Union Territory has been considered.

Major socio-economic benefits of the improvement of highways would be in terms of: Better transportation will ultimately lead to massive savings in vehicle operating costs (VOCs) which include savings in time, savings in cost of wear and tear, fuel etc. It will increase access to the villages and other small settlements with the urban areas, thus providing better connectivity to the urban infrastructure.

- Strengthening of rural economies as the rural sector/ economy is sure to get strengthened, though at a gradual pace.
- Education is one of the most dominant indicators towards the development of a region. Though primary schools are present in almost all villages, access to high schools, higher secondary schools and colleges is not so easy at present. Provision of easy access to higher education can be directly linked to the improved educational scenario.

- Indian villages are yet not well-equipped with all types of medical facilities and services like Public Health Centres (PHCs), dispensaries, hospitals. Due to inaccessibility, reaching even the nearest health centre sometimes becomes a colossal task.
- Other than this, there would be inevitable Negative impacts that the improvement of the concerned highway would lead to:
- **Land Acquisition:** Impacts leading to agricultural land being affected, either completely or partially. It is chiefly restricted to acquisition of agricultural land, revenue land, pasture land and other government lands.
- **Loss of roadside structures:** People will be affected by land acquisition, which possess title or other tenured status. Consequent to the land acquisition requirements, wells, houses (pucca, semi-pucca, and kutcha) and other structures like religious places (temples, mosques), community structures like bus stand, community sitting places, hand pumps, tube wells etc are likely to be affected.
- **Loss of livelihood:** Big and small shops, roadside restaurants and hotels, other small commercial developments etc. are also likely to be affected due to road improvement and widening. The people directly or indirectly dependent on these would experience an abrupt loss in their income.

6.3.1 Location and Districts involved

Location and Geography

Jammu and Kashmir

The Union Territory of Jammu and Kashmir covers an area of 42,241 sq.km. The state is very rich in natural heritage since it is located mostly in Himalayan Mountains. Jammu and Kashmir borders with the states of Himachal Pradesh and Punjab to the south. Jammu and Kashmir has an international border of Pakistan on the east, the Line of Control separates it from the Pakistan. Jammu and Kashmir consist of two divisions: Jammu and Kashmir and is further divided into 20 districts. Jammu and Kashmir is home to several valleys such as the Kashmir Valley, Tawi Valley, Chenab Valley, Poonch Valley, Sind Valley and Lidder Valley. The main Kashmir Valley is 100 km. The Indus, Tawi, Ravi and Chenab are the major rivers flowing through the region. Jammu and Kashmir is home to several Himalayan glaciers. With an average altitude of 5,753 meters (18,875 ft) above sea-level, the Siachen Glacier is 76 km (47 mi) long making it the longest Himalayan glacier. In the south around Jammu, the climate is

typically monsoonal. In the hot season, Jammu city is very hot and can reach up to 40 °C whilst in July and August, very heavy though erratic rainfall occurs with monthly extremes of up to 650 millimeters.

Anantnag District

The project bypass stretches lies in the Anantnag district. It is a district in the newly formed Union Territory of Jammu and Kashmir. It is one of ten districts which make up the Kashmir Valley. The district headquarters is Anantnag city. As of 2011, it was the third most populous district of Jammu and Kashmir (out of 20), after Jammu and Srinagar.

Anantnag is located about 54 Km from Srinagar and about 254 Km from Jammu. The district is well connected with other districts and National Highway NH-1A (44) and NH-1B (244) pass through the district. The district has a good road network. District Anantnag is called the Gateway of Kashmir Valley. The nearest airport is located at Srinagar, which is about 65 Km away and the nearest Railhead is located at Jammu. The general approach to the whole of the District is through road and one can avail the transport facilities like Taxi, Deluxe Buses etc. both from Jammu and Srinagar. Geographically the district lies between 33-20' to 34 -15' north latitude and 74-30 to 75-35 East Longitude bounded by north west by Srinagar and Pulwama districts and in the north east by Kargil district, in the southeast by district Doda, Kishtwar and in the south and south west by Ramban and Kulgam districts respectively Anantnag features a moderate climate (Köppen climate classification). It's climate is largely defined by its geographic location, with the towering Karokaram to its east and the Pirpanjal range to the south. It can be generally described as cool in the spring and autumn, mild in the summer, and cold in the winter. As a large city with a significant difference in Geo location among various districts, the weather is often cooler in the hilly Areas of east as compared to the flat northern part of Anantnag. The hottest month is July having mean maximum temperature 32 °C, and the coldest are December-January (mean minimum temperature -15 °C)

6.3.2 Administrative Setup

Jammu and Kashmir consist of two divisions: Jammu and Kashmir Valley further divided into 20 districts. The major cities in Jammu and Kashmir are:

Table 6.6: Population of Major Cities of Jammu and Kashmir

Divisions	Districts	Area (Square Km)	Population	Headquarters
Jammu	Kathua District	2651	616,437	Kuthua
	Jammu District	2336	1,529,858	Jammu
	Samba District	1002	3,18,898	Samba
	Udhampur District	5550	5,544,984	Udhampur
	Reasi District	1719	314,667	Reasi
	Rajouri District	2630	642,415	Rajouri
	Poonch District	1674	476,835	Poonch
	Doda District	2625	409,936	Doda
	Ramban District	1239	283,713	Ramban
	Kishtwar District	7737	230,696	Kishtwar
Kashmir	Anantnag District	2917	1,078,692	Anantnag
	Kulgam District	1067	424,483	Kulgam
	Pulwama District	1398	560,440	Pulwama
	Shopian District	612.9	266,215	Shopian
	Budgam District	1370	753,745	Budgam
	Srinagar District	1979	1,236,829	Srinagar
	Ganderbal District	1979	297,446	Ganderbal
	Bandipora District	345	392,232	Bandipora
	Baramulla District	3353	1,008,039	Baramulla
	Kupwara District	2379	870,354	Kupwara

6.3.3 Demographic features of the Union Territory

According to the 2011 census of India, the total population of Jammu and Kashmir is 12258433. The official language of the UT is Urdu among other languages such as Kashmiri, Dogri, Hindi, Punjabi, Pahari, Balti, Ladakhi, Gojri, Shina and Pashto are also spoken in other parts of Jammu and Kashmir. It has a rich literary heritage with roots that lie deep in the sociological and historical movements of the region. Its literature reflects the regional

consciousness and the evolution of an identity distinct from others in Northern India. The literacy is about 68.74%.

Table 6.7: District Wise Population of Jammu and Kashmir

S. No	District	2001 Census Persons	2011 Census Persons	Male	Female	Density	Rural	Urban
1	Srinagar	1202447	1250173	665789	584384	1056	15928	1234245
2	Ganderbal	NA	297003	158900	138103	284	250203	46800
3	Budgam	629309	755331	400583	354748	550	666620	88711
4	Anantnag	1172434	1069749	552203	517546	366	791237	278512
5	Kulgam	NA	423181	216873	206308	396	343739	79442
6	Pulwama	652607	570060	297988	272072	525	491370	78690
7	Shopian	NA	265960	136302	129658	852	251010	14950
8	Baramulla	1169780	1015503	542171	473332	242	40948	174555
9	Bandipora	NA	385099	201531	183568	967	320070	65029
10	Kupwara	650393	875564	475126	400438	368	776322	99242
11	Leh (ladakh)	117232	147104	92907	54197	3	83901	63203

12	Kargil	119307	143388	80791	62597	10	130635	12753
13	Jammu	1588772	1526406	815727	710679	653	768577	757829
14	Samba	NA	318611	168948	149663	350	264990	53621
15	Kathua	550084	615711	327953	287758	246	527176	88535
16	Poonch	372613	476820	252240	224580	284	438176	38644
17	Rajouri	483284	619266	332424	286842	235	575332	43934
18	Udampur	743509	619266	332424	286842	235	575332	43934
19	Reasi	NA	314714	166392	148322	185	288010	26704
20	Doda	691929	409576	213091	196485	137	377003	32573
21	Kishtwar	NA	231037	120496	110541	29	216196	14841
22	Ramban	NA	283313	149032	134281	210	271527	11786
	Total	10143700	12548926	6665561	5883365	124	9134820	3414106

(Data Source: Digest of Statistics, 2011-12)

6.3.4 Economical Profile of Project Influence Area (PIA):

The economy of Jammu and Kashmir has suffered from disturbed conditions. It would be therefore necessary to put the economy back to the rails to enable an average person get employment opportunities. In this direction, the following 8 sectors of economy have been identified for generation of gainful employment opportunities in the region on sustainable basis:

1. Agriculture (including Horticulture, Floriculture, Food Processing and Animal Husbandry)
2. Handlooms and Handicrafts
3. Industries (including Small Scale industries and Rural industries)
4. Tourism & travels
5. Education & health
6. Large infrastructure projects (Roads & Railways)
7. Information Technology & Telecommunication
8. Construction Sector

Jammu and Kashmir's economy is predominantly dependent on agriculture and allied activities. The Kashmir Valley is known for its sericulture and cold-water fisheries. Wood from Kashmir is used to make high-quality cricket bats, popularly known as Kashmir Willow. Kashmiri saffron is very famous and brings the state a handsome amount of foreign exchange. Agricultural exports from Jammu and Kashmir include apples, barley, cherries, corn, millet, oranges, rice, peaches, pears, saffron, sorghum, vegetables, and wheat, while manufactured exports include handicrafts, rugs, and shawls.

Horticulture plays a vital role in the economic development of the state. With an annual turnover of over 3 billion (US\$47 million), apart from foreign exchange of over 800 million (US\$12 million), this sector is the next biggest source of income in the state's economy.

Economic centers:

Main industrial activity is concentrated in the Jammu and Kathedua districts of Jammu division. This is mainly because Jammu is the only railhead, where loading and unloading of raw material becomes easy and less cumbersome as compared to Kashmir region where transportation cost is higher. The State has set up two industrial growth centers - one in Samba, Jammu and other in Lassipora, Pulwama with the assistance of Central Govt. under the centrally sponsored schemes.

The key industrial activity in J&K includes:

- Horticulture
- Floriculture
- Handloom & Handicraft
- Tourism.
- Mineral based Industries.
- Gem & Jewellery
- Sericulture
- Information Technology
- Pharmaceuticals
- Insecticides
- Pesticides
- Electronics
- Hardware

GDP and Profile of the Sectors Contributing to the Regional Economy:

This is a chart of trend of gross state domestic product of Jammu and Kashmir at market prices estimated by Ministry of Statistics and Program Implementation with figures in millions of Indian Rupees.

Table 6.8: Gross State Domestic Product

S. No	Sector	2011-12(Q)	2012-13(Q)	2013-14
1	Agriculture including Livestock	743878	745110	756542
2	Forestry and Logging	130261	130059	131083
3	Fishing	18071	18160	18347
(A)	Agriculture & Allied (1+2+3)	892210	893329	905972
4	Mining and Quarrying	10446	44768	313638
(a)	Sub-total Primary (A+4)	902656	938097	1219610
5	Manufacturing	290872	305100	956471
5.1	Manufacturing (Registered)	134062	138905	313638
5.2	Manufacturing (Un-registered)	163740	166195	142740
6	Construction	476989	489583	170898
7	Electricity, Gas, Water Supply	185792	188497	508922
(b)	Sub-total Secondary (5-7)	105080	116603	447549

(B)	Industry (b+4)	115526	161371	761187
8	Transport, Storage & Communication	326981	349799	233485
9	Trade, Hotels & Restaurants	290376	299924	379532
10	Banking & Insurance	232571	256991	286321
11	Real Estates, Ownership of Dwelling, Legal & Business Services	228437	238825	249603
12	Public Administration	684436	747025	823423
13	Other Services	519803	554075	594528
(C)	Sub-total Tertiary (Services Sector)	2200827	2366546	2566892
	(8-13)			
	Total GSDP (a+b+c)	4064065	4287825	4539945
	Population in lakhs	118.06	119.52	120.96
	Per Capita GSDP	34424	35875	37533
	Growth Rate	6.19	5.51	5.88

Workforce Characteristics

After collection and verification of the data from time to time, state income division prepares estimates at factor cost usually in the month of January-February every year. These estimates are discussed and verified by CSO during comparable discussion generally in the month of April-May every year. Advance estimates prepared in the current year is finalized in the forthcoming third year after discussion with CSO. For instance, an Advance GSDP estimate for the year 2013-14 has been prepared in the month of January 2014. In January 2015, a Quick estimate will be prepared for the same year. Similarly, In January 2016, a provisional estimate will be prepared for the year 2013-14 and finally In July 2016, GSDP estimates for the year 2013-14 would be finalized after discussion with CSO.

6.4 Socio Economic Profile of Project Road

6.4.1 Demography Data of Area

The project bypass stretch lies in the Anantnag district. It is a district in the newly formed Union Territory of Jammu and Kashmir. It is one of ten districts which make up the Kashmir Valley. The district headquarters is Anantnag city. As of 2011, it was the third most populous district of Jammu and Kashmir (out of 20), after Jammu and Srinagar.

In the region most of the population depends upon agriculture which mainly composed of rice, maize, wheat and mustard. Apple orchards are also present in the area. People are also engaged in Tourism industry as it has a great potential in the region for the years to come.

Category	No
Area	2917Sq.Kms
No. of Revenue Villages	387
No. of Sub Divisions	4
No. of CD Blocks	16
No. of Tehsils	12
No. of Gram Panchayats	303
No. of Municipalities	10
No. of Municipal Corporations	2
No. of Patwar Halqas	99
Literacy Rate	62.69%
Total Population	1078692

If we talk about the religion, Muslim is the major religion in the area as it accounts for more than 98% of the population. The literacy rate is low as 62.69%. The development of project will help in upliftment of society in the region.

S. No	Religion	Total	Male	Females
1	Muslim	1057005	542671	514334
2	Hindus	13180	12010	1170
3	Sikhs	6140	3660	2480
4	Christians	1449	845	604
5	Buddhists	55	35	20
6	Jains	7	4	3
7	Other	7	3	4
8	Not Stated	849	539	310
	Total	1078692	559767	518925

6.4.2 Agriculture/ Irrigation in Project Influence Area

Impact on agricultural land

Jammu and Kashmir is essentially a mountainous region in which only about 30 per cent of the reporting area is under cultivation. Agriculture is the mainstay of the people as it provides employment, directly or indirectly to about 70 per cent of the workforce. It contributes about 65 per cent of the state revenue which explains the overdependence of the state on agriculture. Land is, however, limited and therefore, its judicious utilization is necessary to meet the growing need of the tremendously increasing population and for the sustainability of soils, ecosystems and environment. The total geographical area of the state is 2.23 lakh sq. km including those parts which are under the occupation of Pakistan and China. About 92 per cent of the geographical area of the state consists of high mountains rugged topography and only 5 per cent is available for cultivation.

Being, hilly, mountainous and snow covered, it is only the gentle slopes (below 15°) which may be developed as orchards and pastures after heavy investment. The proportion of old fallow and current fallow is 0.29 and 4.0 per cent respectively. About 12 per cent of the total reporting area is put to non-agricultural uses, e.g., settlement, roads, cemetery, guls (canals) and water bodies. In general, the Jammu plain has a high concentration of wheat, rice, maize, pulses, fodder and oilseeds, while the Valley of Kashmir is well known for its paddy, maize, orchards (apples, almond, walnut, peach, cherry, etc.) and saffron cultivation. In Ladakh, barley, wheat, maize, vegetables, barseem and fodder are the main crops. The Kashmir Valley

has a large capacity of fruit production. Apples, walnuts, almonds, cherries and pears are imported by many foreign countries.

Over 70 percent of the Net Sown Area is under food crops and the area under fruits is a little over 13 percent. Viability of agriculture as a profession is presently affected capital inadequacy, lack of infrastructural support and controls on movement, storage and sale etc of agricultural produce. Dwindling water resources too is a major challenge as only 42 percent of the cultivated area is under irrigation.



The UT of J&K along with Ladakh is predominantly a mono cropped and rain fed with about 40% of the area in Jammu division and 60% in Kashmir Division having assured means of irrigation. Irrigation is crucial input for development of agriculture in the state. The major area in the state falls under the command of canal irrigation. Rice, Maize and Wheat are the major crops in the state. While in Kashmir region Wheat, Oil Seeds and Fodder is being introduced as the secondary crop. In Jammu farmers are raising paddy as an additional crop. The production level of paddy adds about 40 quintals per hectare in Kashmir Valley and is highest in the country (Source: SOER, J&K 2012-13)

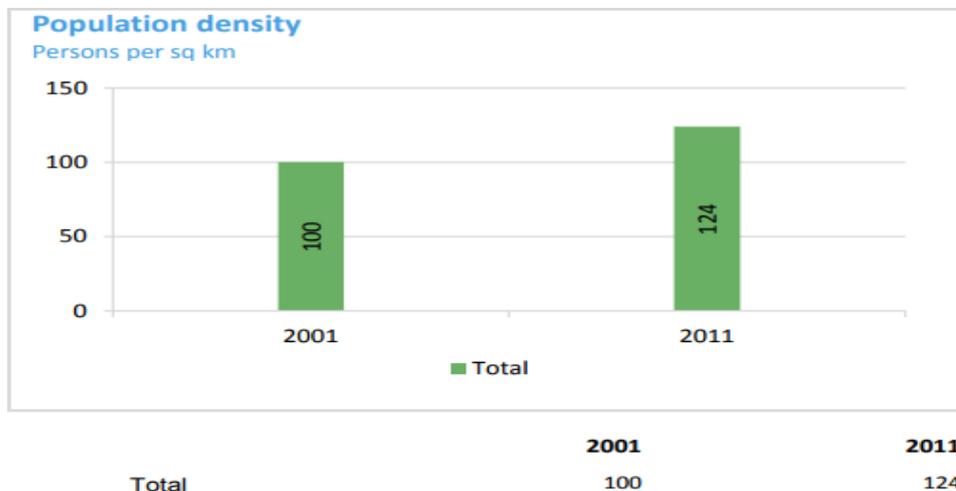
As per the figure for 2011-12 area not available for cultivation accounts for 574 thousand hectares. The category consists of 245 thousand hectares following under land put to non-agriculture use and 312 thousand hectares under barren and uncultivable land, 5 thousand hectares is under still water, marshy and water lodged category which is negligible proportion.

The crop yield for the year 2011-12 regarding principal agriculture crops was estimated to be 1.6 metric tons per annum for maize, 2.078 metric tons per annum for rice and 1.68 metric tons per annum for wheat, which are the major crops of the region.

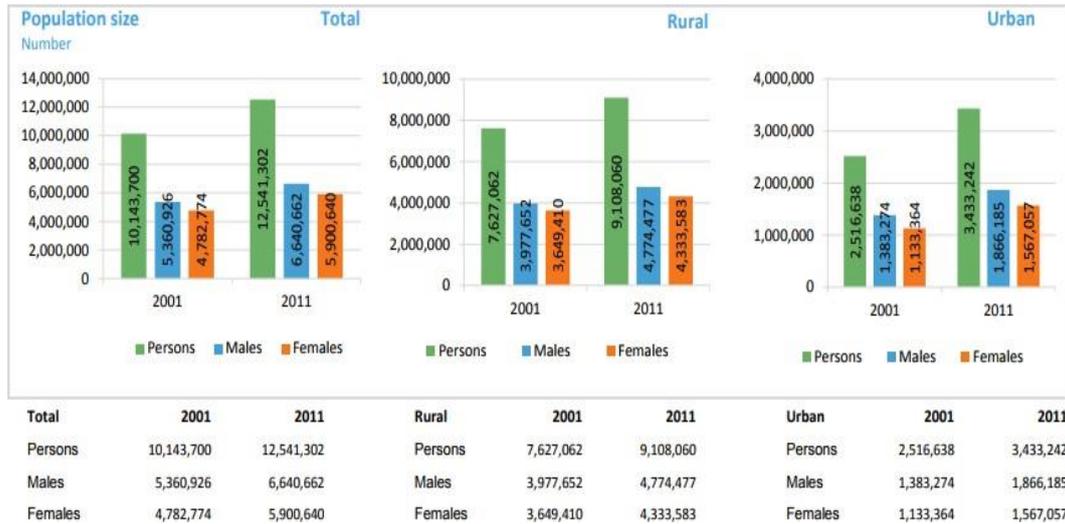
S.No	District	Area Irrigated (Hectares)				
		Rice	Maize	Wheat	Barley	Other cereals Pulses & Millets
1)	Anantnag	25147	1335	-	-	538
2)	Kulgam	16812	530	-	-	68
3)	Pulwama	16567	849	-	-	110
4)	Shopian	556	162	-	-	48
5)	Srinagar	3709	-	-	-	17
6)	Ganderbal	7684	1290	-	-	104
7)	Budgam	24665	1428	6	-	536
8)	Baramulla	20236	5413	-	-	659
9)	Bandipora	9486	973	-	852	333
10)	Kupwara	15639	10122	-	-	-
11)	Leh	-	-	1092	4	3679
12)	Kargil	-	-	1324	-	5544
13)	Jammu	52338	118	49474	8	832
14)	Samba	7063	56	6350	29	171
15)	Udhampur	2926	4582	1654	169	96
16)	Reasi	1425	193	931	3	70
17)	Doda	1890	727	707	123	46
18)	Kishtwar	1202	836	253	227	801
19)	Ramban	1386	-	203	126	-
20)	Kathua	20000	297	15916	21	84
21)	Rajouri	453	118	3159	-	50
22)	Poonch	3621	98	2192	-	-
	Total	236888	29127	83261	1562	13786

6.4.3 Population & Literacy

As per details from Census 2011, the following data is given by the Department of Ecology Environment and Remote Sensing The Population Density of J&K is as below:.



Population Size of Jammu and Kashmir



Culture

The culture of Kashmir is a diverse blend and highly influenced by northern South Asian as well as Central Asian culture. Along with its scenic beauty, Kashmir is famous for its cultural heritage; it amalgamates Muslim, Hindu, Sikh and Buddhist philosophies and has involved composite culture based on the values of humanism and tolerance which is collectively known as Kashmiriyat.

The culture of Jammu and Kashmir is a comprehensive mingling of customs and practices of its three distinct regions, Kashmir, Jammu and Ladakh. Apart from its demographical variations, specific cultural diversions of its elements are what make the culture of Jammu and Kashmir remarkable. Music, dance, cuisine, lifestyle, festivals all these only highlight the diversities prevalent in these provinces. Unity is restored when a common thread of cultural tradition binds them together thus making it a part of Jammu and Kashmir as a whole. Culture of Jammu and Kashmir is therefore an interesting reflection of color, zest, harmony and concord which makes Jammu and Kashmir to stand apart with its distinct features of age-old tradition and deep ethnicity. The paradise on earth, Jammu and Kashmir is home to a rich cultural heritage, besides a panoramic landscape that leaves many a visitor spellbound. This culture and tradition is reflected in the several fairs and festivals in Jammu and Kashmir that are widely celebrated across the state with much zeal and gaiety. We at Indian Holiday take you on tours to Jammu and Kashmir that provide you with an exclusive opportunity to be a part of these memorable celebrations.

Almost all the major Hindu festivals in India are celebrated with equal enthusiasm in the state of Jammu and Kashmir. Some of such prominent fairs and festivals in Jammu and Kashmir

include Lohri, Holi, Navratri, Baisakhi or New Year Day, Guru Ravi Das's Birthday, Tihar and Sankranti. People from across Jammu and Kashmir gather in large numbers during the time of these festivals. Interestingly, all Hindu, Muslim or Sikh tairs and festivals are religiously observed in the entire state of Jammu and Kashmir.

6.4.4 Transportation Profile of the state

Roads

Jammu and Kashmir has a vwide range of road network that connects all the cities The major highways in Jammu and Kashmir are NH L NH 3. NH 44. NH 144. NH 244, NH 144-A NH 301. NH 444, NH SOL, NH 701, NH 701-4, Srinagar-lammu National Highway, Udhampur Jammu Highway and Skardu Kargil Road, A detail road network in the state is shown as below in the map.

National Highway 1

NH-1 is a national highway in the Indian state of Jammu & Kashmir. NH 1 comprises parts of old NHIA and NHID. The number 1 indicates, under the new numbering system. that it is the northernmost East-West highway in India.

NH, I pass from Uri to Baramulla. Srinagar, Sonamarg, Zojila. Drass, Kargil and Leh. The route passes through high mountain passes and most to the road clings to mountainsides The NH is the lifeline of the Ladakh region, An alternative route, the Leh-Manali Highway. exists but it climbs over even higher mountain passes. NH 1 passes near the India-Pakistan border.

National Highway 44

National Highway 44 is the longest-running major north-south National Highway in India It begins from Srinagar and terminates in Kanyakumari; the highway passes through the states of Jammu and Kashmir. Punjab, Haryana, Delhi, Uttar-Pradesh, Madhya Pradesh Maharashtra, Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu.

National Highway 144

National Highway 144 is a national highway in state of Jammu and Kashmir in India NH-144 is a branch of National Highway 44. It passes through Domel, Katra, Riasi. Pauni and Bamla

National Highway 144-A

National Highway 144A is a national highway in State of Jammu and Kashmir in india NH 144A is a spur road of National Highway 44 which passes through Jammu. Akhnur, Naoshera Rajauri, Punch.

National Highway 244

National Highway 244 (NH 244) is a National Highway in India. It is located entirely within the state of Jammu and Kashmir. It was originally called National Highway 18. NH 244 starts at NH44 near Khanabal. Achabal, Kokernag, Daksum, Sinthan pass (Elevation: 3748 m). Chatroo, Kishtwar, Doda and terminates at NH44 near Batote. Our project road lies in this stretch from Khellani to Chatroo having project length of 96.050 Km.

National Highway 301

NH 301 is a national highway in India. It is a spur road of National Highway 1. NH-301 traverses the state of Jammu and Kashmir in India. It provides route for Kargl to Padum.

National highway 701

NH 701 commonly referred to as NH 701 is a national highway in India. It is a spur road of national highway 1. NH-701 traverses the state of Jammu and Kashmir in India. And it connects Baramulla- rafiabad-kupwara -tangdhar.

National highway 444

NH 444 is a national highway in India. It is a spur road of national highway 1. And it traverses through jammu and Kashmir connecting panchtarni-chandanwari-pahalgam-batakut-martand-Khanabal.

National highway 501

NH 501 is a national highway in India. It is a spur road of National Highway 1. And it traverses through Jammu and Kashmir connecting Panchtarni - Chandanwari - Pahalgam - Batakut- Martand – Khanabal.

Jammu-Srinagar National Highway

The Jammu-Srinagar National Highway is the northernmost segment of NH 44. It runs from Srinagar in the Kashmir Valley southward to the city of Jammu. It is one of the two road links that connects the Kashmir Valley with the rest of India. The tragic on the highway is controlled by two control rooms, one in Srinagar and the other in Jammu.

Udhampur Jammu highway

Udhampur Jammu highway is the national highway and the road in Jammu and Kashmir that connects municipal committee of Udhampur with Jammu City. The highway is 64 kilometer’s long passing through lofty mountain terrains. The highway also provides road link which connects Katra with rest of India. The highway is the small part of Srinagar Jammu National Highway.

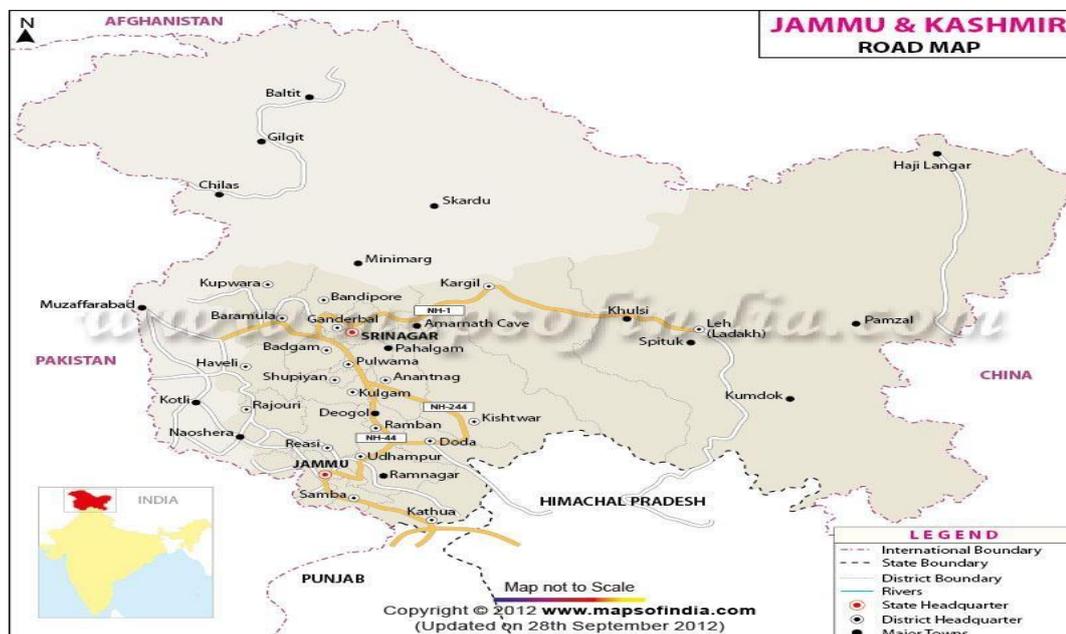


Fig 6.5: Jammu and Kashmir Road Map

Railways

Jammu & Kashmir have railway network of only 238.77 kms. The state government has recognized the crucial role of railways in the process of economic development and in response to that the government of India has also extended full cooperation in all respects by providing technical and financial support for developing railways links in the state at a very fast speed. The Jammu-Srinagar-Baramulla railway line is a railway track being laid to connect the Kashmir Valley in the Indian state of Jammu and Kashmir with Jammu railway station and hence to the rest of the country. This railway line will connect the state with mainstream of country and will lead to boost in trade, economy and tourism in the state.

The list of railway stations in J&K and Ladakh can be divided into 2 parts:

- **Railway stations in Jammu Region**
- **Railway stations in Kashmir Region**

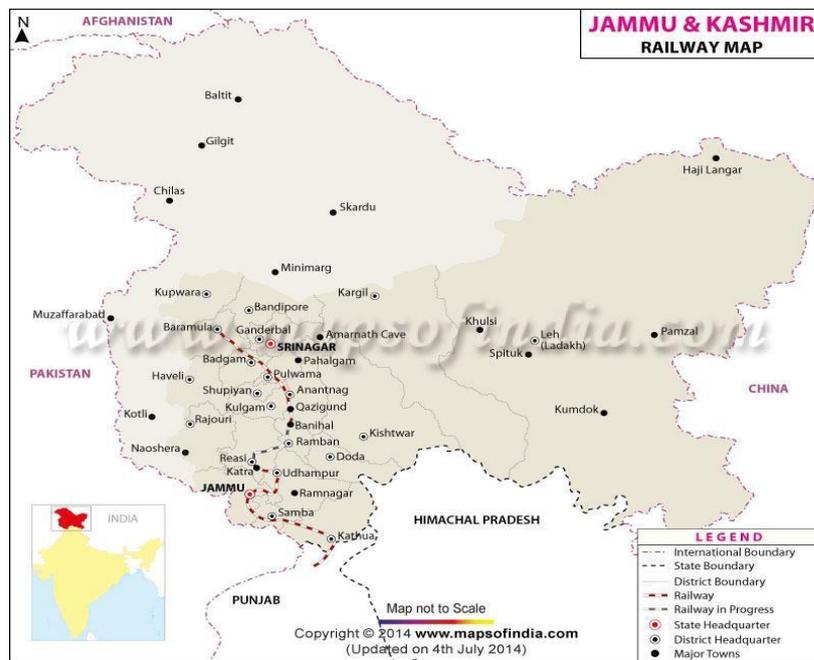


Fig 6.6: Jammu and Kashmir Railway Map

6.4.5 Trade and Tourism:

Jammu & Kashmir with its vast potential and growing economy has immense potential for the sustenance of the tourism industry. Tourism has historically remained an instrument of economic growth in the State of Jammu Kashmir and has contributed a lot in developing the economy, particularly in Kashmir Valley and Ladakh. This sector has given jobs to many people and generated economic activities especially in the tertiary sectors. Its impact is visible in-service industry sectors of the State such as transport, hospitality, horticulture and small-scale industry. The tourism activities at a particular place are directly related to the arrival of tourists at that place. The more the arrival, the more economic activities get generated and make impact on the related sectors accordingly. Tourist expenditure generates multiple effects on the service sector such as agriculture, horticulture, poultry and handicrafts.

Jammu & Kashmir is an important tourist destination and has been a place of attraction for tourists since centuries. The lush green forests, sweet springs, perennial rivers, picturesque alpine scenery and pleasant climate of Kashmir valley has remained an internationally acclaimed tourist destination, whereas Jammu region is attracting many pilgrim tourists and the important destination has been Shri Mata Vaishno Devi Shrine at Katra.

6.4.6 Industrialization in Project Influence Area:

Main industrial activity is concentrated in the Jammu and Kathua districts of Jammu division. This is mainly because Jammu is the only railhead, where loading and unloading of raw

material becomes easy and less cumbersome as compared to Kashmir region where transportation cost is higher. The Industry sector has been declared as the main vehicle for accelerating economic activity besides providing employment opportunities to the unemployed educated youth in the State. To attract investment, the State government has come up with a new eco-friendly industrial policy in 2004, which is valid until 2015. The industrial policy is designated to promote rapid industrialization and has evoked great deal of interest in the private investment. The policy has slew of incentives in the form of subsidies for all sorts of industries, especially for small-scale industries to make them capable of competing in the present market. The policy also lays emphasis on promoting industries based on local raw materials and skills. The State has set up two industrial growth centers one in Samba, Jammu and other in Lassipora, Pulwama with the assistance of Central Govt. under the centrally sponsored schemes.

The key industrial activity in J&K includes:

Horticulture

Floriculture

Handloom & Handicraft

Tourism.

Mineral based Industries.

Gem & Jewelry

Sericulture

Information Technology

Pharmaceuticals

Insecticides

Pesticides

Electronics

Hardware

The key industrial clusters are located at:

Industrial Complex Bari Brahmana, Jammu

Industrial Estate, Gangyal, Jammu

Industrial Growth Centre, Samba, Jammu

Industrial Infrastructure Development Project (IDP), Udhampur

Expert Promotion Industrial Park (EPIP) Kartholi, Jammu

Industrial Complex Rangreth, Srinagar

Industrial Complex Lassipora, Pulwama, Kashmir

Industrial Complex Khunmoh, Srinagar

Industrial Complex, Zainkot, Srinagar

Industrial Estate, Zakura, Srinagar

Industrial Growth Centre, Ompora, Budgam

Infrastructure

Housing

As per the census 2001 there were 155768 households in the state. The average household size is 6.5%. In urban areas, the average household size is little less i.e., 6.4%, the corresponding household size in rural areas is 6.6%.

Census 2001 has revealed that 55% of the households occupy permanent house whereas 32.16% resided in semi-permanent houses and 12.68% of household in temporary and unclassifiable houses.

Airports

Jammu and Kashmir have a very large area under mountainous topography, in difficult terrains like high mountainous areas of Leh and Kargil when road connectivity is disrupted during winter months due to heavy snowfall, the airways are the only source of access to such places. Airways connect all the three regions of the state with other parts of the country and abroad.

Out of the three airports of the state, Srinagar airport has been upgraded as international airport named as Sheikh-ul-Alam airport, whereas the facilities at Jammu and Leh airports are also being upgraded. One more airport at Kargil headquarters has been connected by decota service. Although some areas have been covered by helipads, the difficult terrain and scattered area in the state need more airports and better connectivity. For promotion of tourism in the state starting of air taxi services between Katra-Bhaderwah is also under the consideration.

6.4.7 Sources of Employment:

J&K has Agro-climatic conditions best suited for horticulture and floriculture. Horticulture is the mainstay of the rural economy, providing employment to large number of local inhabitants. The state's share in the overall apple production in India increased from 65.97 per cent in 2013-14 to 69.15 per cent in 2015-16, with the overall production of apple in the state reaching around 2.00 million metric tons (MT) in 2015-16. The state is also a major exporter of walnut & its international market share is about seven per cent.

At Current prices, the gross state domestic product (GSDP) of Jammu & Kashmir was US\$ 17,73 billion in 2015-16 and has expanded at a compound annual growth rate (CAGR) of 10.2 per cent from 2004-05 to 2015-16. As of November 2015, J&K had a total installed power generation capacity of 3,142.34 Megawatts (MW), comprising 1579.81 MW under central utilities, 1511.53 MW under state utilities and 51.00 MW under private utilities.

Key Sectors:

Food processing and Agro-based industries (excluding conventional grinding and extraction units) thrive in the state due to an excellent climate for horticulture and floriculture. Handicrafts have been receiving priority attention from the Government in view of its large employment base and exports potential. J&K is famous for its small-scale and cottage industries such as carpet weaving, silks, shawls, basketry, pottery, copper and silverware, papier-mâché and walnut wood. J&K SIDCO is the nodal agency for promotion and development of medium- and large-scale industries in the state. To boost infrastructure, J&K has approved funding of about US\$ 1.8 billion. Additionally, US\$ 120.07 million is earmarked under the Pradhan Mantri Gram Sadak Yojana during 2015-16.

6.5 Stakeholder Consultation

Definition of Stakeholder

Stakeholders are the individuals or groups that are likely to affect or be affected positively or negatively by a proposed project or activity. Stakeholders play a very important role in deciding the course of project implementation. It is very much essential to address the interests of the stakeholders in implementation of the proposed project and to modify/accommodate their views in the project plan or programmed. It is crucial to develop the co-operation between stakeholders the project team to ultimately achieve the successful completion of the project. Benefits of reaching out to stakeholders through surveys and one-on-one meetings consultations are:

- **Quality input leads to quality decision-making. A broader perspective reduces 'group think', helps to challenge traditional thinking and sparks creativity in problem solving.**
- **Greater stakeholder satisfaction with the final planning product comes from their involvement in shaping it.**
- **The chances of successful implementation increase as more stakeholders feel committed to the plan or project's goals and take ownership of the plan's design.**

- Good governance, transparency and open communication are served when we communicate and receive feedback from stakeholders, instead of being guided by personal agendas.

Types of Stakeholders Consulted for Feasibility / Screening Studies

In our present study, most important stake holders are the public living by or near the project road, Road development/construction department officials including project implementation unit, forest officials and NGOs working in the locality. These stakeholders hugely influence the process of project decision making

Stakeholders were identified to ensure as wide coverage as possible of the project area as follows:

- **Households in the project area including potential project Affected Persons**
- **Local voluntary organizations/ Non-government Organizations (NGOs)**
- **Government agencies /forest department**
- **Community leaders**

Questionnaire survey/discussions were designed to obtain background information and details of general environmental issues were discussed with relevant government officials, beneficiaries and community leaders.

6.6 Existing Key socio-economic issues and Risks of the Project

Poverty:

Since 1989, terrorist activity and violence have shattered peace and disrupted economic stability in Jammu and Kashmir. The constant threat to economic resources from rising militancy has led to its over-dependence on central government funding. Economic growth of the state measured in terms of per capita gross domestic product (GDP) from 2004-05 to 2013-14 was 12% per annum, at least 2 percentage points lower than the national average.

With this slow growth, the state could do very little to reduce the poverty rate during this period. As per the Tendulkar Committee's poverty estimates, poverty reduction in the seven-year period since 2004-05 has been merely three percentage points, from 13% in 2004-05 to 10% in 2011-12, compared with an average decline of 1s percentage points at the national level.

Though the extent of poverty (10%) in the state is not high relative to other states, a telescopic view shows chunks of poor population across the state. The eastern part of the state accounts for a large part of its poor population. The three districts, Jammu, Kupwara and Anantnag together account for one-third of the total poor in the state.

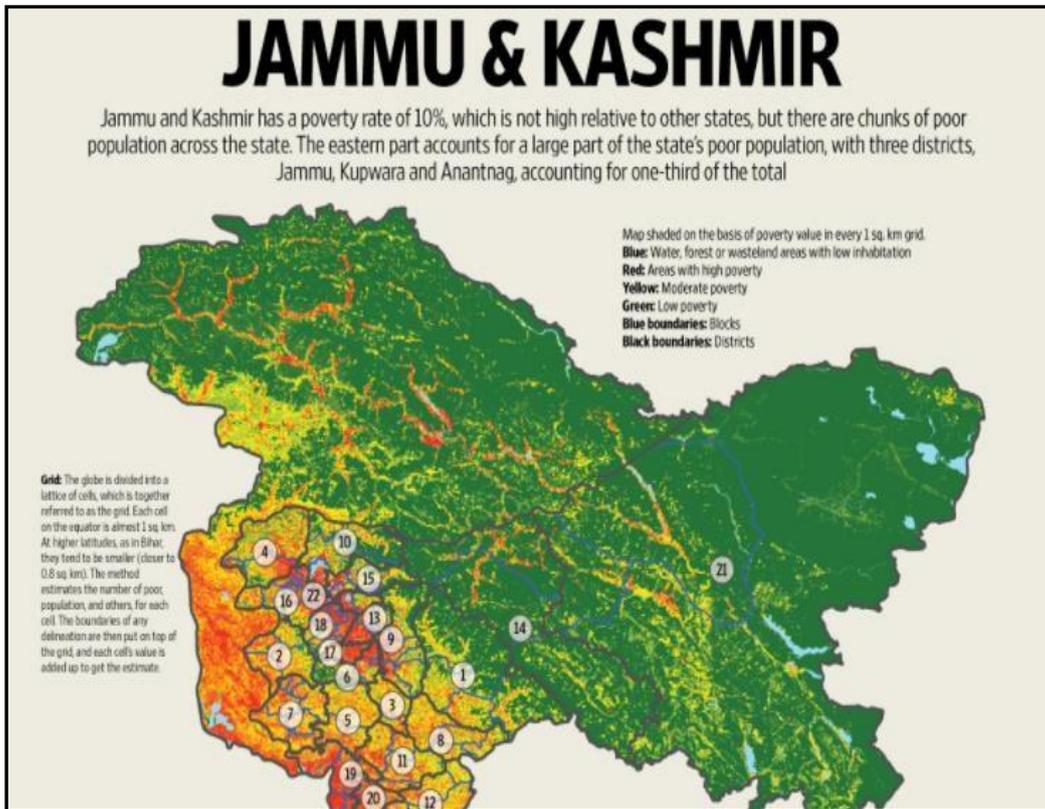
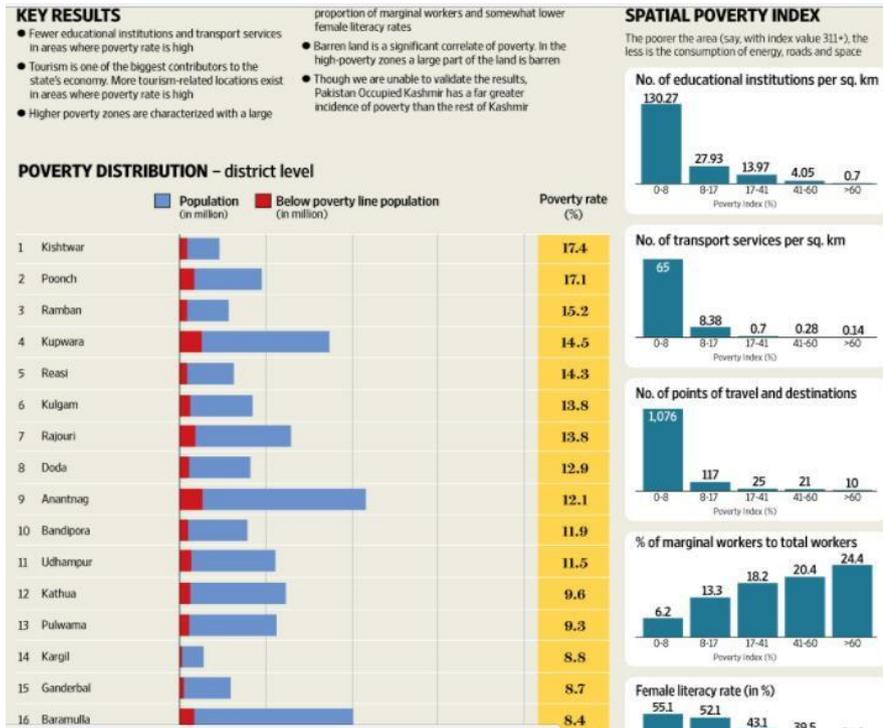


Fig 6.7: Poverty Index of Jammu and Kashmir



6.7 Access to government programs:

The government response:

The enforcement authorities at the district such as department of labor and police had Department Women and Children, Department of Education, Department of Civil Supplies hardly have any clue or data about the movement of people. In the process of human mobility, the migrants are let out from grassroots governance process and Stay away om Gram Sabha, General Elections, poverty survey and the ongoing Census operations and UID (Unique identification) is going to bypass lakhs of migrant unaccounted. In the past, thousands of hapless peoples include women, children and laborers were rescued in distress from various states are yet to be rehabilitated by the administration. Undoubtedly, the MNREGA and the array of food entitlement have the necessary element of reducing distress migration and poverty. While, the MNREGS can provide gainful employment and create livelihood assets, food security will be met from the food entitlements. However, it all depends whether the administration gears up the program and target it to address the distress situations. Till today, most of the programs are in state of despair and yet to full its key objectives. The government of India under its National Disaster Management Authority clearly laid down guideline's tor effective response and disaster management. All most every State today has a policy, plans and infrastructure towards mitigation and reduction of disasters and its effects.

The disaster risk reduction (DRR) mandate of the government is a well-articulated step towards making the community disaster resilient. It is often observed that, due to lack of preparedness and adequate relief and rehabilitation, poor people tend to move out to safer places and become vulnerable to migrate to far-flung areas. Hence, timely response and rehabilitation help the people to overcome the shocks of disasters. The impact of climate change on farmer, fishing communities and the forest dwelling communities will further alienate from their traditional livelihood and make them vulnerable to migrate to sustain their livelihood. Migration sometime regarded as alternative livelihood for the people. Due to rapid industrialization and infrastructure building, there is a huge demand and need for skilled person power requirement in various sectors. And finally, the migrant who are outside of the realm of social security, food security and various labor welfare measurers should be adequately addressed. Both the sending states and the receiving states need to have a proper coordination to create win-win situation for the migrants.

6.7.1 Other social issues and Risks to be managed under the project.

Women Empowerment:

Jammu and Kashmir is considered as one of the poorest states in India. Apart from high incidence of poverty, social and human development indicators reveal persistent gender, caste and class disparity. Women fare worse than men with respect to most of the indicators. The gender disparity is too glaring for any further neglect in development strategy; Educational improvements in the overall sense have been modest, yet these are expectedly socially skewed with the backward sections being most deprived. This reality affects the nature of women's labor market participation quite adversely. The vulnerability of women is also reflected by their lower participation rate in the labor market.

Poverty in Jammu and Kashmir is predominantly rural. A large proportion of the population is landless and near landless, and therefore most of the rural poor tend to depend on agricultural wages or casual non-farm jobs for income. Over the years seasonal migration of mainly male workers in search of alternative income opportunities has substantially increased. There have been some positive developments about the empowerment of women in the state. A very important development is the provision of 50 per cent reservation for women in all three tiers of the local bodies. This is a recent introduction and its impact on the lives of women has not been systematically examined so far.

6.8 Resettlement policy and Framework

Resettlement and Rehabilitation Framework

- Verify the legal boundaries of the Right of Way according to the revenue records
- Establish the likely types of economic and social impact on people including on private land, traditional and customary rights, lease land, common property resources, different usage
- Establish the cut-off date for entitlements; d) Carry out market surveys to establish the likely monetary allowances for each
- Entitlement; e) Carry out meaningful public consultation with project affected people and other
- stakeholders on the types of R&R measures to ensure that the livelihood of the affected people will be improved;
- Assess the capacity of Institutions to implement monitor and evaluate the R&R program

Prepare the draft R&R framework that is based on the following principles;

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs;
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons affected/displaced by the project to share in project benefits;
- Affected/displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs
- Affected/Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. This will be inclusive of full replacement cost for losses of assets attributable directly to the project, assistance during relocation, residential, commercial sites agriculture sites, transitional and subsistence allowance;
- Special provisions for the vulnerable to provide them with development opportunities

6.9 Land Acquisition and Budget

6.9.1 General

Land is the most vital resource of a region. It is a fixed asset and cannot be expanded to the need of an increasing population. Therefore, every effort is to be taken to achieve optimum land utilization. In a country like India where cropped land is at premium, land acquisition always has a negative impact on the population in general and agricultural population. Land acquisition is a major concern in a highway development project. In Indian situation, the settlements are normally compact and linear; if abetting a road, the land holdings are small and people have very close sentimental relationship with religious / worship places. Land acquisition for even a small width may have wider implications across the family. At the same time, development of infrastructure like highways is basic to the development of the regional and national economies and need to be developed even if some loss to properties and assets are involved. Generally, land acquisition in a highway project is done not only for the present requirement of road construction, but also considering the future requirement if land is available without eroding the social structure.

6.9.2 Social Management Framework and budget estimates.

Institutional Arrangements

Effective implementation of the RP will require joint efforts of the Collector of Districts; district administration; Land Acquisition Officer, revenue department engaged NGOS and CBOs; and affected communities and PAPs. The RP includes actions and commitments by GoB to coordinate the work of the districts block and village level committees, along with NGOS contracted. District

/block level R&R committees will be formed, consisting of the LAO, Tehsildar (Revenue Officer), Block Development Officer (BDO), Sub-Divisional Magistrate (SDM), Panchayats Samiti representative (Pradhan), NGO partners and CBO/PAP representatives with the District Collector as Chairperson.

Village/hamlet level R&R committees will also be formed to implement the RP activities in the field, consisting of Patwari, Gram Panchayats representatives/Sarpanch, PAPs/CBOs, NGOs and other stakeholders. All officers and staff appointed by the appropriate Government under this policy shall be subordinate to the Administrator for Resettlement & Rehabilitation. The State Government shall appoint an officer of the rank of Commissioner / Secretary of

that Government for resettlement and rehabilitation in respect of such projects to which this policy applies to be called the Commissioner for Resettlement & Rehabilitation. For this Policy, the Administrator for Resettlement & Rehabilitation and other officers and employees appointed for the purposes of resettlement and rehabilitation of PAPs shall be subordinate to the Commissioner for Resettlement and Rehabilitation.

The Commissioner shall be responsible for supervising the formulation of resettlement and rehabilitation plans / schemes, proper implementation of such plans/ schemes and redressal of grievances R &R Policy. Wherever tribal PAPs are involved, Commissioner, TW shall also be involved in above responsibilities and functions.

Entitlement: R&R Benefits for project affected families

The resettlement and rehabilitation (R&R) benefits shall be extended to all the Project Affected Families and Project Displaced Families (PAF) whether belonging to below poverty line (BPL) or non-BPL. Except to the extent where specifically restrictions mentioned in the policy.

Budget for RAP

To assess the budget for implementation of RAP, the cost estimate has been sub divided into costs of Private land, Private buildings, Transitional allowance, relocation of Community assets, development of Resettlement sites and Training & Administrative measures. The budget has been prepared based on the market rates as well as the official rates..

6.10 Environmental and Social Management & Capacity Building Consultant

Public Works Department, J&K appointed consultant at implementation stage for Environment Management & Capacity Building (EMCB). The consultant shall be responsible for

- Review institutional capacity of PWD, J&K and PIAs vis-à-vis environmental management in general and addressing environmental issues
- Identify organizational needs in terms of structure, resources (facilities, and staff), roles and responsibilities in PWD / PIAs.
- Develop and plan training programmer including:
- Identification of different training modules covering various courses at different levels (initial and recurring)
- Identification of trainers
- Development of training programs for each module

- Development of training material for each module (slides, videos and information support material)
- Planning a training schedule
- Development of a mechanism for training feedback assessment
- Conduct or organize training program according to the above program and provide feedback on the effectiveness of the training.
- Helping to develop uniform codes of practice for construction management for all PIAs that integrate all relevant environmental concerns upstream in subprojects (based on a review of what currently exists within the PIA's)
- Assisting in supervision of studies to be undertaken under the project, for example study on noise levels along the project road to be undertaken to map the noise levels with respect to sensitive receptors with a view to recommending adequate mitigation measures.

6.11 Recommendation and Conclusion

6.11.1 Recommendations

Keeping in view the general scope for socio-economical parameters and most importantly sustainable environment and economic development, the following confusions and recommendations have been drawn.

- Present road needs improvement as it needs to accommodate ever growing traffic.
- Road safety is a critical issue in the present scenario as there is a possibility of high rate of accidents. Also, critical sections identified are to be developed as “speed restriction zone”.
- In addition, local slow-moving traffic adds to the fast-moving traffic on NH, thus causing reduction in traffic speed and increased travel time. If existing national highway can be developed without considering the proposal of bypasses, then major R&R issues and conflict between pedestrian, non-motorized traffic, local traffic and through traffic will be the issue of concern both at present and future stage. Also, plenty of trees, sensitive receptors, religious properties and community properties are expected to have adverse effect.
- One of the major issues that surfaced during the public consultation was drainage of carriage way & drainage facility along the road side. This need to be developed to prevent houses/shops getting inundated during heavy rains.

Summary of Key Benefits from the sub-project / Project Intervention

Availability of adequate and quality infrastructure is a pre-requisite for rapid development of any economy. Region of the project road being one of the emerging economic & densely populated areas of Jammu and Kashmir, it has quite high traffic intensity on roads due to considerably increased growth. The existing road is not capable to cater to increasing traffic demand due to rapid development in project influence area.

Improvement in the project road will result in the following benefits:

- Providing better level of service in terms of improved riding quality and smooth traffic flow.
- Faster transportation will ultimately lead to massive savings in the form of reduced wear and tear of vehicles, reduced vehicle operating costs (VOCs) and total reduction in transportation costs etc. Mostly people of two the Anantnag district will get benefitted by this.
- Local people will get more benefit for all the point
- With the improvement of road surface, the traffic congestion due to obstructed movement of vehicles will be minimized and thus wastage of fuel emissions from the vehicles will be reduced.
- Introduction of additional safety measures like crash barrier, road illumination, retro-reflective boards, delineators etc. will result in lesser accidents.
- Increased passenger comfort due to good road condition shall be an added benefit.
- It will increase access of the villages and other small settlements to urban areas, thus providing connectivity of rural produce to urban markets, thereby Enhancing the reach and export of fresh able farm-goods, leading to better remuneration for the producer.
- The reach and export of perishable farm-goods will have quite a positive impact and this will prove to be a boon for the rural agricultural sector.
- Providing connectivity to the urban infrastructure.
- Rural industrial produce, whether from cottage industries, small-scale industries or medium-scale industries will have easy access to the urban markets. Especially silk industries in Bhagalpur are sure to get benefitted.
- Strengthening of rural economies: The rural sector / economy is sure to get strengthened, though at a gradual pace.

- Higher education: Education is one of the most dominant indicators towards the development of a region. Though primary education facilities are present along the project road, access to high schools, higher secondary schools and colleges is not so easy at present. Provision of easy access to higher education can be directly linked to the improved educational scenario.
- Access to medical facilities: Villages in the project region are not yet well equipped with all types of medical facilities and services like Public Health Centers (PHCS), dispensaries, hospitals. Due to inaccessibility, reaching even the nearest health center sometimes becomes a colossal task. Even the doctor's reluctance will be converted into willingness to visit these areas after widening and improvement of the project road.
- By reducing the transportation costs, it will be more feasible to transfer construction materials which are important for many economic activities (house building, school building, small hydro-electric, projects etc.) to hinterland. This will in turn, lead to direct as well as indirect strengthening of local economies.
- During the execution of the project, i.e. during the construction period, employment will be provided to workers from the local communities. The educated as well as uneducated people from villages will obtain access to new employment centers.
- The improvement of the road will reduce the number & frequency of collisions. This would be very beneficial from the safety point of view and will thus, reduce accident rate.
- Overall improved quality of life for the lesser developed areas in the neighborhood.

Value Addition

- Aesthetic enhancement: Landscaping & road side plantation.
- Wayside facilities: Truck-lay bays, footpaths etc.
- Bypasses, under/over bridges, raised carriageway.
- Better road safety, signage and improved road surface.

Key Recommendations from Stakeholder Consultation Exercise

Based on the stakeholder consultation, the following recommendations are made:

- Drainage of carriage way & drainage facility along the roadside need to be developed to prevent houses /shops getting inundated during heavy rains.
- Road safety features need to be upgraded to reduce/bring down the frequency and number of accidents

Summary Opportunities and Constraints at the sub-project Level

Opportunities:

With this project taking place, following opportunities are anticipated for the public:

- Improved road will indeed result in increased productivity, lesser transportation costs, lesser vehicle operating cost, increased access to urban markets for rural agricultural /nonagricultural products.
- Better connectivity to urban infrastructure for rural industrial products, there by strengthening rural economy.
- Better as to Health and educational facilities will lead to improved health and educational scenario in the project region. Also, this would be followed by many economic activities.

Constraints:

- There are many encroachments in the project road, so the process of widening the road at required sections may pose some opposition, as it will result in the loss of livelihood of some persons.
- Cost of land acquisition of non-forest land (Agri/non-agri) will be involved, to avoid huge R&R costs if the road is aligned in the existing densely populated settlements. This would further involve compensation amount given for displacement.

7.0 Environmental Impact Assessment of the Project Influence Area

7.1 Introduction

7.1.1 Project Description

The National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has **assigned M/S Technocrat Advisory Services Pvt. Ltd In association with Space Engineers Consortium Pvt. Ltd as Consultants** to carry out the "Consultancy Services for Preparation of Detailed Project Report for intermittent Two Lane plus Paved Shoulder stretches to Four Lane in between Design Km 148+589 (Existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir

The agreement was signed on 07 Nov 2024.

However, end point of the project stretch shall be Donipawa at existing km 176+532 as per direction of NHIDCL official. Start point at Vailoo (Existing Km 148+589) and end at Donipawa (Existing km 176+532 i.e. Start of the Vailoo - Donipawa).

7.1.2 Project Proponent

National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India

7.1.3 Description of the Project

The entire proposed project road is in the union territory of Jammu and Kashmir. The UT occupies a total area of 42,241 square kilometres. Jammu and Kashmir borders with the states of Himachal Pradesh and Punjab to the south and Ladkha to the east. Jammu and Kashmir has an international border with Pakistan on the east.

The Vailoo-Donipawa road section "Project Road" situated in west part of Jammu and Kashmir is having total Existing length of about 27.94 Kilometers. The consultants have proposed intermittent road stretches from Vailoo to Donipawa with design chainage km 0.00 to km 8.643 having total design length of 8.643 km. The project road has significant influence on Jammu and Kashmir, specifically on the Anantnag district since it lies entirely in that district. Jammu and Kashmir is located around 33.7782° N, 76.5762° E.

The Project Road starts from Existing Donipawa at existing km 176+532 as per direction of NHIDCL official. Start point at Vailoo (Existing Km 148+589) and end at Donipawa (Existing km 176+532 i.e. Start of the Vailoo – Donipawa passes through Wandevalgam, Zalangam, Bindoo, Bidder, Hangalgund, Dan Veth Pora, Sagam, Takia Ahamad Shah, Buchoo, Peertakia, Hiller, Hillar Arhama, Akingam, Badoora, Achabal, Koleh Garh, Thajiwara, Barakpora, Donipawa,

The surroundings of existing road stretch consist of vegetation, orchards and even built ups.

Table 7.1: Project road characteristics

Existing chainage		Road type	Carriage width	Earthen shoulder		Paved shoulder		Road way width	Pavement condition
Start	End			Left	Right	Left	Right		
148+639	148+689	Bitumen	7.00	0.00	1.00	1.50	1.50	11.00	Good
148+689	148+739	Bitumen	7.00	0.00	1.00	1.50	0.00	9.50	Good
148+739	148+790	Bitumen	7.00	0.00	1.00	1.50	0.00	9.50	Good
150+940	150+990	Bitumen	7.00	0.00	1.00	1.50	0.00	9.50	Good
150+990	151+040	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
151+040	151+090	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
151+090	151+140	Bitumen	7.00	1.00	1.00	1.50	0.00	10.50	Good
151+140	151+190	Bitumen	7.00	1.00	1.00	1.50	0.00	10.50	Good
151+190	151+240	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
151+690	151+740	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
151+740	151+790	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
151+790	151+840	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
151+840	151+890	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
151+890	151+940	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
151+940	151+990	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
151+990	152+040	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
152+040	152+090	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
152+090	152+140	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
152+140	152+190	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
152+190	152+240	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
152+240	152+290	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
153+490	153+540	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
153+540	153+590	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
153+590	153+640	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
153+640	153+690	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
153+690	153+740	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
153+740	153+790	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
153+790	153+840	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
153+840	153+890	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
153+890	153+940	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good

153+940	153+990	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
153+990	154+040	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
154+040	154+090	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
157+740	157+790	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
157+790	157+840	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
157+840	157+890	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
157+890	157+940	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
157+940	157+990	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
157+990	158+040	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+040	158+090	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+090	158+140	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+140	158+190	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+190	158+240	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+240	158+290	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+290	158+340	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+340	158+390	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+390	158+440	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+440	158+490	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+490	158+540	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+540	158+590	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+590	158+640	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+640	158+690	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+690	158+740	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+740	158+790	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+790	158+840	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+840	158+890	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
158+890	158+910	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
160+440	160+490	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
160+490	160+540	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
160+540	160+590	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
160+590	160+640	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
160+640	160+690	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
160+690	160+740	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
160+740	160+790	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good

Km 148+589 (existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir

160+790	160+840	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
160+840	160+890	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
160+890	160+940	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
160+940	160+990	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
160+990	161+040	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
161+040	161+090	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
161+090	161+140	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
163+740	163+790	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
163+790	163+840	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
163+840	163+890	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
163+890	163+940	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
163+940	163+990	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
163+990	164+040	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+040	164+090	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+090	164+140	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+140	164+190	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+190	164+240	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+240	164+290	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+290	164+340	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+340	164+390	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+390	164+440	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+440	164+490	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+490	164+540	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+540	164+590	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+590	164+640	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+640	164+690	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+690	164+740	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+740	164+790	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+790	164+840	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
164+840	164+890	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
166+990	167+040	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
167+040	167+090	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
167+090	167+140	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
167+190	167+240	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good

Km 148+589 (existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir

167+290	167+340	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
167+340	167+390	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
167+390	167+440	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
167+440	167+490	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
167+490	167+540	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
167+540	167+590	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
168+690	168+740	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
168+740	168+790	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
168+790	168+840	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
168+840	168+890	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
168+890	168+940	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
168+940	168+990	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
168+990	169+040	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+040	169+090	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+090	169+140	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+140	169+190	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+190	169+240	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+240	169+290	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+290	169+340	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+340	169+390	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+390	169+440	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+440	169+490	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+490	169+540	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+540	169+590	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+590	169+640	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+640	169+690	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+690	169+740	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
169+740	169+790	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
171+590	171+640	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
171+640	171+690	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
171+690	171+740	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
171+740	171+790	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
171+790	171+840	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
171+840	171+890	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good

Km 148+589 (existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir

171+890	171+940	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
171+940	171+990	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
171+990	172+040	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
172+040	172+090	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
172+090	172+140	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
172+140	172+190	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
172+190	172+240	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
172+240	172+290	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
172+290	172+340	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
172+340	172+390	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
172+390	172+410	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
173+890	173+940	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
173+940	173+990	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
173+990	174+040	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
174+040	174+090	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+090	174+140	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+140	174+190	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+190	174+240	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+240	174+290	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+290	174+340	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+340	174+390	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+390	174+440	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+440	174+490	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+490	174+540	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+540	174+590	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+590	174+640	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+640	174+690	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+690	174+740	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+740	174+790	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+790	174+840	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+840	174+890	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+890	174+940	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+940	174+990	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
174+990	175+040	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good

175+040	175+090	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
176+390	176+440	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
176+440	176+490	Bitumen	8.00	1.00	1.00	1.50	1.00	12.50	Good
176+490	176+532	Bitumen	7.00	1.00	1.00	1.50	1.00	11.50	Good
170+423	170+473	Bitumen	8.00	1.00	1.00	1.50	1.00	12.50	Good
170+473	170+523	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
170+523	170+573	Bitumen	8.00	1.00	1.00	1.50	1.50	13.00	Good
170+573	170+623	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
170+623	170+673	Bitumen	7.00	1.00	1.00	1.50	1.50	12.00	Good
170+673	170+730	Bitumen	9.48	1.00	1.00	1.50	1.50	14.48	Good

7.1.4 Over-View of Major Key Project Activities

The following major activities are involved for the design and construction of proposed project road:

- a) Widening
- b) Geometric Improvement
- c) Proposed Pavement & Overlay
- d) Traffic Control and Safety Measures
- e) Bridge and Cross Drainage Structures

7.1.5 Need for the Project Activities

Widening:

Most of the stretch is being widened (concentric widening and eccentric widening)

Requirement of widening

The concept of alignment design is to upgrade the project highway within the existing right of way avoiding land acquisition, except for locations having inadequate width and where provision of short bypass, service roads, alignment corrections, improvement of intersection are considered necessary, practicable and cost effective. These are based on the findings from various engineering features carried out on the project roads such as Reconnaissance Survey, future traffic requirement, Inventory Data and Pavement Investigations.

Proposed Pavement

The Flexible pavement is adopted for proposed new carriageway, and reconstruction. Design period of 20 years considered for new carriageway.

Traffic Control and Safety Measures

Road Marking & Traffic Signs:

Pavement markings are proposed as per IRC: 35-2015, "Code of Practice for Road Marking" with centerline, edge line, continuity line, stop line, give way lines, diagonal/chevron markings and zebra crossings. The pavement marking shall be of hot applied thermoplastic paint with glass beads as per the MoRT&H specification for Road and Bridge Works, 2013(5th Revision, latest reprint).

Appropriate road safety measures are provided with stop signs, give-way signs, traffic merging and diverging signs, lane closure signs, compulsory keep left/right signs or any other signs as

per IRC-67. Advance cautionary signs are proposed for sharp curves along with chevron signs at the outer edge of the curves.

Proposal for Truck Lay byes/Parking cum Rest Area

As per the detailed field surveys and reconnaissance, truck lay bay/ Parking cum rest areas are not proposed in this stretch.

Toll Plazas and Weighing Stations

No Toll Plaza is proposed for the entire length of the project road.

Bridge and Cross Drainage Structures

There are 9 numbers of existing minor bridges and 01 existing Major bridges exists along the project road.

Culverts

There are 01 Pipe culverts and 35 box culverts on existing project road

7.1.6 Expected benefits from the projects:

Following are the expected benefits due to the improvement in the project road:

- Better level of service in terms of improved riding quality and smooth traffic flow.
- Faster transportation will ultimately lead to massive savings in the form of reduced wear and tear of vehicles, reduced vehicle operating costs (VOCs) and total reduction in transportation costs etc.
- With the improvement of road surface, the traffic congestion due to obstructed movement of vehicles will be minimized and thus wastage of fuel emissions from the vehicles will be reduced.
- Increased road landscaping and safety features.
- Enhanced connectivity between rural & urban population which will benefit the all sections of the society like general population, small-medium-large scale industries, farmers, businessmen etc.
- Improved access to higher education facilities & modern health facilities.

- Strengthening of both rural & urban economies which in turn will improve economic scenario of the state and country.
- Improved road connectivity helps in better implementation and management of government schemes.
- With Improvement in economy, more generation of employment opportunities.
- Overall improvement of the region.

7.1.7 Various studies/reports being prepared for the project and how the environment screening study relates to feeds into the overall project preparation.

- Various studies/reports being prepared for the project.
 - Inception Report
 - QAP
 - Feasibility Report which includes Environmental Screening
 - Environmental Impact assessment & Social Impact Assessment Reports.
 - Detailed Project Report.
- The environment screening study relates to feeds into the overall project preparation at various stages.

The various activities / components involved in the project include design process and construction activities. Some of the major activities likely to take place to implement the proposed up-gradation / improvement project are: Site clearing & grubbing, earthwork, pavement removal, granular sub-base, water bound macadam sub-base / base, bituminous pavement layers, pavement widening, drainage, safety measures, bridge & culvert improvement, waste material management, equipment staging & materials, aggregate and sand quarries etc. These major activities have been considered while finalizing the methodology for the impact assessment of the project.

Table 7.3: Details of Environment Feature

Project Component for Design Alignment	Details of Env. Features
Geometric Design & Cut / Fill Balance.	Final alignment should be determined to minimize land take, air pollution, and the impact on people and animals and to avoid unfavourable geological condition and cultural relics. Unusable debris shall be disposed at nearest disposal sites as approved by engineer.
	The design should attempt to equalize cut and fill. The centreline should be aligned so that on all slopes below 60 degrees, half cut, and half fill can be achieved.
	The improvements to the road section may involve the cutting of some hill slopes. At few locations, amount of cut and fill work expected to be significant mainly at curves and bridge locations.
Ecology	
Roadside Plantation	Trees to be cut within the alignment shall be identified/marked with the help of forest department.
	Trees shall be removed as identified and with prior approval of the State Forest Department.
Water	
Water Sources	Water resources shall be protected and enhanced by redesigning as per Enhancement measures plan.
Road Drainage	Provision of adequate size and number of cross-drainage structures (culverts) as well as drains along the road.
Quarries and borrow area	
Illegal and / or improper mining.	Only approved and licensed Quarries and Borrow pits shall be permitted
	Non-Productive, barren lands, raised lands, riverbeds are to be recommended for borrow material after approval of SEIAA or concern authority.
Location of camps	

Site selection/ location of labour camp / Construction camps.	Labour Camp/Construction camps should be located at least 500 m away from existing habitations.
	All sites used for camps should be adequately drained and they should not be subjected to periodic flooding.
	Camps should be located such that drainage from and through the camps will not endanger any domestic or public water supply.
	Living accommodation and ancillary facilities should be erected and maintained to standards and scales approved by the Engineer.
	Toilets and urinals should be provided in accessible places away from the asphalt plant and mixing yard.
	Construction Camp should not be placed in ecologically sensitive areas.
Utilities	
Relocation of utility lines / community utilities.	Affected utilities like electric poles, water pipelines, hand pumps, etc. shall be relocated with prior approval of the concerned agencies.
	All the cultural properties that have been identified as affected shall be relocated.
Road Safety	
Traffic control system.	Temporary traffic arrangement during construction shall be planned in DPR.
	The concessionaire shall take all necessary measures for the traffic during demolition and site clearing activities.
Pedestrian safety.	Special considerations shall be given in the local traffic management to the pedestrian safety Especially at congested locations.
Environmental Quality	
Clearance/permission for establishment of Hot mix plants/Batching plants etc.	NOC from State Pollution Control Board / statutory authorities.
	NOC for quarry sites.
	Improved traffic speeds and riding conditions shall reduce noise levels.

Noise Level For Hot mix plant and construction machinery &At sensitive receptors.	Noise screening by trees plantation scheme proposed as noise barriers.
	Provide noise attenuation at critical locations like Hospital, school etc.
Generation of Debris from Dismantling Structures and Road Surface.	Vegetation will be removed from the Row before the commencement of construction. All works will be carried out such that the damage or disruption to flora other than those identified for cutting is minimized.
	Only ground cover/shrubs that impinge directly on the permanent works or necessary temporary works will be removed with prior approval from the Environmental Expert, of supervision consultant (SC). The concessionaire, under any circumstances will not damage trees (in addition to those already identified to be cut). Compensatory plantation will be provided for cutting of trees.

7.2 Methodology Adopted for Environment Screening Exercise

7.2.1 Purpose/Objectives of the Environment Screening Exercise:

Screening is the first stage of the EIA process. The screening procedure is necessary because of highway project (Development of Roads) and related activities that are potentially subject to EIA. It is intended to ensure that the form or level of impact on Environmental parameters review is commensurate with the importance of the issues raised by a proposal.

The conduct of screening thus involves making a preliminary determination of the expected impact of a proposed project of rehabilitation and widening of highway on the environment and of its relative significance. A certain level of basic information of the proposed project and its location is required for this purpose.

The screening process can have one of four outcomes:

- No further level of EIA is required.
- A full and comprehensive EIA is required.
- A more limited EIA is required (often called preliminary or initial assessment);

- Further study is necessary to determine the level of EIA required (often)

Screening establishes the basis for scoping, which identifies the key impacts to be studied and establishes terms of reference for an EIA. EIA systems have screening and scoping procedures. On occasion, the screening and scoping stages may overlap if a further study is undertaken to determine if the potential impacts are significant enough to warrant a full EIA.

7.2.2 Methodology (Step by Step Process) adopted for Environmental Screening

Exercise:

The requirements for screening and the procedure to be followed are often defined in the applicable EIA law or regulations. The screening is being done prior to development of the project so that the proponent and other participants are aware of the EIA obligations. It should be applied systematically and consistently so that the same decisions would be reached if others conducted the screening process.

Specific methods used in screening include:

- Legal (or policy) approach for the applicability of EIA;
- Inclusion list of projects (with or without thresholds) for which an EIA is automatically required.
- exclusion list of activities which do not require EIA because they are insignificant or are exempt by law (e.g. national security or emergency activities); and
- Criteria for case-by-case screening of proposals to identify those requiring an EIA because of their potentially significant environmental effects.

In this context, screening is a flexible process and can be extended into preliminary forms of EIA study. These 'extended screening' procedures include:

- Initial environmental examination carried out in cases where the environmental impacts of a proposal are uncertain or unknown (e.g. new technologies or undeveloped areas);
- Environmental overview carried out as a rapid assessment of the environmental issues and impacts of a proposal; and

- Class screening carried out for a family of small projects or repetitive activities, where the environmental effects and means of mitigation are known but there is potential for cumulative impacts (e.g. dredging, road realignment, bank stabilization).

Study Methodology:

The World Bank operational manual for piloting of the social and environmental safeguard policies procedures & practices and following Government of India's guidelines are reviewed.

- "Environmental Guidelines for Selected Infrastructure Projects".
- "Project Terms of Reference (TOR)".
- "Environmental guidelines for Road/Rail/Highway Projects", Government of India, 1989
- "Handbook of environmental procedures and guidelines", 1994, Government of India
- "Guidelines for Environmental Impact Assessment of Highway Projects" (IRC: 104-1988); and
- The Environmental (Protection) Act, 1986 and EIA Notification 2006 dated 14th September 2006.

The study is being carried out in following stages:

- The baseline environmental information in the study area viz., climate, physiographic features, drainage, geology, flora, fauna, ambient air, water and noise and socio-economic conditions.
- Reviews of literature, laws and guidelines and discussions with concerned agencies and organizations, National/State Authorities and on-site;
- Reconnaissance survey along with public consultation was undertaken (in the months of July-August 2015 and processes of public consultation continued till the completion of study) to inform the people about the project and collect the information / suggestions on environmental issues. The environmental data was collected within a corridor of 200 meters of centre of road. The vegetation analysis was done by counting the number of trees within corridor of direct impact and observing the vegetation density along the project road;
- Interaction with other members of the Project Team to ensure that environmental considerations were given adequate weight in project planning and design data and other material from the Inception and Feasibility Reports have also been used for the preparation of this report; and

- The monitoring network regarding air, water and noise pollution.
- Assessment of the potential significant impacts and identification of the mitigative measures to address impacts adequately.
- The study of analysis of alternatives incorporating environmental concerns including 'Existing' and 'Proposed' project scenario and modification in the proposed project due to environmental considerations.
- The preparation of the "Environmental Screening" report.

8.0 Improvement Proposals and Design

8.1 General

This chapter describes the various improvement proposals and their necessities to upgrade the existing carriageway facility of project road, if any, into two lanes with paved shoulder, four lane carriageway and four lane divided carriageway or for new alignments/bypasses, in accordance to the Indian standard configuration and design standards proposed for the project road. These improvement proposals are based on the findings of various engineering features carried out on the project roads such as Traffic Survey and Analysis (Chapter-3), Inventory Data and Pavement Investigations (Chapter-4).

The improvement proposals for proposed widening include the provisions for the following major items:

- a) Curvature Improvement
- b) Realignment
- c) Widening Proposal
- d) Proposed Pavement Design
- e) Bridge and Cross Drainage Structures
- f) Traffic Control and Safety Measures

8.2 Design standards

8.2.1 Summary

Following is a summary of the recommended design standards proposed to be adopted for the project road/bypass other than service road and intersections

Summary of Recommended Design Standard			
Design Standards			
(i)	Design Speed (Km/hr) as per IRC SP:84-2019		Plain & Rolling Ruling 100 Kmph & Minimum 80 Kmph Mountainous and Steep Ruling 60 Kmph & Minimum 40 Kmph
	Plain/Rolling Terrain	:	80Kmph - 72% 60-65 Kmph - 7% 50 Kmph - 5% 40 Kmph - 16% Remarks: - Existing Geometry to be followed at few locations.
(ii)	Level of Service	:	
(iii)	Roadway Widths (m) as IRC SP:84-2019		22m
	Plain/Rolling Terrain	:	7 m divided 2-lanes carriageway in urban area both side, Footpath cum Drain of 1.5 m along with utility corridor 2.0m. Remarks: - Existing typical section to be followed.
	Mountainous Terrain	:	7 m divided both side for 2-lanes carriageway in urban area, Footpath cum Drain of 1.5 m with one side hill and one side valley.
(iv)	Roadway Elements as IRC SP: 84-2019 Plain/rolling Terrain with Paved and earthen shoulders either side.	:	Carriageway 4-lane-2X7.0m Footpath cum Drain : 2x1.5 m Earthen Shoulder: NA

(v)	Camber as per IRC SP:84-2019	:	Carriageway Flexible- 2.50% Rigid - 2.00% Paved Shoulder Flexible-2.50% Rigid - 2.00% Unpaved Shoulder Flexible-3.50% Rigid - 3.00%
(vi)	Right of Way	:	As the Alignment follows Existing ROW ,at few locations Land is Required for improving Geometry E-ROW varies From 26 m to 28m
(vii)	Embankment/Cutting Slope	:	
	Fill height, up to 3.0 m		In filling-1V: 2H
	Fill height from 3.0 m to 6.0 m		In filling- 1V: 1.5 H
	Fill height exceeding 6.0 m		To be designed based on soil parameters, (IRC:75-2015)
(viii)	Stopping Sight Distance	:	20 m for design speed of 20 km/hr
			25 m for design speed of 25 km/hr
			30 m for design speed of 30 km/hr
			40 m for design speed of 35 Km/hr
			45m for design speed of 40km/hr
			60 m for design speed of 50km/hr
	Intermediate sight distance	:	40 m for design speed of 20 km/hr
			50 m for design speed of 25 km/hr
			60 m for design speed of 30 km/hr
			80 m for design speed of 35 Km/hr
			90 m for design speed of 40km/hr
			120 m for design speed of 50km/hr
(ix)	Super-elevation	:	
	(As per IRC SP:84-2019)		7%, if radius of curve is less than 400 m 5%, if radius of curve is more than 400 m

	Radii for Horizontal Curves as per IRC		
(x)	Plain/Rolling Terrain		Ruling Minimum 400 m Absolute minimum 250 m Remarks: - Existing Geometry to be followed at few locations.
(xi)	Gradient		
	(As per IRC SP:84-2019) Clause No-2.9.3		
	Plain/Rolling Terrain		
	Ruling		2.50%
	Limiting		3.30%
	Mountainous Terrain		
	Ruling		5.00%
	Limiting		6.00%
	Steep Terrain		Ruling 6.00% & Limiting 7.0%
(xii)	Minimum k factor		
	Summit Curve		
	Plain/Rolling Terrain		Desirable: 135 Minimum: 60 Remarks :-Adopted Based On Design Speed
	Valley Curve		
	Plain/Rolling Terrain		Desirable: 41.5 Minimum: 25.3 Remarks :-Adopted Based On Design Speed
(xiii)	Bridge Clearance		
	Vehicular underpass		5.50% (NA)
	Light and Smaller Vehicular Underpass		4%
(xiv)	Design flood frequency		
	Bridges		100 years
	sewers and ditches		60 years

8.2.2 Road Functional Classification

National Highways & Infrastructure Development Corporation Limited (NHIDCL), Ministry of Road, Transport & Highways, Govt. of India has been assigned the work of preparation of feasibility study / DPR and providing pre-construction services of road stretches/ corridors for up-gradation to four laning.

Consultancy Services for Preparation of Detailed Project Report for intermittent Two Lane plus Paved Shoulder stretches to Four Lane in between Design Km 148+589 (Existing Km 235+070) (Vailoo) to Design Km 176+532 (Existing Km (263+070) Donipawa of 8.643 Km Length on Khellani-Khanabal Section of NH-244 in the UT of Jammu and Kashmir

8.2.3 Geometric Design

8.2.3.1 General

Geometric design of a highway is the process whereby the layout of the road in specific terrain is designed to meet the needs of the road users keeping in view the road function, type and volume of traffic, potential traffic hazards and safety as well as convenience of the road users. The principal areas of control for fulfillment of this objective are the horizontal alignment, vertical alignment and the road cross-section.

The Consultants have referred to the latest IRC publications and MORT&H circulars regarding design standards for National Highways in India. After careful review of all available data and requirements of the project road the proposed Design Standards for adoption on the project road have been recommended.

8.2.3.2 Design Speed

The project road passes mainly through plain terrain. For geometric design of the highway, design speed is used as an index which links road function, traffic flow and terrain. An appropriate design speed should correspond to general topography and adjacent land use. The speed selected for design should also cater to travel needs and behavior of the road users.

The ruling design speed corresponding to the type of terrain as per IRC: SP: 84-2019.

Table 8.1: Design Speed Standards

Terrain Classification	Design Speed (km/h)	
	Desirable	Minimum
Plain & Rolling	100	80
Mountainous & Steep	60	40

8.2.3.3 Levels of Service (LOS)

The Level of Service (LOS) characterizes the operating conditions on the roadway in terms of traffic performance measures related to speed and travel time, freedom to manoeuvre, traffic interruptions, and comfort and convenience. The levels of service range from level-of-service A (least congested) to level-of-service F (most congested). The Highways Capacity Manual (HCM) provides the following levels of service definitions:

Table 8.2: Standards for Level of Service

Level of Service (LOS)	General Operating Conditions
A	Free flow
B	Reasonably free flow
C	Stable flow
D	Approaching unstable flow
E	Unstable flow
F	Forced or breakdown flow

Considering the importance of the highway, whereas Level of Service (LOS) 'B' is desirable and level of service up to LOS-'C' may be acceptable.

8.2.3.4 Cross Sectional Elements

Adequate roadway width will be provided for the requisite number of traffic lanes besides the shoulders and a central median dividing the traffic flow directions. As specified in the IRC: SP-84-2019 in general, standard lane width shall be 3.5m for project highway. Based on a

comparative review of international standards and safety, the values proposed to be adopted for the roadway elements by the Consultants for the project highway are as follows:

a) Roadway Width for Four Lane Highways

Table 8.3: Road Cross Section (Plain/Rolling terrain)

Item	Two-Lane with Paved Shoulder
Carriage width	2X7.0m
Paved shoulder	0 m
Unpaved shoulder	0m
Total Roadway width	14 m

b) Lane Width

Lane width has a significant influence on the safety and comfort of the road. The capacity of a roadway is marked by affected by the lane width. In general, safety increases with wider lanes up to a width of about 7 m. The lane width as per IRC: SP 84: 2019 is 7 m.

Experience shows that operating speed normally remains less than the design speed because of the partially access controlled facility and the other ambient conditions. Based on this assumption a 3.5 m lane width is proposed. This also concurs with other National Highways in India currently under construction.

c) Shoulders

Shoulders are a critical element of the roadway cross section. Shoulders provide recovery area for errant vehicles; a refuge for stopped or disabled vehicles; and access for emergency and maintenance vehicles. Shoulders can also provide an opportunity to improve sight distance through cut sections.

According to IRC: SP 84-2019 for two lane highways the normal shoulder width shall be 2.5 m paved shoulder on either side for plain terrain.

d) Pavement Camber (Cross fall)

IRC: SP 84: 2019 recommends the following camber for various surface types:

Table 8.4: Provision for Cross Fall

Category of surface	Annual Low rainfall (less than 1500 mm) (%)	Annual High rainfall (more than 1500 mm) (%)
Bituminous	2.5	2.5
Cement Concrete	2.0	2.0
Metal/Gravel	2.5	3.0
Earth	3.0	4.0

Considering of bituminous surfacing (bituminous concrete) the Consultants propose to provide a camber of 2.5% for the main carriageway as well as paved shoulders and 3.5% for the unpaved shoulder.

e) Land Width (Right of Way)

The IRC: SP:73-2018 has specified following land width values or Right-of Way for National Highways:

Table 8.5: Provision for ROW

Right of Way (m)	Normal
Open Areas (Improvement)	60
Built-up Areas (Improvement)	60
New Bypasses	60

It may be noted that the provisions stipulated above corresponds to the carriageway configuration of Two-Lane Highway.

In built up areas the ROW will depend on the adjacent land strip available for development.

f) Embankment Slopes

The slope of embankment is linked with its height. In accordance with the Manual for Safety in Road Design (MoRT&H publication), the following are proposed to be adopted:

Ht of embankment 4.5 m and above	2 H: 1V with crash barriers
Ht of embankment 3 m to 4.5 m	2.5 H: 1 V
Ht of embankment 1.5 m to 3 m	3H:1V
Ht of embankment less than 1.5 m	4H:1V

As per IRC: SP 84: 2019 the side slopes for embankment shall not be steeper than 2H: 1V unless soil is retained by suitable soil retaining structure. The side slopes of cutting shall be provided in accordance with the nature of soil encountered. The slope shall be stable for type of strata. Where required, benching including use of slope stability measures like pitching, etc. shall be adopted to make the slopes stable and safe.

The Consultants propose to provide slopes of 2H: 1V in Fill sections. Cut slopes are proposed as 1H: 1V in general however, these sections will be specifically analyzed for stability before adopting this slope or steeper slopes.

8.2.3.5 Horizontal Alignment

a) General

For balance in highway design, all geometrical elements should be determined for consistent operation under the design speed in general. A horizontal alignment should be as smooth and consistent as possible with the surrounding topography. To achieve that, an appropriate blending with the natural contours is preferable to the one with long tangents through the terrain.

b) Sight Distances

Visibility is an important requirement for the safety of travel on roads. For this it is necessary that sight distance of adequate length is available in different situations, to permit drivers enough time and distance to control their vehicles so that chances of accidents are minimized. Sight distance is a direct function of the design speed. On divided highways, the design should correspond to Stopping Sight Distance, which is the clear distance ahead needed by a driver to bring his vehicle to a stop before meeting a stationary object in his path. On two-lane roads, normally intermediate sight distance should be available throughout for design purposed. In stretches where even intermediate sight distance is not available, safe stopping site distance should be provided with traffic signs depicting "Overhead prohibited at all such locations.

Sight distance corresponding to various design speeds are given below.

Table 8.6: Sight distance for various Speeds

Design Speed	IRC: SP:84-2019	
	Km/h	Minimum sight distance
40	90	165
60	180	340
80	260	470
100	360	640

It is desirable to design the highway for more liberal values for operational convenience. An appropriate allowance would be considered to take care of the effect of adverse incidents. The value recommended by IRC & guidelines are proposed to be adopted in design.

c) Horizontal Curve

The minimum horizontal curve radius is the limiting values of curvature for a given design speed and is determined based on from the maximum rate of super elevation and the side friction factor. As per the IRC: SP:84-2019 the minimum ruling radii of Horizontal curve for National Highways corresponding to different terrain conditions are as follows:

Table 8.7: Horizontal Radii Criteria

Type of terrain	Minimum radii of horizontal curve	
	Desirable minimum	Absolute minimum
Plain	400	250
Mountainous	150	75

Absolute minimum and ruling minimum radii correspond to the minimum design speed and the ruling design speeds respectively.

On new roads, horizontal curves are designed with liberal radius provision that blends well the overall geometry and topography. However, for locations with constraints and to make use of available roadway, it is proposed to keep minimum radius in accordance with the IRC recommendations. The horizontal curve detail is given in **Annexure 8.1**.

Table 8.8: Adopted Horizontal Radii

Speed (km/h)	Absolute minimum radius (m)
100	400
80	250
65	155
50	90

d) Transition (Spiral) Curves

The purpose of a transition (spiral) curve is to provide a smooth and aesthetically pleasing transition from a tangent and a circular curve. In addition, the transition curves provide the necessary length for attainment of super-elevation runoff.

The IRC:SP:84-2019 and IRC:38-1988 design standards suggest 115 m and 55 m transition curve lengths for circular curves of radii 400 m (design speeds of 100 km/hr, 80 km/) and 90 m and 50 m transition curve lengths for circular curves of radii 250 m (design speeds of 80 km/hr, 65 km/). The AASHTO (2001) design guidelines specify transition curve lengths of 72 m, 65 m and 50 m, and the TAC (1999) design guidelines recommend transition curve lengths of 80 m, 80 m and 50 m for curve radii of 440 m, 250 m, 90 m (design speeds of 100 km/hr, 80 km/hr and 50 km/hr) respectively.

e) Extra Width of Pavement and Roadways

Since the project road is of two-lane categories extra widening is necessary on curves having radius less than 300 m to counter balance mechanical and psychological disorder of the vehicle. Extra widening is achieved by increasing the width at a uniform rate along the curve. On curve having no transition, widening is achieved in same way as super elevation L_e , two third is being attained on the straight section before start of the curve and one third on the curve. In hill roads. And on curves without transitions extra widening is provided on inner side of the curve. As per IRC: SP: 73-2018, the extra widening shall be increased as follows:

Table 8.9: Extra width of Pavement and Roadway

Radius of curve	Extra width
75-100m	0.9m
101-300m	0.6m

The value and guide lines recommended by IRC are proposed to be adopted in design.

f) Super-elevation

7%, if radius of curve is less than 400 m (Desirable Minimum), 5%, if radius of curve is more than 400 m (Absolute Minimum) as per IRC: SP: 84-2019.

g) Service Road Standards

There is No Service Road in the Project stretch.

8.2.3.6 Vertical Alignment

a) General

The vertical alignment should produce a smooth longitudinal profile consistent with standard of the road and of the terrain. Wherever possible horizontal and vertical curvature should be so combined that the safety and operational efficiency of the road is enhanced.

b) Gradients

The IRC: SP 84: 2019 the vertical Gradient is as follows:-

Nature of Terrain	Ruling Gradient	Limiting gradient
Plain and Rolling	2.5%	3.3%
Mountainous	5.0%	6.0%
Steep	6.0%	7.0%

proposes ruling vertical grades of 2.5% for plain/rolling terrains; however, for the project road, the following standard is proposed.

Table 8.10: Vertical Gradient

Terrain	Ruling (%)	Limiting (%)
Plain	2.5	3.3
Mountainous	5.0	6.0

c) Vertical Curves

As per IRC: IRC:SP:84-2019 and IRC: SP:23-1993 design standards, the minimum lengths of vertical curves are 60 m and 50 m for design speeds of 100 km/h and 80 km/h respectively and are 40 m and 30 m for design speeds of 60 km/h and 50 km/h respectively. At complex locations such as interchanges and major intersections the minimum lengths of vertical curves should be designed for safe decision sight distance. The length of a vertical curve is calculated using the following equation:

$$L=K \times A,$$

Where

L =Length of vertical curve in meters;

K= Coefficient, a measure of the flatness of a vertical curve; and

A =Algebraic difference of grade lines (%)

Summit or Crest Curves

According to AASHTO (2001) design guidelines, the minimum K values for stopping sight distance requirements are 52, 26 and 7 for design speeds of 100 km/hr, 80 km/h and 50 km/hr respectively.

According to TAC (1999) design guidelines, the minimum K valves for stopping sight distance requirements are 45 to 80, 24 to 36 and 6 to 16 for design speeds of 100 km/hr, 80 km/hr and 50 km/hr respectively.

The Consultants propose minimum summit curve K values of 75, 35, 20 and 15 for design speeds of 100 km/hr, 80 km/hr, 65km/hr and 50 km/hr respectively.

Valley or Sag Curves

The minimum K values for valley or sag curves, in accordance with AASHTO (2001) design guidelines are 45, 30 and 13 for design speeds of 100 km/hr, 80 km/hr and 50 km/hr respectively. The minimum K values for valley or sag curves, in accordance with TAC (1999) design guidelines are 37 to 50, 25 to 32 and 7 to 16 for design speeds of 100 km/hr, 80 km/hr and 50 km/hr respectively.

The Consultants propose minimum sag curve K values of 42, 30, 20 and 15 for design speeds of 100 km/hr, 80 km/hr, 65km/hr and 50 km/hr respectively.

Table 8.11: k values for summit and valley curve

Terrain categories	K-values of summit curves		K – values of valley curves		Minimum length of curve (m)
	Desirable	Minimum	Desirable	Minimum	
Plain	74	38	42	28	60
Rolling	38	18	28	18	50
Mountainous	8	5	10	7	30

8.2.4 Design Standards for Structures

The design of new structures shall be based on the following materials and loading-

8.2.4.1 Materials

Concrete Grade

The minimum Grade of concrete in various elements shall be as under for moderate conditions of exposure:

Major bridge		Minor bridge/culvert
ALL RCC	M 35	M 30
ALL PCC	M 45	-
ALL PCC	M 15	M 15

Reinforcement Steel

- High yield strength deformed bar/TMT shall be of grade Fe-500D
- Mild steel bar shall be of grade Fe-240

8.2.4.2 BRIDGE DESIGN STANDARDS

1.1 Design Assumptions

- The design would be carried out using the limit state design philosophy satisfying the requirements of IRC-112. The structure would be designed to meet both the ultimate and serviceability requirements of the code.
- Ultimate limit state: This cover static equilibrium and failure of structural element or structure as a whole when acted upon by ultimate design load.
- Serviceability limit state: This deals with the condition of structure subjected to serviceability design loads. These conditions include level of internal stress, fatigue failure, deflection, cracking and discomfort by vibrations.
- Load Combination shall be adopted as per table 3.1 to 3.4 of IRC: 6 as given below: -
- Table 3.1 for Verification of Equilibrium.
- Table 3.2 for Verification of Structural Strength
- Table 3.3 for Verification of Serviceability
- Table 3.4 for Base Pressure and Design of Foundation

S. No	Design Figure	Standard
1	Exposure Condition: As the general environment condition is dry for project location, Exposure condition is classified as Moderate & accordingly clear cover is provided for structural components as per IRC: 112. Minimum clear cover to reinforcement is given below.	
	i Superstructures	45mm
	ii Crash Barrier	40mm
	iii Substructures	50mm
	iv Pre-stressing cable duct	75/90mm
	v Pre-cast elements	35mm
	vi Foundations	75mm
	vii Earth Face of Abutment, return wall, retaining wall, box side wall	75mm
2	Grade of Steel	
	i HYSD bars	Fe500D
	ii Structural Steel	Fe490 (E-350)

S. No	Design Figure		Standard
3	Grade of Concrete		
	i	Pre stressed Concrete Girder and Box Girder	M50
	ii	RCC Deck slab over PSC Girder	M35
	iii	RCC Box type structure	M35
	iv	Pier and Pier Cap	M35
	v	Bearing Pedestal	M40
	vi	RCC Abutment, Abutment cap, Return Wall, Dirt wall.	M35
	vii	Open foundation	M35
	viii	Crash Barrier	M40
	ix	Approach slab	M30
	x	Box Culverts	M30
	xi	Leveling course	M10
	xii	Head Wall	M20
4	Dead load-(unit wt.)		
	i	Prestressed Concrete	2.5 T/m ³
	ii	Reinforced Concrete (RCC)	2.5 T/m ³
	iii	Plain Cement Concrete (PCC)	2.5 T/m ³
	iv	Steel	7.854 T/m ³
	v	Wearing Coat	2.2 T/m ³
5	Live Load		
	i	Footpath	400 Kg/m ² (Rural area)
			500 Kg/m ² (Urban area)
	ii	c/w 5.3m to 9.6m	One lane of class 70R or Two lane of Class A

S. No	Design Figure		Standard
	iii	c/w 9.6m to 13.1 m	One lane of class 70R for every two lanes with one lane of class A on the remaining lane or 3 lanes of class A
	Iv	-	SV Loading
6	Impact		
	Concrete Bridges		
	i	for Class A	4.5/(6+L)
	ii	for Class 70 RT and 70RW	<p>Upto-9m</p> <p>For Tracked-25% for span up to 5m and linear reducing to 10% for span up to 9m.</p> <p>For Wheeled-25% for span up to 9m</p> <p>More than 9 m-</p> <p>For Tracked-10% for span between 9m to 40m.As per curve for span more than 40m.</p> <p>For wheeled-25% for span up to 12m and as per curve for span more than 12m</p>
	Steel Bridges		
	i	for Class A	9/(13.5+L)
	ii	for Class 70 RT & Class 70 R W	<p>Up to -9m</p> <p>For Tracked-25% for span up to 5m and linear reducing to 10% for span up to 9m.</p> <p>For wheeled-25% for span up to 9m</p> <p>More than 9m-</p> <p>For Tracked-10% for all spans. For wheeled-25% for span up to 23m and as per curve for span more than 23m.</p>
7	Wind Load		

S. No	Design Figure	Standard
	i	As per basic wind speed and Type of the structure (IRC:6, clause 209)
8	Hor. Forces due to water current	
	i	Case-I Parallel to pier
	ii	Case-II At inclination of $(20\pm\theta)$ to the pier
9	Longitudinal forces	
	i	Case-I In case of single lane and two lane 20% of first train load plus 10% of load of succeeding train or part thereof
	ii	Case-II In case of bridges with more than two lane braking force for two lanes plus 5 % of the loads on the lanes in excess of two
10	Buoyancy	
	i	100 % buoyancy for stability check
	ii	15 % buoyancy for design
11	Temperature (as per IRC:6, clause 215)	
	For bridge having difference between max and min air shade temperature-	
	>20 degree C	Mean of Maximum and Minimum air shade temperature +,- 10°C whichever is critical
	<20 degree C	Mean of Maximum and Minimum air shade temperature +,- 5°C whichever is critical
	The nonlinear temperature gradient for design of superstructure shall be considered as per clause 215.3 of IRC: 6-2014.	
12	Seismic force (as per IRC:6, clause 219)	
	i	Zone-IV & V Bridges in Seismic Zone-IV & V need to be designed for seismic forces and shall be considered as per Clause 219 of IRC 6

S. No	Design Figure	Standard
13	Expansion Joints	
	i	Filler type For span up to 10m
	ii	Strip Seal Type For Span >10m and movement up to ±80
	iii	Modular Type movement more than ±80
14	Bearing	
	i	Tar paper Solid slab up to 10m
	ii	Elastomeric As per design requirements
	iii	Pot PTFE As per design requirements
15	Wearing Coat	65 mm thick
16	<p>Prestressing</p> <p>The maximum force applied to a tendon at active end during tensioning, shall not exceed 90% of 0.1% proof stress = 0.765xUTS.</p> <p>The analysis of prestressed section would be as per the stress strain properties given in clause 6.3.5 of IRC-112.</p> <p>For serviceability limit state the section would be checked for 10% higher and 10% lower values of prestressing force as per IRC -112</p>	
17	Sheathing	HDPE
18	Minimum Bar Diameter	10 mm
	<p>Diameter if any reinforcing bar including transverse ties, stirrups etc shall not be less than 10 mm. Diameter of any longitudinal reinforcement bars in columns/ vertical member shall not be less than 12 mm. However, diameter of the reinforcing bars shall not exceed 25 mm in slabs and 32 mm in another member.</p>	
19	Margin in Material (FOS)	
	<p>All critical sections shall be checked for stresses under various load combinations. A suitable margin (preferably 5%) shall be there between maximum stress and allowable stress in concrete as well as reinforcement in the final design.</p>	

1.2 Design Codes

This section below outlines the standards to be adopted for the design of the structures given in the Concession Agreement which include Flyovers, Culverts, Minor Bridges, & CUPS.

The IRC codes/Standards/Act, MoRT&H Publications, IS & BIS codes shall be followed in the project. Design of all proposed structures shall be done in accordance with the provisions of the following IRC Codes:

List of IRC Codes

IRC: 5	-	Section I- General Features of Design (Seventh Revision)
IRC: 6	-	Section II- Loads and Stresses
IRC: 22	-	Section IV-Composite construction for Road Bridges (Second Revision)
IRC: 24	-	Section V-Steel Road Bridges (Second Revision)
IRC: 78	-	Section VII- Foundations and Substructure (Second Revision)
IRC:83(Part-II)	-	Section IX- Bearings, Part II: Elastomeric Bearings
IRC: 83(Part-III)	-	Section IX-Bearings, Part III: POT, POT- CUM-PTFE, PIN AND METALLIC GUIDE BEARINGS
IRC: 87	-	Guidelines for the Design and Erection of False work for Road Bridges
IRC: 89	-	Guidelines for Design and Construction of River Training and Control Works for Road Bridges (First Revision)
IRC:112	-	Code of Practice for Concrete Road Bridges
IRC: SP-114	-	Seismic Design of Bridges
IRC: SP13	-	Guidelines for Design of Small Bridges and Culverts

IRC: SP:40	-	Techniques for strengthening & rehabilitation of bridges.
IRC: SP:69	-	Guidelines & Specifications for Expansion Joints
IRC: SP:70	-	Guidelines for the Use of High Performance Concrete in Bridges

Whenever IRC codes are silent, relevant IS & BIS codes shall be followed. In case where even BIS codes are silent, other suitable international codes of practices like BS:5400, AASHTO and EURO codes shall be adopted

1.3 Material

Cement

For construction of structures 43 grade ordinary Portland cement conforming to IS: 8112 and 53 grade ordinary Portland cement conforming to IS: 12269 shall be used. Other types of cement mentioned in IRC-112 Clause 18.4.1 may be used for special requirement of structure with the approval of Engineer in charge.

Admixtures

To improve workability of concrete, admixtures conforming to IS: 9103 shall be used.

Aggregates

Aggregates shall consist of clean, hard, strong, dense, non-porous and durable crushed stone for coarse aggregates and natural particles for sand. The aggregates shall conform to IS: 383 and shall be tested to conform to IS: 2386 parts I to VIII. Size of coarse aggregate shall be selected as per mix design requirement.

Water

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. The pH value of water shall not be less than 6. Other permissible limits for solids in water are given in Table-18.6 of IRC: 112.

Concrete

The grade of concrete shall be as per design requirement and mentioned in execution drawings for each component of the structure. Cement and water content shall be as per mix design requirement; however minimum grade of concrete, minimum cement content and maximum water cement ratio shall be conforming to Table-14.2 of IRC: 112 for moderate condition. The cement content shall not exceed 450 kg/m^3 of concrete as per Clause 14.3.2.5 of IRC: 112.

Permissible stresses in concrete: -

- Under rare combination of loads maximum compressive stress shall be limited to **$0.48f_{ck}$**
- Under Quasi permanent combination of loads maximum compressive stress shall be limited to **$0.36f_{ck}$**
- The parabolic rectangular stress-strain block is of general validity for all design situations. However, simplified equivalent stress blocks such as rectangle or bilinear may be used for design purposes where the net results are sufficiently accurate.
- Partial safety factor used for concrete in limit state design is
 - γ_m - 1.5 for basic and seismic combination
 - γ_m - 1.2 for accidental combination.

Reinforcement

Deformed or TMT reinforcement bar conforming to IS: 1786 shall be used for components of the structures. The reinforcement grade shall be Fe500D. Since the project highway is not in marine environment; coating of reinforcement bar is not required.

Permissible stresses in Reinforcing steel:-

- For checking serviceability criteria permissible stress in reinforcement should be limited to **300 MPa** or $0.6 F_y$ under rare combinations as per IRC -112.
- Partial safety factor used for reinforcement in limit state method for Basic and seismic combination is 1.15 or permissible stress is limited to $0.87 F_y$

Prestressing Steel

Prestressing tendons normally take the form of separate wires, wires spun together helically to form strands or bars. For pre-tensioned steel, wires, strands and occasionally bars are used, simply to permit the concrete to bond directly to them; when post-tensioning is

used, it is common practice to group the separate tendons together, so as to reduce the number of anchorages and ducts required to accommodate them. When grouped in this way, the tendons in each duct are usually termed a cable.

Uncoated stress relieved low relaxation steel conforming to IS: 14268 shall only be used for pre-stressing steel so as to reduce losses due to relaxation. Data in respect of modulus of elasticity, relaxation loss at 1000 hours, minimum ultimate tensile strength, stress-strain curve etc. shall necessarily be obtained from manufacturers. Pre-stressing steel shall be subjected to acceptance tests prior to actual use on the works (guidance may be taken from BS: 4447). The modulus of elasticity value, as per acceptance tests, shall conform to the design value which shall be within a range not more than 5 percent between the maximum and minimum.

Many cables with different arrangements of wires and strands and different methods of anchorage are available as pre-stressing steel. So type and size of cable and methods of anchorage shall be decided on the basis of design requirement.

Permissible stresses in Prestressed concrete: -

For prestressed concrete structures under the frequent combination of action and prestressing force, only compressive stresses occur at the extreme concrete fibers, under Serviceability Limit State.

Sheathing

The duct or sheath for cables to be used of Corrugated HDPE having coefficient of friction as 0.17 and wobble coefficient per meter length of steel 0.0020. The thickness of sheathing shall be as specified in clause 13.4.3 of IRC:112.

Bearings

Bridge bearing must be designed to transmit all the loads and appropriate horizontal forces. From the material point of view, these bearings can be made from metal, rubber, metal and elastomer and even concrete. However, following three types of bearings are recommended to be used on this project

Elastomeric Bearings

Elastomeric bearing can accommodate translation movements in any direction and rotational movements in any axis by elastic deformation. They should not be used in tension or when

rotation is high and vertical load small.

The basis of design is that the elastomer is an elastic material, the deflection of which under a compressive load is influenced by its shape (shape factor). Reinforcing plates should be bonded to the elastomer to prevent any relative movement at the steel/Elastomer interface.

The dimension and the number of internal layers of elastomer chosen shall satisfy the following clauses of IRC: 83(Part-II).

Table-7: Design Criterion

Design Criterion	Clause no of IRC: 83 (Part-II)
Dimensional	916.3.3
Translational	916.3.4
Rotational	916.3.5
Frictional	916.3.6

IRC: 83 (Part-II) recommends that chloroprene (CR) only shall be used in the manufacture of bearing. The elastomer shall conform to all the properties specified in table 1 of IRC: 83 (Part-II), and tolerances in dimensions specified in table2 of IRC: 83 (Part-II).

POT/PTFE Bearings

Due to initial low cost, easy availability, maintenance free and easy replacement, for simply supported structures elastomeric bearing shall be used. Wherever it is unavoidable, POT/ PTFE bearings shall be used. However, for continuous structure POT/ PTFE bearing shall be used.

The design of the POT/ PTFE bearing shall be done by the manufacturer conforming to the provisions of material as well as design parameters IRC: 83(part-III) and shall be got approved by the engineer. However the forces, movements and rotation etc shall be provided by the designer of the project on the format given in appendix –1 of IRC: 83 (part-III). In support of quality assurance, acceptance specification given in clause 928 of IRC: 83 (part-III) shall be followed.

Tar Paper Bearings

Tar paper bearings shall be used for small span RCC solid slab superstructure due to their cost effectiveness and speedy construction.

1.4 Miscellaneous Items

Crash Barriers

Suitably designed crash barriers shall be provided at the situations to safeguard against errant vehicles:

- Major and Minor Bridges
- Cross drainage structures

The type of crash barriers is provided according to their applications summarized below.

P-1: Normal Containment. This shall be provided on the Bridges/Flyovers/Overpasses for National Highways.

The other structures which cross the national highway shall be provided with P-2: Low Containment.

The Crash barrier has been provided according to IRC:SP:84-2014

Expansion Joints

Expansion joint shall be provided as per IRC: SP: 69-2005.

These shall conform to Section 2600 Technical Specification of MORTH.

Types of expansion joint based upon the length of span and movements are as given below:

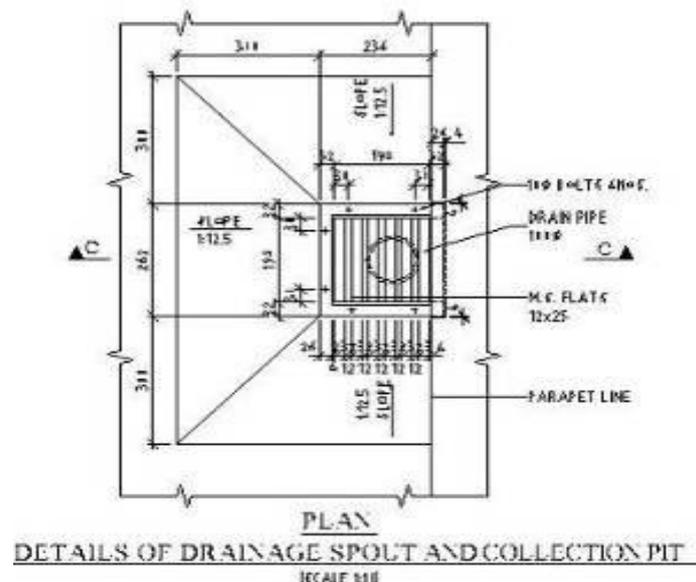
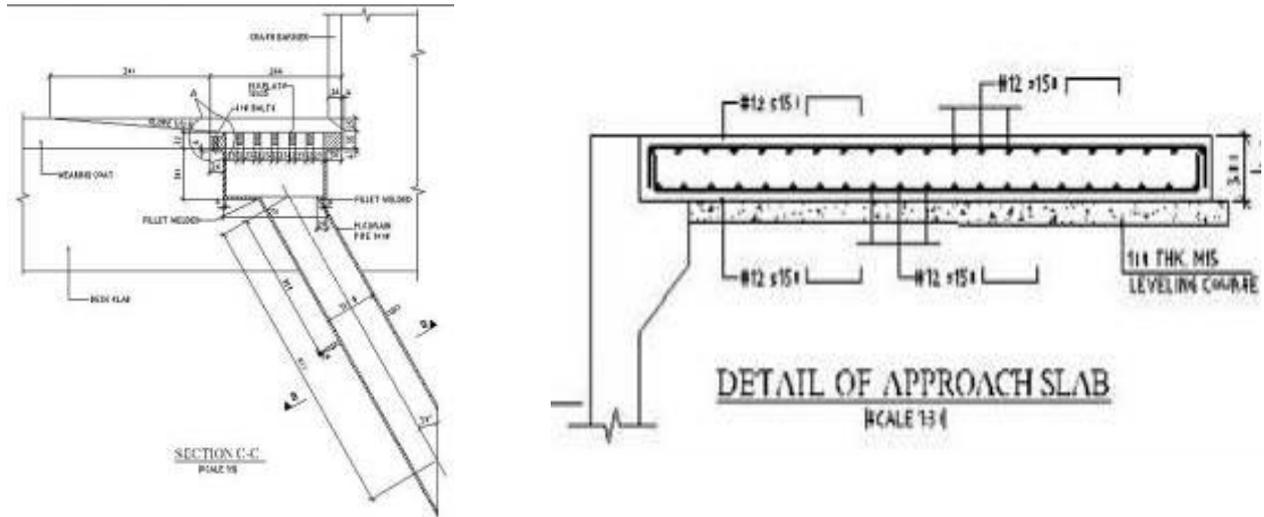
Table-8: Type of Expansion Joints

S. N.	Span	Expansion Joints
1	For RCC slabs up to 10 m span only	Buried type expansion joints
2	For all other bridges having span longer than 10 m and where movements are up to ± 80 mm	Elastomeric Single Strip Seal type expansion joints
3	Superstructure having movements more than ± 80 mm.	Modular Strip Seal expansion joints

Wearing Course

65mm thick bituminous wearing coat shall comprise of, Bituminous Concrete 40mm thick overlaid with 25mm thick mastic asphalt. Before laying wearing coat the deck surface shall be

thoroughly cleaned and tack coat shall be applied. The construction operations and bituminous mixes and tack coat shall conform to Section 500 of the MoRTH Specifications.



Edge Treatment

A drip course of 25mm shall be provided at the edge and bottom of the cantilever of the superstructure to barricade the flow into the base of superstructure.

Approaches

The approaches on the either side of the Flyover would generally have provisions for viaduct spans wherever needed. Thereafter they are of earth retaining structures or of conventional embankments as per the site conditions. The approaches on the either side of

the Bridges would have slope protection in the form stone pitching and turfing shall be provided on the embankment slopes. Stone pitching shall be constructed in accordance with clause 2504.2 of the MoRTH specifications. Where the stones of required size are not economically available, cement concrete blocks in minimum M15 grade concrete conforming to Section 1700 of MoRTH or stones in wire crates, shall be used.

The lowest course of pitching shall be started from the toe wall and built up in courses upwards. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Clause 1405.3 of the manual of Specifications in case of dry rubble pitching and it shall be in nominal mix cement concrete (M15) conforming to Clause 1704.3 of the manual of Specifications in case of cement concrete block pitching.

Approach Slab

Approach slab will dispense with in case of culverts without fill as per Clause 13.5.3 of IRC SP: 13 and MORTH standard drawings for culvert. Wherever Approach slab is not provided proper compaction of back filling shall be ensured in order to avoid settlement of the soil.

Reinforced concrete approach slabs, 3.5 m long and 300 mm thick, in M30 grade concrete at either end of the bridge, will be provided. One end will be supported on the reinforced concrete bracket projecting from the dirt wall and the other end resting over the soil, in accordance with the guidelines issued by MoRT&H. A leveling course, 150 mm thick, in M-15 grade concrete will be laid under the approach slabs as per MOST standard.

Drainage Spouts

Drainage spouts will be provided in accordance with MOST standard plans. The minimum spacing shall be kept preferably as 5.0m c/c which may be adjusted to suit span length. The drainage spouts at nalla/canal Bridge are proposed with free down fall.

For Flyover/Grade separator, sprinkler type drainage spout to be used to avoid the horizontally running pipe for down take at pier location.

Protection Works

For bridges with raft foundations, protective flooring, curtain wall and apron will be provided for both up-stream and down-stream side as per IRC SP-13/MOST standard.

Filter Media

The filter material shall be well packed to a thickness of not lesser than 600mm with smaller size towards the soil and bigger size towards the wall and provided over the entire surface behind abutment, return wall, retaining wall, box side wall to the full height.

Weep Holes

100mm diameter PVC pipes shall be provided as weep holes and shall extend through full width of abutment / return wall / side wall with slope of 1 vertical: 20 horizontal towards the draining face as per Clause 2706 of the MoRTH. The spacing of weep holes shall be 1.0m in either direction with the lowest at 150 mm above the low water level or ground level whichever is high.

1.5 Loading

Dead Load (DL)

The dead load i.e. the self weight of the superstructure, substructure and foundations, backfill will be considered as per the Cl. 203 of IRC : 6 and are summarized as below:

Density of green Concrete - 2.6 t/m³ (IRC: 87)

Reinforced Cement Concrete - 2.5 t/m³

Prestressed Cement Concrete - 2.5 t/m³

Asphaltic Concrete - 2.2 t/m³

Earth Compacted dry - 2.0 t/m³

Superimposed Dead Load (SIDL)

SIDL comprises of the following items

Crash barrier without Hand Rail - 0.8 t/m

Crash barrier with Hand Rail - 1.0 t/m

Wearing Course - 0.246 t/m²

Railing - 0.6 t/m

Footpath Load

Crash barrier is adopted as per IRC: 5.

Construction Live Load

Construction load wherever applicable may be considered as 0.36 t/m².

Temperature Gradient

Effective bridge temperature shall be estimated from the isotherms of shade air temperature given in fig 8 and fig 9 of IRC: 6-2014.. Difference in temperature between the top surface and other levels through the depth of the structure, where ever applicable shall be taken in accordance with clause :215.3 of IRC:6.

Centrifugal Forces

Centrifugal forces are considered for spans in curved portion as per IRC 6.

Centrifugal forces shall be determined from following formula:

$$C = \frac{WV^2}{127R}$$

Where,

C =Centrifugal force acting normal to the traffic. W = Live load (tonnes/m)

V= Design speed of vehicles (Km/ hour)

R = Radius of curvature (m)

Earth Pressure

For Abutment and Other Earth Retaining Structures

For abutment & Earth retaining structures Active earth pressure is considered as per IRC 6.

For RCC Box Structure

Active Earth pressure / Earth pressure at rest will be considered to be acting on the vertical walls of the RCC Box. The Co-efficient of such Earth pressure will be taken as 0.5.

Surcharge Pressure

All Earth retaining wall are designed for a live load surcharge pressure equivalent to 1.2 m earth fill as per IRC 6.

Live Load Combinations

Live load combinations mentioned in IRC:6 Table-2 shall be followed as per relevant carriageway width.

In general for Bridges and Flyovers following combinations shall be used

- i) Class A 3-Lane Loading
- ii) 1 Lane of 70R + 1 Lane of Class A Loading
- iii) SV Loading

Minimum clear distance between the two vehicles shall be 1.2m.

The loads which are not mentioned in this clause, shall be as per IRC: 6.

Shrinkage and Creep

Shrinkage and creep coefficient to be calculated as per IRC 112 and its effect in long term loading to be incorporated.

Seismic Forces

The project corridor falls under seismic zone-II which is a moderate seismic zone. Seismic design is carried out as per zone and as per codal provisions.

Design Methodology

1.6 Superstructure

Design of RCC I- Beam and Slab (Precast girder & in-situ slab)

- The structure behaves as composite section for all loads since the staging is released only after the deck slab gains strength.
- The deck structure shall be analyzed for self-weight manually using excel sheet, SIDL and live loads using grillage analogy method. The superstructure will be idealized into a series cross set of discrete torsion less members which are able to resist the loads applied in a plane perpendicular to the plane of assemblage, through bending shear of the members.
- The minimum dimension of various elements shall be provided conforming to the latest IRC codes and standards. The minimum thickness of deck slab including that at tip of the cantilever shall be 200mm. The thickness of web shall not be less than 290mm. Thickness of cross girders shall not be less than the minimum web thickness of main longitudinal girder. There shall be at least two cross girders in any beam and slab type structure (i.e at the ends.)

- For obtaining maximum shear stress, the section at a distance equal to effective depth from the face of the support shall be checked and the shear reinforcement calculated at the section shall be continued up to the support.
- The design of deck slab supported transversely on the precast girder shall be carried out assuming un-yielding support at the girder points and using effective width method.

Design of PSC I Beam and Slab (Pre-cast Girder and in-situ slab)

- The design of such type of structure is very much dependent on the construction sequence. The structure is in iso-static condition up to the stage of casting of deck slab and diaphragm and after developing proper bond with girder, the structure behave as composite section.
- The design therefore shall be done with only the girder section being effective upto the stage of casting of deck slab and diaphragm and composite section shall be considered for all subsequent loads (i.e for SIDL and live loads).
- The deck structure will be analyzed using grillage analogy method for SIDL and Live Loads. Self-weight of girder and Dead Load of slab will be applicable on girder section alone and hence the design forces for DL will be calculated separately and results superimposed. The superstructure will be idealized into a series cross set of discrete torsion less members which are able to resist the loads applied in a plane perpendicular to the plane of assemblage, through bending and shear of the members.
- The minimum dimension of various elements shall be provided conforming to the latest IRC codes and standards. The minimum thickness of deck slab including that at tip of the cantilever shall be 200mm. The thickness of web shall not be less than 290mm. Thickness of cross girders shall not be less than the minimum web thickness of main longitudinal girder. There shall be at least three cross girders in any beam and slab type structure (i.e one at the centre and two at the ends.).
- For obtaining maximum shear stress, the section at a distance equal to effective depth from the face of the support shall be checked and the shear reinforcement calculated at the section shall be continued up to the support.
- The design of deck slab supported transversely on the pre-cast girder shall be carried out assuming un-yielding support at the girder points.
- Effect of differential shrinkage and creep between pre-cast girder and in-situ slab shall be considered.
- Prestress forces and losses due to instantaneous and time dependent and extra 20% time

dependent loss as specified in the code shall be considered.

Design of RCC Box Culvert:

- Box is designed based on line analysis in STAAD for dead load, live load and earth pressure.
- In the design of Box Culverts effective live load moments may be calculated based on effective width method conforming to Annexure B-3 of IRC: 112. Bending moments due to other loads can be taken to be distributed over the full width.
- For skew box, grillage analysis shall be carried out for finding out the design forces and moments.

1.7 Seismic Design and Detailing

Most of the project corridor parts falls under seismic zone-IV or V which is a severe seismic zone, Seismic analysis of the bridge structure is proposed to be carried out in 2 steps.

Step-1: To carry out single mode analysis to obtain the fundamental vibration period of the bridge in two orthogonal directions (i.e. longitudinal & transverse direction).

Step-2: To estimate seismic forces using the spectrum response, defined in IRC: 6.

The calculation for fundamental period can be done either by using the simplified expression given in Annexure-D of IRC:6 or else by modeling the structure in STAAD Pro and carrying out dynamic analysis.

Vertical seismic coefficient shall be taken as “two third” of the horizontal seismic coefficient. The vertical seismic shall be combined with the horizontal seismic in any one direction. The seismic combination to be considered is as follows:

1. $\pm S_X \pm 0.3S_Y \pm 0.3S_Z$
2. $\pm 0.3S_X \pm S_Y \pm 0.3S_Z$
3. $\pm 0.3S_X \pm 0.3S_Y \pm S_Z$

Where S_X & S_Z are seismic forces in longitudinal & transverse direction respectively while S_Y is the seismic force in vertical direction.

Ductile detailing specification

- For project corridor falls in Seismic zone III ductile detailing shall be carried out

according to IRC 112 and IRC-SP-114, Project areas fall in Seismic zone IV or V, so ductile detailing is required.

1.8 Bearings

Elastomeric bearings if used for transferring in-plane horizontal forces shall be checked using minimum frictional value and minimum vertical load, including combined effects of horizontal of earthquake. Anchored elastomeric bearings may be used in case it is not possible to satisfy the above criteria.

Provision of Elastomeric Bearings or POT-PTFE Bearing shall be done as per design requirements.

1.9 Sub-Structure and Foundation

The scour to be considered for design shall be based on mean design flood. In the absence of detailed data the scour to be considered for design shall be 0.9 times the maximum design scour depth.

In loose sands or poorly graded sands with little or no fines, vibrations due to earthquake may cause liquefaction or excessive total and differential settlements. Since this project is located in high seismic zone, hence liquefaction effect is to be required to be considered.

8.2.5 Seismic Zone

The project road is in a seismic zone V. It is proposed to design the bridges for seismic forces as mentioned in modified clause 219 of IRC: 6-2017.

8.2.5.1 Structural Steel

Composite construction consisting of structural steel girders with cast-in-situ deck slab may be proposed over deep valleys by keeping in view the seismic zone of the project roads. Superstructure weight shall be substantially reduced by using structural steel girders. Structural steel shall conform to IS: 226.

8.2.5.2 Bearings

Reinforced elastomeric bearings shall be proposed for short span simply supported superstructures. Elastomeric bearings shall be designed as per IRC: 83 (Part II) and shall conform to C1.2005 of MoRT&H Specifications for Road & Bridges Works (5th Revision). RCC solid slab superstructures of culverts and minor bridges shall directly rest on pier/abutment caps with a tar paper in bearing.

Pot fixed/Pot PTFE sliding/ metallic bearings shall be proposed for long span simply supported superstructures and continuous superstructures. The loads and forces on the bearings shall be calculated to enable the manufacturer to design these bearings and these shall conform to Cl. 2006 of MOR&TH Specifications for Road & Bridges Works (5th Revision).

8.2.5.3 Expansion Joints

The following types of Expansion Joints shall be adopted:

Filler type expansion joints shall be proposed for minor bridges with solid slab superstructures having span lengths not exceeding 10 meters. These types of joints shall conform to Cl. 2605 of MOST's Specifications for Road & Bridge Works (5th Revision).

Single Strip seal expansion joints shall be proposed for superstructures having movements up 80mm. (± 40 mm).

The strip seal joints shall conform to Cl. 2607 of MOST's Specification for Road and ~Bridges works (5th Revision).

Concrete Clear Covers:

For all reinforcement	-	As per IRC: 112-2011 and 78-2014
For other covers and inter duct spacing	-	As per IRC: 112-2011

8.2.5.4 Loads

Dead Loads

Following unit weights shall be assumed in the design as per IRC 6 Code.

Superimposed Dead Loads

Wearing coat: 40mm thick Bituminous Concrete with 25 mm mastic asphalt total weight of 2.2 t/m³.

In addition, Footpath / Kerb as well as Crash barriers, wherever feasible and provided are also considered as SIDL

Carriage way Live Load

Bridge Live load: One lane of Class 70R for every two lanes with one lane of Class A for the remaining lanes, if any, OR One lane of Class A for each lane.

The impact factor shall be as per Cl. 208 of IRC: 6-2017 for the relevant load combinations.

Longitudinal Forces

The following effects shall be considered for calculating the longitudinal forces in the design-

Braking forces as per the provision of Cl. 211 of IRC: 6.-2017

Frictional resistance offered to the movement of free bearings due to change of temperature.

Distribution of longitudinal forces due to horizontal deformation of bearings/frictional resistance shall be carried out as per Cl. 211.5 of IRC: 6-2017 by assuming stiff supports.

Centrifugal Forces : Bridges on a horizontal curve shall be designed for centrifugal forces based on the following equation-

$$C=W*V^2/127R,$$

Where C =Centrifugal force acting normal to the traffic.

W =Carriageway Live Load

V= Design speed of the Vehicles using the bridge in km per hour.

R= Radius of curvature in meters.

The centrifugal force shall be considered to act at 1.20m above the formation level of the bridge in the transverse direction. No impact value on carriageway live load shall be considered for calculating the centrifugal force.

Water Current Forces

The effect of water current forces shall be calculated in accordance with clause number 210 of IRC: 6-2017 on sub structure and foundations. High flood level and Velocity shall be calculated based on the details received from relevant Government departments or Local inquiries.

Impact Forces

All the sub- structure and foundations in the river shall be designed for the impact due to striking of rolling boulders on the sub-structure in mountainous terrain. The magnitude of force shall be decided based on field studies and in consultation with client.

Earth Pressure

Horizontal forces due to earth pressure shall be calculated as per the provision of CL. 214 of IRC: 6-2017 assuming the following soil properties:

Type of soil assumed for backfilling:

Density of:

Angle of Internal friction:

Angle of Wall Friction:

Coefficient of Friction μ at base: $\tan(2/3\phi)$, where ϕ is the angle of internal friction of substrata immediately under the foundation.

Live Load surcharge shall be considered as equivalent to 1.2m height of earth fill in case of abutments and equivalent to 0.6m height of earth fill in case of return/wing walls.

Wind Forces

Structures shall be designed for wind effects as stipulated as Cl. 209 of the IRC: 6-2017. The Wind force shall be considered in the following two ways. The design shall be governed by the one producing the worst effect.

Full wind forces at right angle to the superstructure 65% of wind force as calculated in (1) above acting perpendicular to the superstructure and 35% acting in the traffic direction.

8.2.5.5 Seismic Effect

The project road falls under seismic zone V. Horizontal seismic force shall be calculated using the following formula-

$$F_{eq} = A_h \times (\text{Dead Load} + \text{Appropriate Live Load})$$

Where, A_h Horizontal seismic co-efficient = $(Z/2) \times (S_a/g)/(R/1)$

Z = Zone factor

I = Important factor and is taken as 1.5 for important Bridges.

R = Response reduction factor and is equal to 2.5

S_a/g Average response acceleration coefficient depending upon fundamental period of vibration T

T = Fundamental period of Bridge in seconds in horizontal vibrations.

The vertical seismic coefficient shall be considered in the case of structures built in seismic V. The vertical seismic coefficient shall be considered as half of the horizontal seismic force. Both horizontal and vertical seismic forces shall be assumed to act simultaneously for the design of bridge components.

8.2.5.6 Temperature Range

The bridge structure/components i.e. bearings and expansion joints shall be designed for a temperature variation of 7.5 to 45° C considering extreme climate.

The super structure shall be designed for effects of distribution of temperature across the deck depth as per stipulations of BD 37/88 suitably modified for the surfacing thickness.

8.2.5.7 Differential Shrinkage Effects

A minimum reinforcement of 0.2% of cross-sectional area in the longitudinal direction of the cast-in-situ slab shall be provided to cater for different shrinkage stresses in superstructures with in-situ slab over pre-cast girders as per C1.605.2 of IRC: 22-2015.

However, effects due to different shrinkage and/or different creep shall be duly accounted for in the design.

8.2.5.6 Differential Settlement Effects

Differential Settlement effects for continuous superstructure units shall be appropriately assessed for each structure. However, in any case of differential settlement of ± 12 mm shall be accounted for in the design.

The differential settlement effects in continuous superstructures shall be accounted for under following conditions:

A minimum of 12mm differential settlement of supports with half value of 'E'.

To simulate the bearing replacement conditions, a 12mm differential uplift with full value of 'E' shall be considered but without any live load on the superstructure.

8.2.5.7 Buoyancy

100% buoyancy shall be considered while checking stability of foundations irrespective of their resting on soil/weathered rock/or hard rock. However, maximum base pressure shall also be checked under an additional condition with 50% buoyancy in cases where foundations are embedded into hard rock. Pore pressure uplift limited to 15% shall be considered while checking stresses of the substructure elements.

In the design of abutment, the effects of buoyancy shall be considered assuming the fill behind abutment has been removed by scour.

8.2.5.8 Load Combination

All members shall be designed to safely sustain the most critical combination of various loads and forces that can coexist. Various load combinations as relevant with increase in permissible stresses considered in the design shall be as per Cl. 202 of IRC:6-2017 and Cl.706 of IRC:78-2014.

In addition, the stability of a bridge resting on neoprene/pot bearings shall be checked under one span dislodged condition. The load case shall be checked with seismic/wind load combinations.

8.2.5.9 Design Criteria of Culverts

The culverts shall be designed as per relevant IRC codes and special publications. The following IRC codes have been adopted for design of culverts:

IRC: 5-2015	General Features of Design;
IRC: 6-2017	Loads & Stresses;
IRC: 40-2002	Brick, Stone & Block Masonry;
IRC: SP: 13-2004	Guidelines for the Design of Small Bridges and Culverts;
IRC: SP: 48-1998	Hill Road Manual

8.2.5.10 Codes to be adopted for Design

Various codes of practices which shall be used for the design of culverts and bridges are mentioned below:

- i) IRC:5-2015: Standard Specifications and Code of Practice for Road Bridges, Section I- General Features of Design (Seventh Revision).
- ii) IRC:6-2017: Standard Specifications and Code of Practice for Road Bridges, Section II- Loads and Stresses (Fourth Revision).
- iii) IRC:7-2017: Recommended Practice for Numbering Bridges and Culverts (First Revision)
- iv) IRC: 112-2011: Standard Specifications and Code of Practice for Road Bridges
- v) IRC: 22-2015: Standard Specifications and Code of Practice for composite steel Bridges
- vi) IRC:24-2010: Standard Specifications and Code of Practice for steel Bridges
- vii) IRC: 45-1972: Recommendations for Estimating the Resistance of Soil Below the maximum scour Level in the Design of Well Foundations of Bridges.
- viii) IRC:78-2014: Standard Specifications for substructure and foundation for Road Bridges
- ix) IRC: SP: 33-1989: Guidelines on Supplemental Measures for Design, Detailing & Durability of Important Bridge Structures.
- x) IRC: SP:48-1998: Hill Road Manual
- xi) IRC:83-2018: Standard Specifications and Code of Practice for Road Bridges
 - Part II: Elastomeric Bearings
 - Part III: POT/PTFE Bearings

- xii) IRC:89-2019: Guidelines for Design and Construction of River Training & Control Works for Road Bridges (First Revision)
- xiii) IS:2502-1963-Code of practice for bending and fixing of bars for concrete reinforcement
- xiv) IRC: SP:13-2004: Guidelines for the Design of Small Bridges and Culverts (First Revision)
- xv) IRC: SP: 35-1990: Guidelines for Inspection and Maintenance of Bridges.
- xvi) IRC: SP: 40-2019: Guidelines on Techniques for Strengthening and Rehabilitation of Bridges.
- xvii) IRC:SP:112-2017: Guidelines on Quality Systems for Road Bridges (Plain, Reinforced, Pre stressed and Composite Concrete).
- xviii) IRC: SP: 51-2015:-Guidelines for Load Testing of Bridges.

MORTH Specifications

The specifications for road and bridges works of Ministry of Road Transport & Highways (latest editions) published by Indian Road congress shall be used for materials to be used for construction of bridge.

8.3 Widening Scheme

To meet future traffic requirement, the existing carriageway is proposed to upgrade to achieve high speed of travel with comfort and safety. Concentric widening scheme is followed to minimize land acquisition issues and to ensure maximum utilization of existing carriageway.

8.3.1 Typical Cross-sections

Proposed cross-sections summary is shown in **Table 8.12** below and (**Annexure- 8.5**)

Table 8.12: proposed improvement proposal

Summary of TCS

Sr.no	Detail	TCS	Length	
			(m)	(Km)
1	TYPICAL CROSS SECTION-01 NEW CONSTRUCTION OF FOUR LANE IN OPEN COUNTRY	1	120	0.12
2	TYPICAL CROSS SECTION-02 CONCENTRIC WIDENING OF FOUR LANE IN BUILTUP AREA	2	2632	2.632
3	TYPICAL CROSS SECTION-03 ECCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA LHS SIDE	3	2934	2.934
4	TYPICAL CROSS SECTION-04 ECCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA RHS SIDE	4	650	0.65

5	TYPICAL CROSS SECTION-05 CONCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA PROTECTION WORK BOTH SIDE	5	210	0.21
6	TYPICAL CROSS SECTION-06 ECCENTRIC WIDENING OF FOUR LANE IN HILL AREA LHS SIDE ALONG WITH PROTECTION WORKS BOTH SIDE	6	194	0.194
7	TYPICAL CROSS SECTION-07 NEW CONSTRUCTION OF FOUR LANE IN HILLY AREA ALONG WITH PROTECTION WORKS BOTH SIDE	7	340	0.34
8	TYPICAL CROSS SECTION-08 BRIDGE WIDENING OF FOUR LANE IN OPEN COUNTRY	8	85	0.085
9	TYPICAL CROSS SECTION-09 CONCENTRIC WIDENING OF FOUR LANE IN HILL AREA WITH LOAD BEARING DRAIN BUILT-UP AREA	9	330	0.33
10	TYPICAL CROSS SECTION-010 CONCENTRIC WIDENING ON BOTH HAND SIDE SINGLE LANE BRIDGE BUILT-UP AREA	10	30	0.03
11	TYPICAL CROSS SECTION-11 ECCENTRIC BRIDGE WIDENING OF FOUR LANE IN HILL AREA	11	115	0.115
12	TYPICAL CROSS SECTION-12 NEW CONSTRUCTION OF BRIDGE AT VAILOO ROAD JUNCTION	12	30	0.03
13	TYPICAL CROSS SECTION-13 ECCENTRIC WIDENING OF FOUR LANE IN OPEN COUNTRY AREA LHS SIDE	13	947	0.947
14	TYPICAL CROSS SECTION-14 ECCENTRIC WIDENING OF FOUR LANE IN OPEN COUNTRY AREA RHS SIDE	14	890	0.89
15	TYPICAL CROSS SECTION-15 ECCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA / OPEN AREA RHS SIDE	15	230	0.23
16	TYPICAL CROSS SECTION-16 TWO LANE BRIDGE APPROACH SECTION DOWN STREAM SIDE	16	129	0.129
	Total Length		9866	9.866

8.4 Requirement of bypass

No bypass/realignments are being proposed along the project road.

8.5 Geometric Improvement Design

As per the IRC: SP: 84-2019 the project highway should be design with 100 km/hr ruling speed and minimum speed of 80 km/hr.

8.6 Improvement of Bridges

The following approach and methodology for the finalization of designs and drawings for the existing and proposed bridge structures are proposed.

8.6.1 General

- ✓ Review of Past records like Studies, Reports and Data's.
- ✓ Data relevant to bridges shall also be collected from the PWD (NH) and irrigation departments of Chhattisgarh. The following data will generally be looked to the extent available:
 - ✓ Hydrological and geo-technical reports of the existing CD structures.
 - ✓ Complete 'as built' drawings of existing two-lane bridges along with their design calculations, if available.
 - ✓ Details of repair/rehabilitation, if any, carried out for the existing Single lane bridges.
 - ✓ Nature and extent of damage observed during floods to any of the existing two-lane bridges.
 - ✓ Utility services to be carried over the bridges.
 - ✓ Any other engineering data found suitable for the detailed engineering of proposed bridge structures.

This Chapter covers the various methodologies and design criteria, Codal provisions for proposed Bridges.

Following are the grades of construction material proposed for the project

Foundation

Concrete Grade : M35 for Bridges & Culverts

Reinforcement : HYSD of grade Fe500D

Abutment/Abutment Cap and Pier / Pier Cap

Concrete Grade : M35 for Bridges with RCC Substructure and Foundation

Reinforcement : HYSD of grade Fe500D

Superstructure

Concrete Grade : M35 for RCC girders

: M45 for PSC precast girders

	: M35 for Bridge decks over girders
	: M35 for RCC solid slabs
	: M35 for RCC solid slab of Slab Culverts
	: M30 for RCC Box Structures
Reinforcement	: HYSD of grade Fe500D
Structural Steel	: Grade E250 (Fe410 W B grade) (For ROB)

Crash Barrier

Concrete Grade	: M40
Reinforcement	: HYSD steel of grade Fe500D

Approach Slab

Concrete Grade	: M30
Reinforcement	: HYSD steel of grade Fe500D

Clear Cover to any Reinforcement is followed as below

Foundation	: 75 mm
Substructure	: 50 mm
Superstructure	: 40 mm

Bearings

- For Span 6.00-10.00 m, Tar paper bearings shall be adopted for slab superstructure.
- For Span 10.00-20.00 m, Elastomeric Bearing for RCC solid slab, RCC girder superstructure.
- For Larger span, POT/PTFE bearing for RCC / PSC girder superstructure.

Expansion Joints

Compression seal for slab superstructure and strip seal for girder superstructure.

Wearing Coat

- Cross-drainage structure: 40 mm thick bituminous concrete overlaid with 16 mm thick mastic asphalt.
- Minor and Major Bridges: 40 mm thick bituminous concrete overlaid with 25 mm thick mastic asphalt.

Approaches

RCC Return or Retaining wall for Culverts and Bridges are considered.

Drainage Provisions.

Drainage spouts shall be placed not greater than 10.00 m centre to centre. Down take pipes will be provided to dispose the water.

Margins in Material (FOS)

All critical sections shall be checked for stresses under various load combinations. A suitable margin (preferably 8-10%) shall be there between maximum stress and allowable stress in concrete as well as reinforcement in the final design.

Conceptual Guidelines for Structure

Following guidelines will be followed in design and construction of structures:

- The existing structures will be widened or extended to match the new road cross sections.
- For Major and Minor bridges in urban or rural areas, open median shall be provided with minimum 3.50 m clear gap between two crash barriers of bridges.
- New Bridges will be planned without affecting the foundations of adjacent existing bridges, if any.
- All new / reconstructed pipe culverts will constitute minimum 1.20 m diameter size pipes that confirm to NP4 specifications. The existing 0.90 m or more diameter pipe culverts will be extended to new carriageway with the same diameter or 1.20 m diameter pipes. In case where the culverts are hydraulically inadequate, shall be replaced by RCC Box / RCC Slab culvert of adequate size.
- Rehabilitation of substructure / superstructure of the existing Bridges which are proposed to be retained, including, but not limited to, replacement of bearings, expansion joints, pitching, bed protection, provision of crash barrier and railings, shall be done by the Concessionaire in accordance with the Concession Agreement.

Relevant Codes Followed for Design of Structures

List of IRC Codes

The list of IRC codes for the design of various all types of structures are as follows.

- IRC: 5-2015 - Standard Specifications & code of Practice for Road Bridges. Section-1 General features of Design (8th revision)
- IRC: 6-2017 - Standard Specifications & code of Practice for Road Bridges.

Section-II Loads and Stresses (5th revision)

- IRC: 7-2017 - Recommended Practice for numbering Bridges and culverts (1st revision)
- IRC: 112-2011 Standard Specifications & code of Practice for Road Bridges
- IRC: 24-2010 Standard Specifications & code of Practice for Road Bridges. Section-V Steel Road bridges (1st revision)
- IRC: 78-2014-Standard Specification & code of Practice for Road Bridges.

Section-VII Foundations and Substructure (2nd revision)

- IRC: 83-2018 (part III) - Standard Specifications & code of Practice for Road Bridges. Section-IX Bearings Part II- Elastomeric Bearings
- IRC: 89-2019 - Guidelines for Design & Construction of River training & Control works for Road Bridges (1st revision).

List of IRC-SP Codes

- IRC: SP: 13-2004 - Guidelines for the Design of Small Bridges and Culverts
- IRC: SP: 35-1990-Inspection and maintenance of Bridges
- IRC: SP: 40-2019 Guidelines on Strengthening and Rehabilitation of Bridges
- IRC: SP: 84-2019- Manual of Specifications and Standards for Four Laning of Highways through public private partnership

Ministry of Surface Transport Publications

MORT&H Specifications for Road and Bridge Works, 2013 (Fifth Revision)

Existing structures on the project road have been classified in three categories based on the reconnaissance survey.

(a) Culverts

Structures having an overall length up to 6.0m shall be treated as culverts.

Most of the culverts have no protection works.

(b) Minor Bridges

Structures having a length between inner face of dirt walls more than 6.0m and up to 60.0m shall be treated as minor bridges. These bridges on project roads are of reinforced concrete solid slab, structural steel trusses/ girder and RCC I- beam girders type. Minor bridges seen during the site visit have spans varying from 8.0m to 50.0 m with R&R masonry wall type abutments and stone masonry/plain cement concrete wall type piers. The protection works around abutments are either damaged or not existing.

(c) Major Bridges

Structures having a length of more than 60.0m shall be called major bridges.

8.6.2 Type of Proposed Bridges

Following type of super-structures will be most suitable for bridges:

- Structural steel girders/trusses
- Reinforced concrete pre-cast bridges
- Pre-cast Post tensioned concrete bridges
- RCC Box type structures where SBC is less

Following type of sub-structures will be most suitable for bridges:

- RCC abutment and pier for bridges
- PCC abutment and pier for culverts

Piers shall be avoided in the mid-stream where velocity of water is more than 5.0m/second. It is generally seen that it is very difficult to construct sub-structure in such locations and there is possibility of bridge being washed away. Thus, all efforts shall be made to provide large spans for the mid-stream in order to avoid any pier.

Circular/cellular circular/wall type piers shall be used after considering the aesthetics and economy. Solid wall type abutments/counter fort type abutments based on the height shall be selected. Counter fort type abutments are generally provided if height of the abutments is more than 10.0 meters

Submersible Structures

Submersible Bridges and Causeway are highly suitable where the floods are flash and do not interrupt the traffic for long period.

These are normally built on non-erodible bed rock with protective pitching or apron Though submersible bridges are cheap compared to high level bridges, they need greater maintenance for approaches if there is considerable spread of water. Design of hard rails, impact of floating debris and the hydrodynamic effect of the water acting over the whole bridges also required to design submersible Bridges. These have to be considered along with the buoyancy in design.

8.6.3 Proposal of New Cross Drainage Structure

A total of 36 culverts are proposed out of which 29 are to be re-constructed. The Brief detail of proposed structures have been provided as **Table 8.13**.

Based on Hydraulics, alignment modifications, widening requirement etc. New C.D. structures along the project stretch are prepared and presented detailed vide **Annexure 8.2 arid 8.3**.

Table 8.13: Bridges & Culverts proposals

S. No.	Topo Chainage	Revised Design Chainage	Type of Structure	Existing Span Arrangement	Carriageway Width (m)	Overall Width (m)	Revised Proposal For Structure	Type of Prop. Structure	Prop.span Arrangement (m)
1	148+589	0+000	Vialloo Bridge	1x23	3.5	5.5	Re-constructio n	PSC I Girder	1 x 25
2	151+096	0+200	Minor Bridge	1 x 30	7	12.5	New 2 lane	Steel Girder	1 x 30
3	158+061	0+340	Minor Bridge	1 x 10	8.3	12.4	RHS Widening	Rcc Box	1 x 10
4	163+790	0+078	Minor Bridge	1 x 10	8.7	12.9	New 2 lane	Rcc Box	1 x 10
5	164+090	0+270	Major Bridge hiller	3 x 35	7	12.3	Existing Retain + New 2 lane	PSC I Girder	3 x 35
6	164+362	0+406	Minor Bridge	1 x 10	7	12.5	Existing Retain + New 2 lane	Rcc Box	1 x 10
7	164+400	0+680	Minor Bridge	1 x 24.23	7	12	Existing Retain + New 2 lane	Rcc I Girder	1 x 24.23
8	164+769	1+011	Minor Bridge arhama	1 x 40	7	12.4	Existing Retain + New 2 lane	PSC I Girder	1 x 40
9	164+840	1+105	Minor Bridge	1 x 10	7.3	12.6	New 2 lane	Rcc Box	1 x 10
10	170+467	0+060	Minor Bridge	1 x 13	10.9	12.5	concentric widening	Rcc Box	1 x 13

S. No.	Topo Chainage	Type of Structure	Existing Span Arrangement	Carriageway Width (m)	Overall Width (m)	New Proposal For Structure	Skew	Type of Prop. Structure	Prop.span Arrangement(m)	Vent height	REMARKS	LHS widening	RHS widening
1	151+959	Culvert	1x2	6.80	12.15	Concentric Widening		Rcc Box	1x2	2	Streect h-3	1.4	6.3
2	152+282	Culvert	1x2	8.30	12.20	Concentric Widening		Rcc Box	1x2	2	Streect h-3	2.6	5.1
3	153+572	Culvert	1x2	7.00	12.10	Concentric Widening		Rcc Box	1x2	2	Streect h-4	2.6	4.85
4	153+825	Culvert	1x2	7.00	12.10	Concentric Widening		Rcc Box	1x2	2	Streect h-4	4.2	3.6
5	157+763	Culvert	1x2	7.50	16.20	RHS Widening		Rcc Box	1x2	2	Streect h-5	-	2.85
6	158+125	Culvert	1x2	7.50	12.30	Concentric Widening		Rcc Box	1x2	2	Streect h-5	5	2.5
7	158+393	Culvert	1x2	6.90	11.70	Concentric Widening		Rcc Box	1x2	2	Streect h-5	9	1.1
9	158+669	Culvert	1x2	7.10	12.10	RHS Widening		Rcc Box	1x2	2	Streect h-5	-	7.1
10	160+461	Culvert	2x2	7.00	20.00	Retained		-	-	2	Streect h-6	-	-
11	160+711	Culvert	2x2	7.00	20.00	Retained		-	-	2	Streect h-6	-	-
12	160+840	Culvert	1x4	7.00	20.00	RHS Widening		Rcc Box	1x4	3	Streect h-6	-	3.2
13	160+909	Culvert	1x2	7.00	20.00	LHS Widening		-	-	2	Streect h-6	5.15	

15	163+825	Culvert	1x2	7.00	12.35	RHS Widening		Rcc Box	1x2	2	Streect h-7	-	8.55
16	164+153	Culvert	1x2	7.00	12.35	RHS Widening	13	Rcc Box	1x2	2	Streect h-7	-	10.8
17	164+275	Culvert	1x2	7.00	12.00	RHS Widening		Rcc Box	1x2	2	Streect h-7	-	10.5
18	164+345	Culvert	1x2	7.10	12.20	RHS Widening		Rcc Box	1x2	2	Streect h-7	-	11.5
20	164+535	Culvert	1x2	7.00	11.90	RHS Widening		Rcc Box	1x2	2	Streect h-7	-	10.3
21	164+630	Culvert	1x2	7.00	13.20	RHS Widening		Rcc Box	1x2	2	Streect h-7	-	14.3
22	164+910	Culvert	1x2	16.60	20.00	Retained		-	-	2	Streect h-7	-	-
23	167+115	RRM Culvert	1x2	7.00	12.10	New construction		Rcc Box	1x2	2	Streect h-8	3.9	5.2
24	167+320	Culvert	1x2	7.00	12.00	LHS Widening		Rcc Box	1x2	2	Streect h-8	9.95	-
25	168+788	Culvert	1x4	7.00	12.10	Concentric Widening		Rcc Box	1x4	3	Streect h-9	1.7	6.45
26	169+330	Culvert	1x2	7.00	12.10	Concentric Widening		Rcc Box	1x2	2	Streect h-9	2.85	5.25
27	169+640	Culvert	1x2	-	-	New construction		Rcc Box	1x2	2	Streect h-9		
28	170+430	Culvert	1x2	7.00	18.30	Retained	19	-	-	2	Streect h-10	-	-
29	170+550	Culvert	1x2	6.90	13.80	LHS Widening		Rcc Box	1x2	2	Streect h-10	3.45	-
30	170+601	Culvert	1x2	7.00	12.50	Concentric Widening		Rcc Box	1x2	2	Streect h-10	1.95	2.25

31	171+589	Culvert	1x2	7.00	20.00	Retained		-	-	2	Streect h-11	-	1.68
32	171+978	Culvert	1x2	6.90	15.80	LHS Widening		Rcc Box	1x2	2	Streect h-11	6.05	-
33	172+285	Culvert	1x2	7.00	12.80	Concentric Widening		Rcc Box	1x2	2	Streect h-11	4.8	2.3
34	174+020	Culvert	1x2	7.00	11.90	Concentric Widening		Rcc Box	1x2	2	Streect h-12	5.8	2.1
35	174+452	Culvert	1x2	7.00	12.30	Concentric Widening	7	Rcc Box	1x2	2	Streect h-12	2.2	5.7
36	174+879	Culvert	1x2	7.00	12.00	Concentric Widening		Rcc Box	1x2	2	Streect h-12	4.3	3.7
37	174+990	Culvert	1x2	7.00	12.30	RHS Widening		Rcc Box	1x2	2	Streect h-12	-	8.7
38	176+398	Culvert	1x2	7.00	14.00	Concentric Widening		Rcc Box	1x2	2	Streect h-13	2.3	3.35
39	176+696	pipe culvert	1200	7.00	19.00	Re-constructio n		Rcc Box	1x2	2	Streect h-13		

8.7 Formation Width for New Bridges and Culverts

The formation width of structures shall be proposed to be maintained as full formation width of road section.

8.8 Drainage Design

A good drainage system is vital for the safety and longer life of any structure. This is more relevant in the case of highways. Proper drainage of road surface, pavement and the foundation layers is basic requirement for maintaining the structural soundness and functional efficiency of a road. Pavement structure including sub grade must be protected from any ingress of water. For this purpose, the following conditions have to be ensured:

- Interception of the surface runoff;
- Keeping the water flow duration on the pavement to a minimum;
- Saving the pavement structure from stagnation of water;

- Efficient dispersal and disposal of water; and
- Quick disposal of sub-surface water away from the pavement.

Design for drainage is proposed to be carried out in accordance with the provision contained in IRC: SP 42-2014 and IRC: SP 50-2013.

8.8.1 Hydrological Design Methodology

For the calculation of discharge of the stream by Area-Velocity method, topographical survey including levelling surveys have been carried out across and along the water courses to determine the cross-section and the slope. A number of cross-sections have been taken at regular intervals on both upstream and downstream side of the structure, including one at the proposed location of the structure in accordance with IRC specifications.

The following assumptions have been made for peak discharge calculation:

For locations where water spreads over the banks, the cross-sections were extended up to the HFL, in order to calculate the effective cross-section of flow.

The longitudinal section to determine the bed slope have been taken following the channel course extending on both the upstream and the downstream sides of the structure. Caution is taken by following the curved flow line for longitudinal gradient, rather than a straight line.

Assessment of Peak Discharge

The peak discharge is calculated by the following method for cross section on the upstream and the downstream sections.

Area = Velocity Method (Kutter's constant)

$$Q = A \times V$$

$$V = C \times V(R \times S)$$

Where, Q = the discharge in cumecs:

A = Area of the cross section in sq. m.

V = Velocity in m/sec:

R = Hydraulic mean depth in m. A/P

P = Wetted perimeter of the stream in m.

C = Kutter's constant which is given by

S= Bed slope of the stream; and

N= Co-efficient of rougosity which depends upon the roughness of the stream

The Design Discharge had been taken as the maximum of discharges at different cross sections.

This will have 10% variations with one another.

Hydraulic Analysis for Design HFL

HFL is fixed at the bridge location by local enquiry, then line parallel the bed slope line is drawn at this HFL, from this line HFL at different cross sections are found.

Afflux Calculation

When the waterway area of the opening of a bridge is less than the unobstructed natural waterway area of the stream, i.e. when bridge contracts the stream, afflux occurs. The afflux will be calculated using Orifice formula as given below:-

$$Q = C_o \sqrt{2g} L D_d \times v (h + (1+e) (U^2/2g))$$

Where, h=Afflux in meters;

Q = Discharge

U = velocity

L = Linear waterway

D_d=Depth at D/S side

W = width of River

C_o and 'e' = Orifice formula co-efficient is taken from graph

Scour Depth Calculation

To provide an adequate margin of safety for design of foundation, a further increase by 30% has been made over the design discharge as per IRC: 78-2014, to calculate mean scour depth.

By IRC: 5-2015/IRC: 78-2014

As per IRC: 5-2015 or IRC: 78-2014, the mean depth of scour below the highest flood level, DSM, will be given by the following equation: $d_{sm} = 1.34 \times (D_b^2/K_{sf})^{1/3}$

Where, D_b the discharge in cumecs per meter width and K_{sf} =Silt Factor.

The value of 'D_b' shall be the total design discharge divided by the theoretical effective linear waterway between abutments.

For most of the bridges, the silt factor, K , has been calculated as per guidelines given in IRC-78: 2014 since most of the bridges are Ghat section the bed material composes of pebbles and course sand for which silt factor assumed as 4.

Maximum Depth of Scour for Design of Foundation

The maximum depth of scour below the Highest Flood Level (HFL) for the design of piers (dsmp) and abutments (dsma), having individual foundations without any floor protection are as follows:

Near pier: $dsmp = 2 \times D_{sm}$

In the vicinity of abutment: $dsma = 1.27 \times D$

Vertical Clearance

Provision of vertical clearance in bridges above HFL shall be kept as per IRC SP-13, clause 12.3 as under.

Discharge in m^3/s	Minimum Clearance in m
up to 0.30	0.15
Above 0.3 and up to 3.0	0.45
Above 3.0 and up to 30	0.6
Above 30 and up to 300	0.9
Above 300 and up to 3000	1.2
Above 3000	1.5

8.8.2 Design Storm Calculation

The design of drainage system involves (a) calculating the total discharge that the system will require to drain off and (b) fixing the slope and dimensions of the drain to have adequate capacity to carry the discharge and afford maintenance.

(a) Hydrological Design

Hydrological study is an important step prior to the design of road drainage system. Such analysis is necessary to determine the magnitude of flow and the duration for which it would last. Hydrological data required for design includes drainage area map, water shed delineation, arrow indicating direction of flow, outfalls, ditches, other surface drainage facilities, ground surface conditions, and rainfall and flood frequencies.

To estimate the amount of runoff requiring disposal at given instant, information regarding rainfall intensities within the catchment area and the frequency with which this precipitation to assess peak run-off is essential. The 'Rational Method' is universally accepted empirical formula relating rainfall to run-off and is applicable to small catchment areas not exceeding 50 sqkm. The discharge is calculated by.

$$Q = 0.028 P A I_c$$

Where:

Q= Discharge (Peak run-off) in cum/sec

P= Coefficient of run-off for the catchment characteristics

A = Area of catchment in Hectares

I_c = Critical intensity of rainfall in cm per hour for the selected frequency and for duration equal to the time of concentration

Coefficient of run-off 'P' for a given area is not constant but depends on a large number of factors such as porosity of soil, type of ground cover, catchment area, slope and initial state of wetness and duration of storm.

For specific site conditions, the following values of 'P' given in IRC: SP 42-1994, 'Guidelines on Road Drainage' have been adopted.

Table 8.14: Values of Coefficient of Run-off

Sr . no.	Description of surface	Co-efficient of Run-off(P)
1	Steep bare rock and water tight pavement surface	0.9
2	Steep rock with some vegetative Cover	0.8
3	Plateau areas with light vegetative cover	0.7
4	Bare stiff clayey soils (impervious soils)	0.6
5	Stiff clay soils with vegetative cover with uneven paved road surface	0.5
6	Loam lightly cultivated or covered and macadam or gravel road	0.4
7	Loam largely cultivated or turned	0.3
8	sandy soil, light growth ,parks, gardens, lawns, and meadows	0.2
9	sandy soil covered with heavy bush or wooded / forested areas	0.1

The primary component in designing storm water drains is the design storm Le. rainfall value of specified duration and return period. For the project road a return period of 25 years is considered to be adequate. As the extent of drainage system for the project road is small, even an intense rainfall of short duration may cause heavy outflows. The storm duration chosen for design purposes is equal to time of concentration. It has two components- (a) entry time and (b) time of flow. Because of lack of data for small duration peak rainfall for small catchments in project influence area, the following equation has been used to estimate the rainfall intensity for the shorter durations:

$$I = F(T+1) / T(1+1)$$

Where,

i= Intensity of rainfall within a shorter period of 't' hrs within a storm

F= Total rainfall in a storm in cm falling in duration of storm of "T" hrs

t= Smaller time interval in hrs within the storm duration in "T" hrs

For the purpose of design storm, one-hour maps available from Directorate of Hydrology (small catchments), Central Water and Commission, New Delhi have been used. 1-hr rainfall for return period of 25 years for the project influence area has been taken as 100 mm.

(b) Design of Drain Section

For uniform flow in open channels, the basic relationships are expressed by the Manning's Formula:

$$Q = \frac{1}{n} AR^{2/3} S^{1/2}$$

Where,

Q= discharge in cum/sec

n=Manning's roughness coefficient

R= hydraulic radius in m which is flow cross section divided by wetted perimeter

S= energy slope of the channel which is roughly taken as slope of drain bed

A= Area of flow cross section in sqm

In design, the flow is assumed to be sub-critical. The slope and velocity are kept below the critical level. If design depth is less than critical depth, the section is to be redesigned to avoid critical flow situation.

To simplify the analysis the following energy slopes have been considered for the site-specific conditions:

- For longitudinal median drain: 1 in 200
- For lateral median drain and intersection drainage system: 1 in 285
- For side drains in urban areas: 1 in 200
- For side drains in plain terrain: 1 in 100

8.8.3 Hydraulic Design and Resizing of Existing Culverts

Culverts like Slab culverts and Pipe culverts are predominant along the existing alignment. But they are neither sufficient in number not in terms of vent height at few locations. Hence as per Hydraulic designs per SP13:2004, re-sizing of culverts is proposed and improvement of culverts are presented vide Annexure 8.3.

8.8.4 Slope Stabilization and Protection Works

Erosion prevention is one of the major factors in design, construction and maintenance of highways. The most direct application of erosion control occurs in drainage design and in the

writing of specifications for landscaping and slope planting. Erosion is minimized largely by the use of flat side slopes, rounded and blended with natural terrain; serrated cut slopes; drainage channels designed with due regard to width, depth, slopes, alignment, and protective treatment: inlets located and spaced with erosion control in mind; prevention of erosion at culvert outlets; proper facilities for groundwater interception; dikes, berms, and other protective devices to trap sediment at strategic locations, and protective ground covers and planting.

8.8.4.1 Treatment of High Embankment

High embankment will be site specifically designed considering the quality of the available material, prevalent moisture condition and associated pore water pressure, bearing capacity of the founding strata and the requirement of any preloading etc. Stone pitching/gabion walls are proposed at these locations.

8.8.4.2 Reinforced Earth Wall

The RE Wall has been provided as per required.

8.8.5 Design Methods for Widening of Bridges

Longitudinal drains are designed in such a way that drains merges either at invert level of culverts or at bridge. Also, all bridges are proposed to be widened or reconstructed 11.0m width without foot path and 16m with footpath which is more than full formation width of road ie. 14.0m for 2 lanes. In case of 4 lane section two separate bridges / ROB/ flyover are proposed with full formation width of 2 lanes for both side structures excluding median, if any.

8.8.6 Designs for Road Side Drainage

Presence of a good drainage system is essential. It is therefore necessary to perform a detailed survey of the existing drainage system, the adjoining terrain and its slope, and recommendations for new drainage system or modification to existing drainage system.

Some basic principles have been adopted in order to meet IRC standards.

The surface water from the carriageway, the paved shoulders, the embankment slopes and the adjoining land must be effectively drained off without allowing it to percolate into the sub-grade.

The drains must have sufficient capacity and adequate longitudinal slope to drain away the entire collected surface water to the nearest natural surface stream, river or nallah.

No roadside drains are proposed where the longitudinal water bodies are present parallel to the road. In the project alignment, the following types of drains will have to be proposed:

- Unlined Open Drain in rural section
- Lined Drain in urban areas
- Chute Drains

The hydraulic adequacy of the drains shall be checked as per IRC SP-42 "Guidelines on Road Drainage". The design return period for the drains shall be as 25 years for median drains, chute drains, urban drains and other important drainage systems while the 2 years shall be taken as rural drainage system.

The rain water from the right of way of the road is ultimately required to be transported away before it can cause nuisance or damage. First of all, water has to be transported over the surface. This aspect has been well looked after by providing adequate cross-slope and compatible longitudinal profile. After running over the surface, most of the runoff is collected in the covered / open drain along the road. Open drains are preferred over covered ones as these are easier to maintain and allow removal of silt and other solids easily. Also, for a given cross section open drains can carry much larger discharge particularly in flood conditions where drain is surcharged.

8.8.6.1 Unlined Open Drain in Rural Section

In rural areas where embankment height is less than 1.5m, open unlined toe drains and 1V: 2H side slope have been proposed near ROW on both sides of the road as per guidelines given IRC SP-42: 2014.

8.8.6.2 Lined Drain in Urban Areas

In urban areas, water will flow across separators through cross cuts of size 150 cm x 150 cm top covered by precast slab in RCC M 20 grade provided at an interval of 10 m. This will also facilitate crossings near building lines/built up areas. However, an attempt has been made to minimize such locations as low-level maintenance of covered drain is envisaged in post-

construction phase. The design runoff has been considered not only from the road but also from the adjoining building lines.

8.8.6.3 Drainage at Intersections

Any stagnation of water at intersections would reduce the capacity of junction resulting in queuing up of traffic. The level of junction has been kept higher than the cross roads so that water can reach the main drainage system which is along the main carriageway. No covered drain will be provided as these are likely to be choked due to sweepings from the road during the dry season. The side drain will have to be extended along the cross roads till the appropriate out-fall. In extreme cases, pipe drain will have to be proposed across the cross road to maintain the continuity of the drainage network if out-fall is not possible near-by due to site conditions.

8.8.6.4 Drainage at Bridge

In case of bridges across a river, the main water is to be discharged into river bed through drainage spouts as per IRC standards. Properly designed filter media is to be provided behind abutment / earth retaining structures along with weep hole arrangement at 1.0 m interval to drain out the percolated water.

On approach portion longitudinal drains will have to be provided at the edges of roadway as kerb channel cum ditch drain. Kerb channel will be 55 cm wide having 6% slope and ditch will be of size 50 cm x 45 cm. Kerb channel will have RCC grating at 4.5 m interval to guide water into ditch. In initial stretch smaller depth, say 30 cm, can be adopted which then can be increased progressively to achieve 45 cm depth at the end of ramp.

8.9 Road Markings, Signs and Other Safety Devices

8.9.1 Road Markings

Road markings will be made for center and edge lines using reflective thermoplastic paints. Appropriate road markings will also be provided at junctions and crossings.

8.9.2 Road Signs

Road signs are to place according to IRC: 67-2012. The signs are to be placed on embankment so that extreme edge of sign would be 2.0m away from the edge of the carriageway. The location of each sign is to be decided in accordance with the guidelines there in.

8.9.3 Safety Barrier

Traffic barriers are protective devices that are placed between traffic and a potential Hazard off the roadway, with the intention of reducing the severity of a collision when an errant vehicle leaves the travelled portion of the roadway. Barriers are to be provided at high embankments, sharp curves and bridge approaches. The barrier is to be located at the edge of paved shoulders.

8.10 Pavement Design

The project road will be constructed as two-lane with paved shoulder and upgrading of the existing pavement to carry the anticipated traffic over the design period. This would involve:

- i) Construction of new pavement for widened and realigned/new alignment.

Flexible pavement is adopted for proposed new carriageway and reconstruction. Design period of 20 years considered for new carriageway.

8.10.1 Traffic or Cumulative Equivalent Single Axle Loads

The project road is used by all types of vehicle with different loading and different axle configuration. For pavement design it is very necessary that all kinds of loads converted to a single common axle load hence using equivalent factor. The equivalent axle load factor (EALF) is based on a procedure of converting the number of repetitions of a given load into an equivalent number of repetitions of 8.16 tonne single axle load. The EALF based on fatigue cracking is different from that based on permanent deformation. The use of a single value for both modes of failure is approximate, at best. The most widely used method for determining the EALF is that which uses the empirical equations developed from the AASHTO Road Test, according to which the damage caused increases as the fourth power of the load. For example, a 10.2 tonne axle load would result in EALF of $(10.2/8.16)^4 = 2.5$. Thus, an increase of 25% in the axle load would result in 2.5 times more damage. This fact becomes even more significant in India where overloading is a norm. The fourth power relationship is internationally accepted and is used for design.

Equivalent single axle loads (ESALs) depends upon:

- i) Initial traffic
- ii) Traffic growth (r)
- iii) Directional split of the traffic or directional distribution factor (DDF)

- iv) Number of lanes or lane distribution factor (LDF)
- v) Axle load spectrum or vehicle damage factor (VDF)

Traffic surveys and subsequent analyses were carried out to determine the above parameters.

From the axle-load survey, VDF for each type of vehicle can be determined. The cumulative ESAL is calculated using the following equations:

$$ESAL = \sum_{i=1}^n \text{Initial Traffic} \times 365 \times (1+r)^i - 1 \times \text{Lane Factor} \times \text{DDF} \times X$$

VDF

The equivalent single axle loads (ESALs) have been calculated assuming that the project road will be opened to traffic in the year 2023. Design ESAL in Millions i.e. MSA for project road has been provided in Annexure 8.4. However concise details are provided in table below:

Table 8.15: MSA projection for 20 years

Year	2025	2027	2032	2037	2042
MSA	1.677	4.429	8.182	13.359	20.589

For pavement design of project road, the above MSA values have been adopted. Pavement thickness is a function of log MSA, therefore, at high MSA values the change in pavement thickness is rather minor compared to the change in the MSA value.

8.10.2 Shoulder

As per AASHTO, "as shoulder is the portion of the roadway contiguous with the travelled way for accommodation of stopped vehicles, for emergency use and for lateral support of sub-base, base and surface course." There should be continuous paved shoulder on both the right and the left side of all freeways facilities and the usable paved width of the shoulder should be between 10ft (3.048m) to 12ft (3.658m).

The factors affecting shoulder design are similar to those of mainline pavement design. The major difference is the amount of traffic. Traffic volume on shoulders is lower than on a mainline and much difficult to predict.

Three types of traffic may be considered in shoulder design:

- Encroaching traffic
- Parking traffic, and
- Regular traffic

Regular traffic is considered only if the use of shoulder as an additional lane for peak hour or detoured traffic is anticipated. If there is no regular traffic, the sum of encroaching and parking traffic is used to design the inner edge of shoulder adjacent to the mainline; while parking traffic is used to design the outer edge of shoulder. When there is a paved shoulder and no lateral obstruction within the shoulder area, trucks using the outer traffic lane tend to encroach on the shoulder. The percentage of parking traffic should be added to the encroaching traffic because any truck must encroach to park on the shoulder. It is a common practice to design mainline and shoulder pavements a single unit.

8.10.3 Drainage

Design methods that develop pavement cross-sections on the assumption that the controlling factors are stress, strain, deformation and fatigue under repeated wheel loads, and ignore the effects of wheel load on water trapped in the pavement structure are a recipe for "designed to fail pavement design. The trapped water in the pavement structure under the wheel loads generates pore pressures which drastically reduce the bearing capacity or strength of the granular layer and erodes the base and sub-base material, resulting in damage. This may cause premature failure of the pavement.

To ensure adequate internal drainage of the pavement a full width of bottom most granular layer is proposed in the case of new rigid pavement, and a drainage layer under the rigid pavement has been provided.

8.10.4 Flexible Pavement Structural Design for New Construction

8.10.4.1 Recommended Pavement Design

Granular subbase should be laid in up to formation width. Similarly, a dense bituminous macadam thickness is proposed as per IRC design, would be most appropriate, and does not

affect either design drastically. The recommended pavement design on project road, therefore, should consist of layer composition as per **Table 8.16**

Table 8.16: Recommended New Pavement Design

Homogeneous section	Design Chainage		CBR	MSA	Crust					Total Thickness
	From	To			SUB GRADE	BC	DBM	WMM	GSB	
Vailoo to Donipawa	148+589	176+532	10%	20	500	40	70	250	200	1060

8.11.7 Scheme of Widening

The existing section of Vailoo-Donipawa under scope of study has multi-dimensional facets in terms of tourist place like Kokernag & Achabal, geometry, pavement condition, existing utilities, religious structure at Achabal, etc. and considering all these aspects the section-wise policy adopted for widening based on the investigations is given in below:

Table 8.17: widening Schedule

Sr.no	Detail	TCS	Length	
			(m)	(Km)
1	TYPICAL CROSS SECTION-01 NEW CONSTRUCTION OF FOUR LANE IN OPEN COUNTRY	1	120	0.12
2	TYPICAL CROSS SECTION-02 CONCENTRIC WIDENING OF FOUR LANE IN BUILTUP AREA	2	2632	2.632
3	TYPICAL CROSS SECTION-03 ECCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA LHS SIDE	3	2934	2.934
4	TYPICAL CROSS SECTION-04 ECCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA RHS SIDE	4	650	0.65
5	TYPICAL CROSS SECTION-05 CONCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA PROTECTION WORK BOTH SIDE	5	210	0.21
6	TYPICAL CROSS SECTION-06 ECCENTRIC WIDENING OF FOUR LANE IN HILL AREA LHS SIDE ALONG WITH PROTECTION WORKS BOTH SIDE	6	194	0.194
7	TYPICAL CROSS SECTION-07 NEW CONSTRUCTION OF FOUR LANE IN HILLY AREA ALONG WITH PROTECTION WORKS BOTH SIDE	7	340	0.34
8	TYPICAL CROSS SECTION-08 BRIDGE WIDENING OF FOUR LANE IN OPEN COUNTRY	8	85	0.085
9	TYPICAL CROSS SECTION-09 CONCENTRIC WIDENING OF FOUR LANE IN HILL AREA WITH LOAD BEARING DRAIN BUILT-UP AREA	9	330	0.33
10	TYPICAL CROSS SECTION-010 CONCENTRIC WIDENING ON BOTH HAND SIDE SINGLE LANE BRIDGE BUILT-UP AREA	10	30	0.03

11	TYPICAL CROSS SECTION-11 ECCENTRIC BRIDGE WIDENING OF FOUR LANE IN HILL AREA	11	115	0.115
12	TYPICAL CROSS SECTION-12 NEW CONSTRUCTION OF BRIDGE AT VAILOO ROAD JUNCTION	12	30	0.03
13	TYPICAL CROSS SECTION-13 ECCENTRIC WIDENING OF FOUR LANE IN OPEN COUNTRY AREA LHS SIDE	13	947	0.947
14	TYPICAL CROSS SECTION-14 ECCENTRIC WIDENING OF FOUR LANE IN OPEN COUNTRY AREA RHS SIDE	14	890	0.89
15	TYPICAL CROSS SECTION-15 ECCENTRIC WIDENING OF FOUR LANE IN BUILT-UP AREA / OPEN AREA RHS SIDE	15	230	0.23
16	TYPICAL CROSS SECTION-16 TWO LANE BRIDGE APPROACH SECTION DOWN STREAM SIDE	16	129	0.129

9.0 Cost Estimate

9.1 Introduction and Assumptions

Detailed cost estimate for **Vailoo - Donipawa** road section has been finalized based on the improvements proposed under Chapter 8. The detailed estimate is worked out based on the quantities calculated for the items of work to be executed in the project and rates derived after detail analysis and as contained in the government Basic schedule of Rates.

Following assumptions have been made for calculating quantities, rate analysis and cost estimate.

- a) It is assumed that suitable water would be available for construction purpose within reasonable lead and hence no separate haulage / rate has been considered for this purpose.
- b) Establishment of good hygienic labour camp is deemed to be included in adopted rates and hence no separate provision has been made.
- c) Establishment of field laboratory for conducting basic tests on soils construction material and for quality control is also deemed to be included in adopted rates. c)
- d) For road work, bituminous construction, bridge work and CD work, basic lead of 5 km is considered for all completed items and thereafter additional lead component has been considered.
- e) All sundries, contractor profit, and other overhead charges are deemed to be included in the derived rates. Items required for adhering to safety standards during construction and maintenance phases mentioned in O&M standards are also deemed to be considered. e)
- f) Mechanized construction using hot mix batching plant, pavers, concrete batching plant etc. has been assumed while working out the rates.

9.2 Adoption of Unit Rates

The cost estimate of the project road as presented in the Feasibility Report is based on the final development proposals and priced at latest schedule of rates of Jammu and Kashmir.

The cost estimate has been done with the consideration that the full proposed length of the road will be constructed in one section under one construction package.

For arriving at unit rates at Feasibility stage, it has been assumed that the specifications generally conform to the provisions made in "**Specifications for Road and Bridge Works (Vh Edition)**" of MORT&H.

To develop a thorough understanding of the prevailing construction rates the Consultant have reviewed Basic Schedule of Rates (BSR) published by Public Works Department, Jammu and Kashmir year 2019 including 5% escalation up to the current year.

9.2.1 Based on Rate Analysis

The consultant has adopted the rates from Schedule of Rates, 2013 of Road Construction Department, Government of Jammu and Kashmir for major items of works including 5% escalation up to current year.

9.2.2 Based on Market Rates

The consultant has thoroughly reviewed the market rate and adopted the market for the items of works such as Bitumen, steel, cement etc.

9.3 Bill of Quantities for Civil Works

The quantities of major items of works have been worked out based on the preliminary highway design, inventory, condition surveys, and other pavement investigations data. The pavement quantities have been worked out based the geometrics and cross sections, pavement design done based on traffic and laboratory investigations.

Site Clearance:

The area considered for Site Clearance is the area within the proposed Right of Way minus the existing carriageway area.

Earth Works:

This item provides for roadway excavation, earthwork in embankment, subgrade and shoulders including disposal of surplus earth and unsuitable material. The earth work quantities like roadway in embankment have been computed based on the data collected during inventory survey. The quantity for cutting in deep section is computed and further classified as cutting in ordinary rock or cutting by open/controlled blasting in hard rock. The earthwork quantities are based on our site surveys and highway design. Sub-grade having a CBR 9% will be taken from borrows area.

Sub-base, Base, Surface Courses:

These provide for the items of GSB and WMM for the main carriageway. The quantities for road pavement, base, sub-base etc. for main carriageway have been calculated through applicable cross-sectional template developed in excel software. A provision for cross-fall correction layer has been made for existing carriageway and its quantity has been worked out.

Bituminous Works:

Flexible pavement has been considered for the project road. Bituminous works provide for all items of bituminous courses and surfacing. Quantities for the pavement component are based on the pavement designs proposed in Chapter 8.

Culverts:

The estimation of quantities for culverts was based on site inventory condition survey and study of require hydraulics. The detailed recommendations are given in

Chapter 8. The quantities for structures have been calculated based on detailed General Arrangement Drawings for structures have been calculated bags using STAAD software and in-house software.

Bridges and structures:

The cost for bridges has been worked out based on the quantities derived from per sqm rate.

Junctions Improvement:

This item includes quantities of kerbs, railings, median etc. The cost for junctions also includes the cost for at grade junctions, which need improvement along the highway.

Traffic Signs and Markings:

Proper traffic signs were planned at required locations along the project corridor. It is reviewed considering the traffic and pedestrian safety. The number of traffic signs shall be adequate and modified if required. Centre line and edge markings required from safety point of view were considered in the quantity estimate. RCC Guard posts, double sided metal beam barrier and pedestrian steel guards have been considered at appropriate locations.

Drainage and Protection works:

Provision under this sub-head has been made for surface, subsurface and roadside drains, drainage chutes in cement concrete and stone pitching at outfalls/escapes for drainage. This

covers for unlined, open lined and covered drains. The quantities for drainage, protection of embankment & protection against tank bund and river training works are computed based on typical drain drawings and tentative drainage plan.

Miscellaneous Items:

A lump sum amount has been provided for project house, furniture and equipment required for project maintenance, parking, footpath, electrifications, and roadside amenities. In addition to these, traffic control and diversion, bus-stops and cross utility ducts have also been provided.

Utility Shifting

Broad provision is made in the cost estimate for raising and or shifting high-tension lines, electric supply lines, telephone lines and other utilities.

Table 9.1: Description of Bills for Cost Estimate

Major Heading	Item of Works
Site Clearance	<ol style="list-style-type: none"> 1. Clearing and Grubbing 2. Dismantling of existing structures/ Km stones/ pavement/ road signs. 3. Cutting of Trees and removal of stumps. 4. Scarifying existing bituminous surface. 5. Dismantling.
Earth work	<ol style="list-style-type: none"> 1. Earthwork in excavation for Ordinary soil/soft rock/hard rock. 2. Embankment construction with material from borrow area. 3. Embankment construction with material from road cutting. 4. Subgrade and Shoulder construction. 5. Turfing.
Non-Bituminous Courses	<ol style="list-style-type: none"> 1. Granular sub-base. 2. Wet mix macadam. 3. Footpath
Bituminous Course	<ol style="list-style-type: none"> 1. Prime coat. 2. Tack coat. 3. Bituminous Macadam as Profile Corrective Course. 4. Dense Bituminous Macadam. 5. Semi dense bitumen macadam. 6. Bituminous Concrete.

<p>Cement Concrete Pavement</p>	<ol style="list-style-type: none"> 1. Dry Lean Concrete. 2. Pavement Quality Concrete.
<p>Bridge and Cross Drainage Structures</p>	<ol style="list-style-type: none"> 1. Earthwork in excavation for Ordinary soil/soft rock/hard rock. 2. Concrete work in foundation, substructure and superstructure. 3. CR masonry work in foundation and substructure. 4. Slab culvert (widening/new construction/repair / on cross road). 5. Pipe culvert (widening/new construction/repair / on cross road/duct for utility crossing) 6. Major/Minor Bridge (widening/new construction/repair). 7. RCC bore pile and pile cap. 8. Load test of Pile. 9. Reinforcement in foundation, substructure and superstructure. 10. HT Steel. 11. Steel liner 12. Bearing - PTFE, Tar paper, elastomeric. 13. Expansion joint - Strip seal, Pre-moulded file. 14. Asphaltic Wearing coat. 15. Cement paint to exposed concrete. 16. PMC mortar & epoxy bonding coat to concrete. 17. Stone pitching in slope and apron. 18. NP-4 Pipe for culvert.
<p>Drainage and Protection works</p>	<ol style="list-style-type: none"> 1. Unlined drain. 2. Covered lined drain. 3. Chute Drain. 4. Pitching. 5. Reinforced Earth Structure. 6. Stone Pitching. 7. Inspection Chamber/Catch pits. 8. Filter media. 9. Reinforced Earth Structure.

Road side Furniture	<ol style="list-style-type: none"> 1. Km. stone/Boundary stone. 2. Road signs. 3. Pavement markings. 4. Road signage. 5. Crash Barrier. 6. Road stud. 7. Railing. 8. Fencing. 9. Kerb.
Maintenance	<ol style="list-style-type: none"> 1. Diversion. 2. Routine Maintenance.
Electrical Works	<ol style="list-style-type: none"> 1. Streetlight in Urban area. 2. Lighting at toll plaza. 3. Lighting at Truck Lay byes. 4. Lighting at Intersections.
Miscellaneous Items	<ol style="list-style-type: none"> 1. Road side Barriers.
Way side amenities	<ol style="list-style-type: none"> 1. Utility duct. 2. Bus shelter. 3. Tree plantation.
Toll plaza	<ol style="list-style-type: none"> 1. Toll Booth. 2. Barrier Gate. 3. Canopy. 4. Administrative Building.
HTMS	<ol style="list-style-type: none"> 1. Highway Traffic Management System.

9.4 Costing for safety devices

The safety device has been proposed based on criteria given in chapter-9 improvement proposal. cost of safety devices like, crash barriers, road signs and markings, delineators kerbs etc. have been derived in Bill of Road side furniture.

9.5 Land Acquisition Cost

Area of land acquisition has been derived based on the actual area calculation from the plan drawings which is difference of proposed Row and existing ROW. The land acquisition cost has been derived cost estimate summary.

9.6 Cost of R&R

R & R (i.e. cost for acquisition of structures, resettlement site development, transitional allowance, staff training, and institutional arrangements & strengthening etc.,) will be provided in final feasibility report.

9.7 Total cost Estimate

The Abstract and detailed cost estimate is presented and summarized in this chapter.

The summary of cost estimate has been computed and presented in **Table 9.2** below.

Section	Proposed Length(km)	Base cost including GST (Cr)
Vailoo - Donipawa	9.866	150.49

10.0 Conclusion and Recommendations

10.1 General

Given the needs of the project to adequately address the concerns of the local population and latest IRC guidelines, the project has been conceived with the provision of underpasses, Railway over Bridges, service roads and wayside amenities completely integrated into the project wherever required. Looking at the peculiarity of soaring prices around the highways for which the widening works are in progress, the aspect of acquisition of wider land strip or formation of bypass has been examined wherever feasible.

10.2 Project Clearances

Following clearances are required before the commencement of construction work. Out of these, few are critical and need to be obtained immediately to avoid the time lag at later date.

Table 12.1: Project Clearances

Sr.No.	Item	Agency
1	Forest Clearance	Jammu and Kashmir Forest Department
2	Pollution Clearance-No Objection Certificate (NOC) (Exempted)	Jammu and Kashmir State Pollution Control Board
3	Shifting of services and utilities including underground water pipeline sewerage line and optical fiber cables	BSNL, BSEB, Public Health Engineering department, Optical fiber cable operator
4	Clearance for cutting trees and transporting	NA
5	Dismantling of structure falling within right of way	Competent Land Acquisition Authority

10.3 Recommendations

- It is intended that the conclusions and recommendations included in this report would generate discussion and interpretation of the environmental and social assessment scope of work. The following general recommendations are made:
- Based on the lane capacity analysis results, the project road requires 4 lanes with paved shoulder for capacity augmentation and efficient movement of traffic up to project common concession period of 20 years i.e. horizon year 2043.
- The project road can be improved without causing significant adverse environmental impacts to the natural, social, economic or cultural environments.

- The process of land acquisition must be initialized immediately after the approval of the alignment, to expedite construction of widening sections.
- The project can be constructed within 18 months period with strategic planning and through one construction package. The construction work may begin from June 2026.

The estimated basic cost is given below table

Section	Proposed length (Km)	Base cost in Crore including GST
Vailoo - Donipawa	9.866	150.49

- Project road section is financially not viable based on the forecasted traffic and MoRT&H user fee with 40% government subsidy. Therefore, under EPC contract option proposed for the entire project section with single package and 20 years concession period is adopted.