

राष्ट्रीय राजमार्ग एवं अवसंरचना विकास निगम लिमिटेड

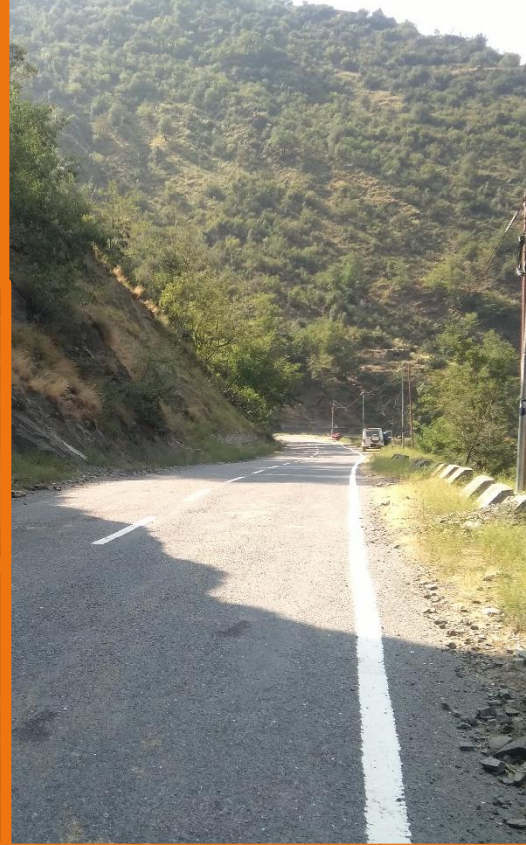
NATIONAL HIGHWAYS & INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.

## FINAL DETAILED PROJECT REPORT

April 2020

CONSULTANCY SERVICES FOR PREPERATION OF DETAILED PROJECT REPORT AND PROVIDING PRE-CONSTRUCTION ACTIVITIES IN RESPECT OF THE FOLLOWING STRETCH ON NH-244 (OLD NH-1B) IN THE STATE OF JAMMU AND KASHMIR.

- (1) SUDHMAHADEV- DRANGA TUNNEL OF APPROX. LENGTH 4.5 KM AND ITS APPROACH ROAD ON CHENANI - SUDHMAHADEV-GOHA ROAD PORTION.
- (2) VAILOO TUNNEL OF APPROX. LENGTH 10.0 KM UNDER SINTHAN PASS AND ITS APPROACH ROAD ON GOHA-KHELLANI- KHANABAL ROAD PORTION.
- (3) ROAD PORTION FROM 82.675 TO 82.925 AT KM 83 ON BATOTE-KISHTWAR ROAD SECTION OF NH-244.
- (4) EXTENDED ROAD SECTION FROM GOHA TO KHELLANI OF 30 KM LENGTH



## KHELLANI TUNNEL & ITS APPROACH ROAD PACKAGE - II (KM 29.030 to KM 31.449) VOLUME - I - MAIN REPORT

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## VOLUME INDEX

The detailed project report consists of the following nine volume

**VOLUME- 1. MAIN REPORT**

**VOLUME- 2. DESIGN REPORT**

**VOLUME- 3. MATERIAL REPORT**

**VOLUME- 4. ENVIRONMENTAL ASSESSMENT REPORT INCLUDING ENVIRONMENTAL MANAGEMENT PLAN (EMP) & RESETTLEMENT ACTION PLAN (RAP)**

**VOLUME- 5. TECHNICAL SPECIFICATIONS**

**VOLUME- 6. RATE ANALYSIS**

**VOLUME- 7. COST ESTIMATE**

**VOLUME- 8. BILL OF QUANTITIES**

**VOLUME- 9. DRAWINGS**

Sr.No	Description	Revision No.	Date
01	Final Detailed Project Report	R0	October 2019
02	Final Detailed Project Report (Packagewise)	R1	November 2019
03	Final Detailed Project Report (Packagewise)	R2	April 2020

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## 1.0 PROJECT BACKGROUND

The Ministry of Road Transport and Highways (MORT&H) is poised to develop all remote and strategically important roads of hilly terrains to perennial routes. In continuation to these developments National Highways and Infrastructure Development Corporation Limited (NHIDCL) has been appointed by MORT&H, to implement these projects.

NHIDCL has engaged **TPF Getinsa-Eurostudios as S.L in Association with Rodic Consultants Private Limited**, to carry out Consultancy Services for preparing Detailed Project Report for Dranga – Khellani section from Sudhmahadev – Dranga Tunnel approach road to Khellani town including a tunnel (Uni-directional) named as Khellani tunnel to bypass the Khellani town in the State of Jammu & Kashmir.

The project corridor length is 18.599 km extended road section from Goha to Khellani Road includes Khellani Tunnel of approx. length 1.5 Km portion from km12.850 to km 31.449 also with connecting to Goha & Bargran village via link road.

This Project Corridor is divided in two packages:

**Table 1: Details of Packages**

Package	Chainage		Length (Km)	Remarks
	From	To		
IA	12+850	20+300	7.450	Road & Bridges
IB	20+300	29+030	8.730	Road & Bridges
II	29+030	31+449	2.419	Road, Bridges & Tunnel

This document contains Package-II report.

## 2.0 EXECUTIVE SUMMARY

The National Highway (NH-1B) is entirely within the state of Jammu and Kashmir. NH 1B links Batote with Khanabal and is 274 km long. It has been renamed as National Highway 244 (NH 244). The Site is in Jammu province on NH 244. The Government of India (GOI) is planning to ease traffic volume on Jammu-Srinagar Highway and would want to connect Srinagar and border areas in J&K with alternate routes with all-weather roads. NH 244 has been selected by the GOI for this purpose.

The NHIDCL has already awarded the Consultancy Services for Preparation of Detailed Project Report and providing Pre-Construction activities in respect of the following stretches on NH-244 (old NH-1B) in the State of Jammu & Kashmir.

- (i) Sudhmahadev – Dranga Tunnel of approx. length 4.5 Km and its approach roads on Chenani – Sudhmahadev – Goha road portion.
- (ii) Vailoo Tunnel of approx. length 10.00 Km under Sinthan Pass and its approach roads on Goha – Khellani – Khanabal road portion to TPF Getinsa-Eurostudios as S.L in Association with Rodic Consultants Private Limited.
- (iii) Road Portion from Km 82.675 to Km 82.925 at KM-83 on Batote-Kishtwar Road Section of NH-244.
- (iv) Extended Road Section from Goha to Khellani of 30 Km Length

This proposed section of Goha - Khellani falls on the newly proposed alternate route for the Jammu – Srinagar highway. It will divert the main traffic from NH-244 (old NH-1B) from Chenani town and traverses through newly proposed Sudhmahadev – Dranga Tunnel approach road and then through this project road section of Goha – Khellani tunnel road and finally terminates again at NH-244 (old NH-1B).

This entire proposed road is very shorter in length and access through many untouched villages and towns in its stretch. This road also traverses through a tunnel, so, it would very convenient to travel through it.

### 2.1 Tunnel Alignment

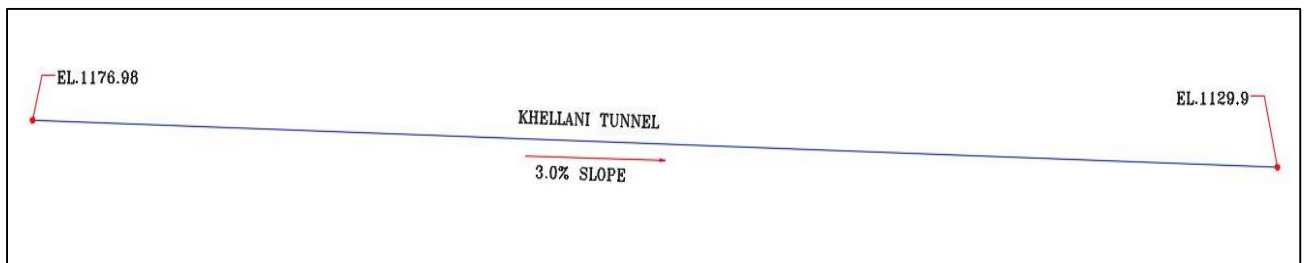
#### Horizontal Alignment

The tunnel is aligned keeping in view of the topography, length and the location such that

tunnel passes through the region having adequate cover all around. Uni-directional tunnel has been proposed to bypass the Khellani village. The length of tunnel tube-1 and tube-2 is 1541m and 1574m respectively. The western portal is located about 45 m away from NH-1B on the existing village road at an El. 1176.98m. Eastern portal is located near the Khellani town near the highway (NH-1B) at an El. 1129.90m. This tunnel traverses straight towards Khellani town with no curves and acts as a Bypass to Khellani village.

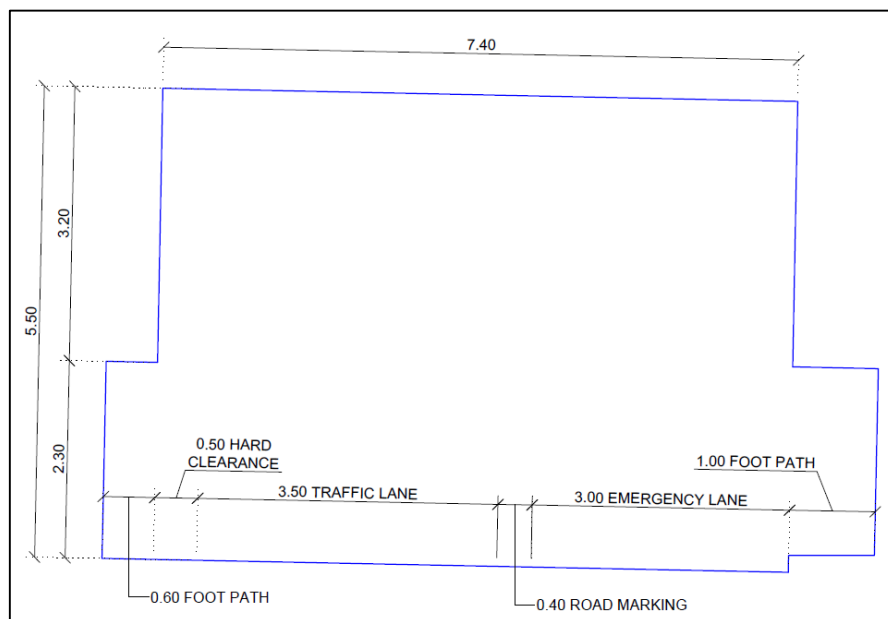
### Vertical Alignment

Western portal & Eastern portal of tunnel have been kept at El. 1176.98m and El. 1129.90m respectively. Slope of 3% has been provided in the tunnel.

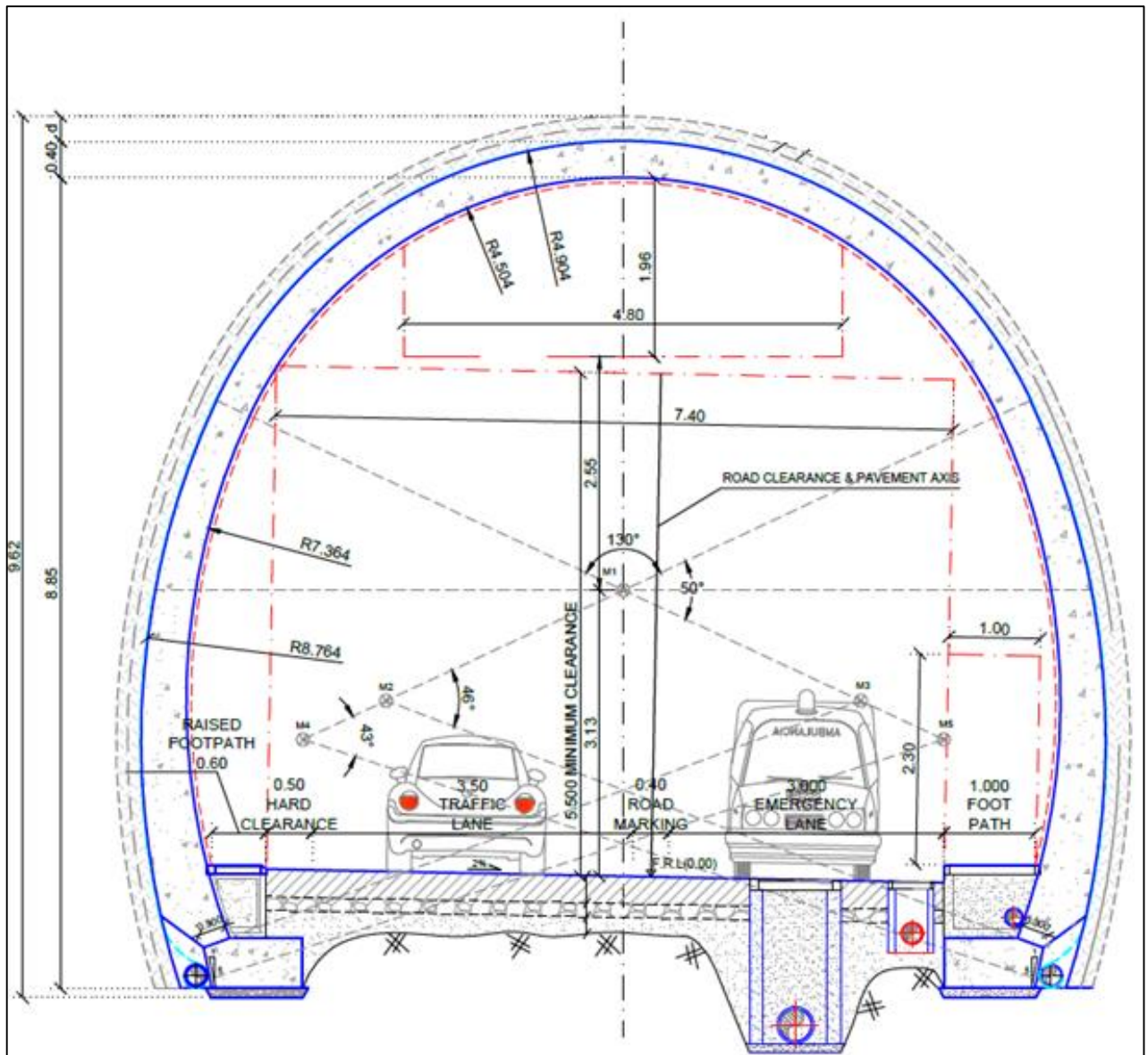


## 2.2 Typical Cross Sections

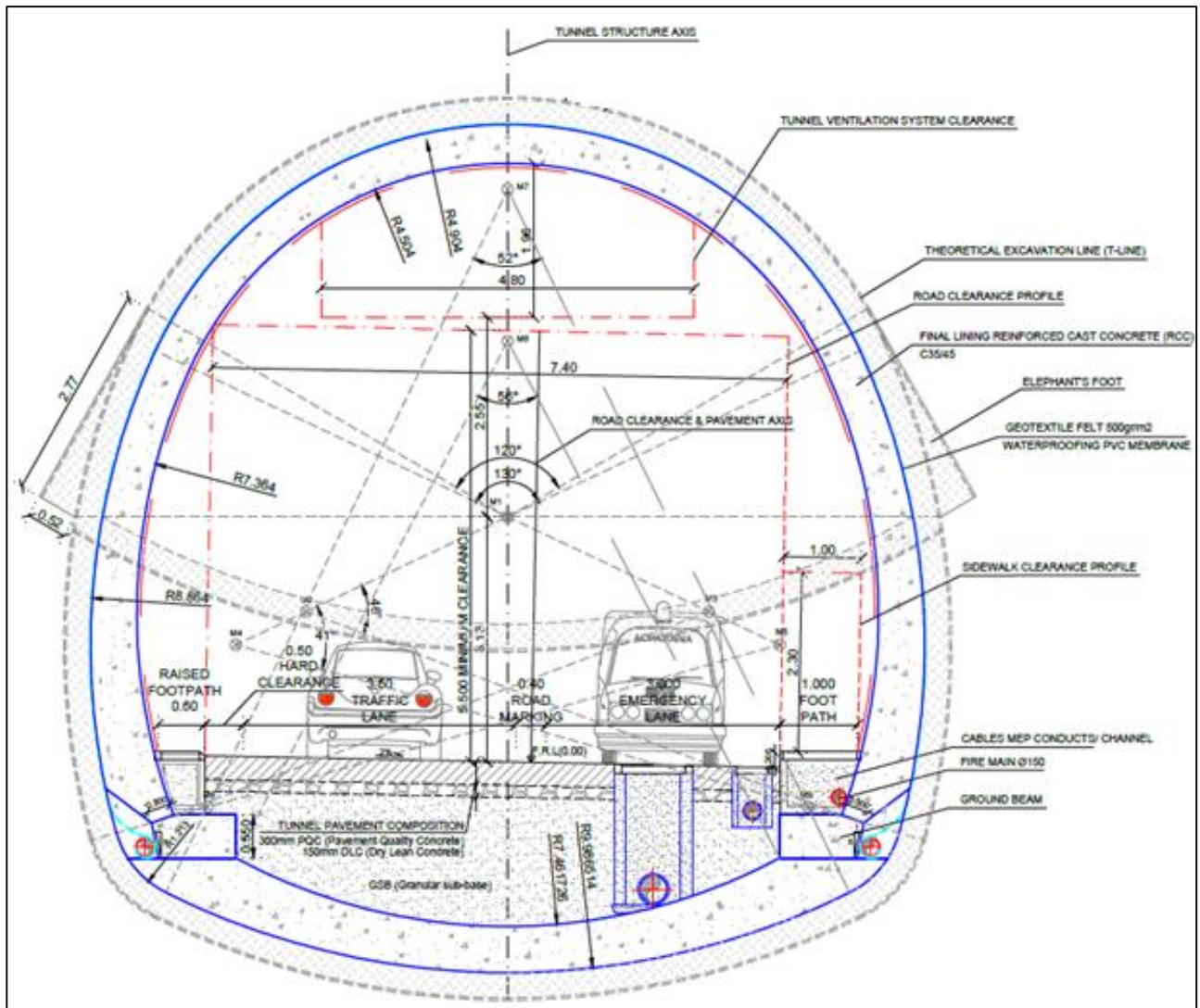
The typical cross section is designed according to Indian and International Standards and Guidelines for road tunnels. Clearance profile as defined in below Fig.



The typical cross sections for the tunnel with and without invert are given in below figures.



**Uni-Directional Tunnel Cross Section without Invert**



**Uni-Directional Tunnel Cross Section with Invert**

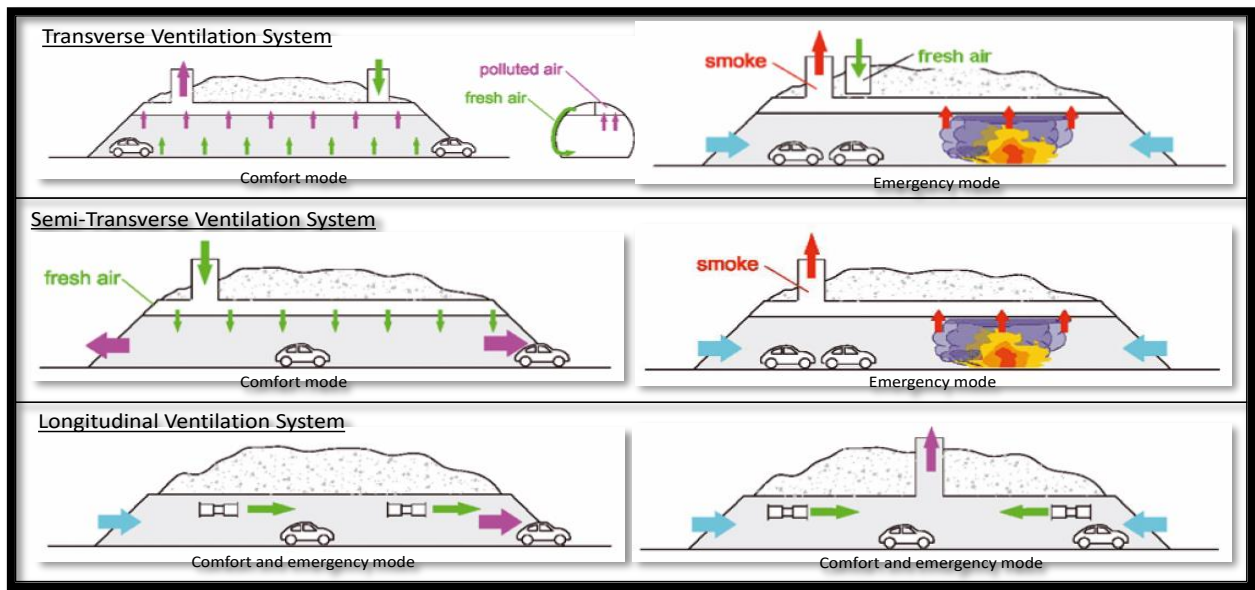
**2.3 Pavement**

The road pavement consists of the following layers:

- 300 mm Pavement Quality Concrete
- 150 mm dry lean cement concrete sub-base layer
- 450 mm GSB

**2.4 Ventilation**

There are different systems for tunnel ventilation, each one with its own advantages and disadvantages. A complete description of the possible systems can be found in NFPA 502. The following lines will serve as a simple introduction, with the minimum concepts necessary for the comprehension of the document.



**Types of ventilation Systems. Source: PIARC**

**Transverse ventilation**

A fully transverse system consists in 2 different ducted ventilation systems, one for fresh air injection (preferable at floor level) and another for exhaust (at the ceiling), evenly distributed along the tunnel.

In case of fire, only the exhaust dampers close to the fire are remotely opened, and fresh air injection must be stopped.

This system is the best for contaminants control and the safest in case of fire if correctly operated, as it exhausts the smoke locally near the fire, maintaining clear of smoke the rest of the tunnel. Its main disadvantage is the high cost involved due to the complex and large civil infrastructures needed (shafts, ventilation buildings, ducts).

**Semi-transverse ventilation**

In this case there is only a ventilation duct along the tunnel, which can work either injecting fresh air for contamination control or exhausting smoke in a similar way as a transverse system.

The problem of this system is that normal operation is usually fresh air injection, as it works better than exhausting polluted air. In case of fire the system has to stop, open/close the adequate dampers and reverse the flow. This can take some time, and during that period the system is working in the worst possible way for a fire: injecting

fresh air at the smoke layer, thus feeding oxygen to the fire and breaking stratification of the smoke.

### Longitudinal Ventilation

This is the simplest tunnel ventilation system, and the most used nowadays, and it consist mainly in developing an air flow inside the tunnel by means of jet-fans or Saccardo nozzles, so that fresh air comes in at one side and polluted air / smoke goes out through the other end of the tunnel.

On certain occasions, this longitudinal air flow may be achieved by means of exhaust shafts that create flow at both sides of the shaft towards it (maybe with the help of jet-fans); or even with both intake and exhaust shafts that divide the tunnel in ventilation sections (push-pull system). This system is typical in subway infrastructures.

In case of a fire, unlike transverse or semi-transverse systems where smoke is directly extracted by the system regardless of its heat release rate (HRR), the main objective of a longitudinal ventilation system is usually reaching the Critical Ventilation Velocity (VC), or the velocity that just impedes back layering of smoke (smoke moving backwards against the airflow), considering that ventilating over that velocity smoke stratification is unlikely.

### Ventilation System Selection

The Austrians guidelines RVS 09.02.31 [3] determine special ventilation systems for certain tunnel and traffic configurations. The field of application of tunnel ventilations systems is shown in below Table.

**Table 2: Ventilation System Selection**

Traffic Situation	AADT/Lane [Vec/24h]	Tunnel Length [m]	Ventilation System
Uni-directional Traffic	-	< 500	Natural Ventilation
	< 5.000 & Low Traffic Jam Frequency	< 700	Natural Ventilation
	> 5.000 bis < 10.000 & Middle Traffic Jam frequency	500 to < 3.000	Longitudinal Ventilation
	> 5.000 & High Traffic Jam frequency	500 to < 1.500	Longitudinal Ventilation
	> 5.000 & High Traffic	1.500 to < 3.000	Longitudinal Ventilation & point

Traffic Situation	AADT/Lane [Vec/24h]	Tunnel Length [m]	Ventilation System
	Jam frequency		smoke extraction (max. 750m distance)
	-	> 3.000	Exhaust extraction with false ceiling
Bi-directional Traffic	-	< 500	Natural Ventilation
	< 2.000	< 700	Natural Ventilation
	< 5.000 & Low Traffic Jam Frequency	500 to < 2.000	Longitudinal Ventilation
	< 5.000 & Middle Traffic Jam Frequency	500 to < 1.500	Longitudinal Ventilation
	> 5.000	1.500 to < 3.000	Longitudinal Ventilation & point smoke extraction (max. 750m distance)
	-	> 3.000	Exhaust extraction with false ceiling

The Khellani Tunnel has a Length of about 1.5 Km with Uni-directional traffic. Therefore, a longitudinal ventilation system according to RVS 09.02.31 is provided. Longitudinal ventilation is the most adequate ventilation system from a cost-effective point of view, provided the following assumptions are met:

- Unidirectional tunnel, so that vehicles would only stop inside the tunnel at one side of an accident
- No traffic jams expected inside the tunnel, because of low traffic is expected and/or a traffic control system at entrance (barriers) is provided
- Relatively short distance between emergency exits (500 m maximum, preferable about 250 m)
- Appropriate control system to avoid counter flow due to unfavourable weather conditions (high wind at exit portal, high atmospheric pressure difference between portals)
- Pollutants concentration design levels can be maintained for normal operation (sanitary ventilation). This is limited by the length of the tunnel and the traffic expected, unless air can be renewed by means of intermediate ventilation shafts.

Khellani Tunnel fully comply with these assumptions, so a longitudinal ventilation

system is considered to be adequate at these infrastructures.

## System Design

### Emergency ventilation

#### - Dimensioning study

The following conditions are used for the design:

- 30 MW fire (equivalent to HGV fire)
- Enough jet fans pairs would be installed to achieve a ventilation velocity over the critical velocity according to NFPA 502 (2017)
- An extra jet fan pair will be installed for redundancy (failure or maintenance)

A sensitivity analysis is made in order to find the most unfavourable fire position for each tunnel/tube.

### Jet-fan

The system proposed is based on the installation of jet-fan pairs along the tunnel, preferably near the transformer room due to electrical limitations (entrances or center of tunnel).

Considering the extra pair needed for redundancy, the number of jet-fans at each tunnel is:

**Table 3: Jet Fan**

Tunnel	Number of Jet Fan Pairs
Khellani Tunnel – TUBE 1	6
Khellani Tunnel – TUBE 2	2

## 2.5 Tunnel Safety Provision

Several tunnel facilities are provided for self-rescue system to provide adequate environment during evacuation period as listed, but not limited to the following:

- The **twin tubes tunnel configuration** allows the unidirectional one lane traffic in each tube, which **reduces the risk of accident inside tunnel**.
- Provision of emergency lane (right side)
- Drivable and pedestrian-use cross passages

- Emergency telephone
- Ventilation system
- Road signs
- Electro-mechanical installations

## **2.6 Construction Method**

The Conventional Tunneling Method (Drill & blast combined with mechanical localized excavation whenever required) is proposed for the construction of tunnel. Tunnel is designed with the principles of NATM.

## **2.7 Geological/Geotechnical Evaluation**

In this valley, the project area around tunnel alignment, gneiss, biotite gneiss, quartzite, mica schist, granitic gneiss, porphyritic granitic gneiss, impure limestone with intercalation of quartz veins of Salkhala Formation of Precambrian age and Kaplas Granite & Bhalla Granite lithounits of Lower Palaeozoic (?) age (Vaid & Lal, 1990-91, GSI). These are best exposed along the main highway and connecting road to main highway.

## **2.8 Comparison of Unidirectional / Bi-directional Tunnel.**

After the analysis with available Project and antecedent data regarding mentioned DPR, below we develop an assessment regarding most convenient tunnel configuration. Observations are as follow:

### **MEP systems and safety concept in tunneling**

- ✓ According to traffic study and forecast, in case of Bi-directional tunnel solution the traffic inside tunnel will be significantly more, so more vehicle emissions, and in the tunnel this solution shall require a transverse ventilation system, instead of longitudinal ventilation system which is feasible in twin tube unidirectional tunnel solution. The transverse ventilation system will be more costly than longitudinal system.
- ✓ The implication of transverse ventilation system is the requirement of ventilation buildings at portals of tunnel and supplementary civil works (ventilation slab plus partition wall) in the final lining structure to accommodate the ventilation ducts separated from the main tunnel road section.

- ✓ The structural connection between the ventilation ducts and the building requires a complex structural design and smooth shaping to match the ventilation parameters, and also the system of ducts should be air-tight, which involves a complication in the treatment of sealing of construction joints.
- ✓ Therefore, these civil works are more sophisticated and sensible during construction stage.
- ✓ In case of unidirectional twin tubes solution, the advantage related to traffic management is that in case of major repairing/maintenance works involving a closure of tunnel, this solution allows the use of the other unidirectional tube with a traffic diversion, and alternate unidirectional traffic flow handled through tricolor lights, flag men or other procedures.
- ✓ Even it can be used the emergency lane under exceptional circumstances under the approval of competent Authority, although this is not recommended in principle. In case of bidirectional tunnel, it is not possible to divert the traffic to the escape tunnel because usually this tunnel is closed and not designed/prepared for commuter's traffic.
- ✓ For bidirectional tunnel solution, the connection between projected road and emergency gallery may involve complications related to alignment.
- ✓ From the purely safety point of view the unidirectional twin tube solution has less probability of accidents inside tunnel, and there is no possibility of frontal crash between vehicles, which habitually leads to major fatalities. Our concern is that in road tunnels, safety is a must, as reflected in PIARC reports and recommendations.
- ✓ In case of unidirectional twin tubes, the adoption of longitudinal ventilation system simplifies the pressurization of evacuation transverse galleries to avoid smoke propagation to the healthy twin tube in case of fire emergency. The transverse ventilation system along with closed escape tunnel implies more complex pressurization system and consequently an increase of ventilation cost, as it can be deduced from Chenani-Nashri Tunnel.
- ✓ According to European Directive 2004/54/CE it is possible to avoid lay bays inside tunnel in case of presence of emergency lanes, as it is the case of unidirectional twin

tube solution. In case of bidirectional tunnel lay bays are required as per national normative/regulations/ recommendations. Nevertheless, to facilitate de maintenance works of MEP teams deployed on ground, it is convenient to include lay bays only at the locations of cross passages equipped with technical rooms (transformer stations, LV rooms, control rooms, etc.) no to create a disturbance for traffic during their intervention.

- ✓ The emergency response team and emergency services can reach more easily and expedited to the accident/incident location inside the tunnel due to the incorporation of emergency lane, which is not in the case of bidirectional tunnel, because only can be in this case the escape tunnel, and better coordination response/evacuation will be required.
- ✓ It has to be accounted for the saving in costs during O&M period in case of safer concept tunnel for unidirectional twin tubes.

**Regarding Traffic parameters and Road cross section configuration (indications from codes and regulations):**

- ✓ It has to be noticed that the hard clearances (shoulders limited in the outer side by kerb for footpaths, including emergency lane in case of unidirectional) are different for unidirectional and bidirectional tunnels: references for unidirectional tunnels as per PIARC in different countries have a range of 2,00-3,95 m (including emergency lane) and 0,30-2,00 m (without e.l.), while for bidirectional tunnel the range is 0,60-1,50 m, with a recommendation not less than 0.75 m.
- ✓ The IRC codes, specifically IRC:SP:48-1998 Hill Road Manual and IRC:SP:73-2007 Manual for two Lanning of State Highways in BOT basis, also mention recommendations for shoulder's width in case of 1 lane, 0.5-1.25 m (here it is assumed for unidirectional traffic) and two lane, 1,0 (hill side) & 2,0 (valley side) to 0,90 m (as per IRC:SP:73-2007 for NH and State Highways). All the references are for straight stretches.
- ✓ In our vision, under the uncertainty of future development of the region and reliability of traffic forecasts due to reasons beyond the control of Consultants, it is advisable to take the solution with more capacity, which will cope with any

expectative of future economic and social progress.

- ✓ There are some references to PIARC design manuals for unidirectional and bidirectional configuration in order to analyze unidirectional versus bidirectional tunnel configuration, which are mentioned in the above Design Standards. These reports contain guidelines for normal traffic capacity in bidirectional tunnels, and theoretical versus practical traffic capacity per hour per lane in unidirectional tubes.
- ✓ Please notice that the European Directive 2004/54/EC, the only recommendation is that for traffic volume more than 10.000 vehicles per lane and day, it is mandatory the configuration of unidirectional twin tubes, but there is no lower limit indicated. Safety assumptions play a main role here.
- ✓ Also, as per Indian Standards, in IRC codes IRC: SP:48-1998 “Hill Road Manual”, and in IRC: SP:73-2007 “MANUAL OF STANDARDS & SPECIFICATIONS FOR TWO LANING OF STATE HIGHWAYS ON B.O.T. BASIS”, there is a limitation for Design Service Volume in PCU per day for two lane Highway, as an indication of Traffic Capacity. This value is between 7.000 and 9.000 PCUs/day, which means that as per your traffic forecast table, maximum by 2033 (15 years) the values recommended for Design Service have been exceeded. Tunnels are structures with minimum life span of 50 years habitually, so the bidirectional tunnel configuration has this disadvantage. These codes are included in the specifications of the ToR.

**Table 4: Cost Comparison of Bi-directional and Uni-directional Tunnel**

Sl. No	Description	Unit	Bi-directional Tunnel			Uni-directional Tunnel		
			Quantity	Rate Rs.	Amount (in Cr.)	Quantity	Rate Rs.	Amount (in Cr.)
1	<b>Surface Excavation</b>							
	Soil/Soft Rock	m <sup>3</sup>	1565	708	0.11	1565	708	0.11
	Hard Rock	m <sup>3</sup>	3651	811	0.30	3651	811	0.30
2	<b>Tunnel Excavation including over break</b>							
	Class II & III	m <sup>3</sup>	165646	2909	48.19	211070	2969	62.67
	Class IV	m <sup>3</sup>	42171	4026	16.98	55241	4095	22.62
	Class V	m <sup>3</sup>	42171	5215	21.99	55241	5344	29.52
3	Steel Supports	MT	47	78742	0.37	66	78742	0.52
4	Lattice Girder	MT	1038	78742	8.17	1174	78742	9.24
5	Rockbolts	m	174075	1111	19.34	230379	1111	25.60
6	Pipe Roofing (89mm Dia)	m	18978	11436	21.70	19524	11436	22.33
7	SFRS	m <sup>3</sup>	15642	14160	22.15	19967	14160	28.27
8	Shotcrete with wire mesh	m <sup>3</sup>	32	10161	0.03	32	10161	0.03
9	<b>Pavement</b>							
	Pavement Quantity	m <sup>3</sup>	6300	6839	4.31	7096	6839	4.85

Sl. No	Description	Unit	Bi-directional Tunnel			Uni-directional Tunnel		
			Quantity	Rate Rs.	Amount (in Cr.)	Quantity	Rate Rs.	Amount (in Cr.)
	Concrete (PQC)							
	Dry lean Concrete (DLC) (M15)	m <sup>3</sup>	3150	3359	1.06	3548	3359	1.19
	Granular Sub base	m <sup>3</sup>	9450	1756	1.66	10052	1756	1.77
	Bed Concrete – M15	m <sup>3</sup>	2101	5984	1.26	2366	5984	1.42
	M-35 Concrete Lining	m <sup>3</sup>	54154	9162	49.62	72592	9162	66.51
10	Precast lagging	m <sup>3</sup>	71	6919	0.05	81	6919	0.06
11	Drilling for grouting/drainage	Rm	17441	2571	4.48	21331	2571	5.48
12	Grouting	MT	1909	7698.2	1.47	2145	7698.2	1.65
13	Reinforcement	MT	1283	69268	8.89	1856	69268	12.86
14	Water Proofing Membrane	m <sup>2</sup>	67938	890	6.05	83497	890	7.43
<b>Subtotal</b>					<b>238.17</b>			<b>304.42</b>
15	Miscellaneous	@	7.5%	-	17.86	5.0%	-	15.22
16	Dewatering	@	2.5%	-	5.95	2.5%	-	7.61
17	Investigation & Design	@	2.5%		5.95	2.5%		7.61
18	Instrumentation	@	0.5%	-	1.19	0.5%	-	1.52
<b>Total</b>					<b>269.13</b>			<b>336.39</b>
19	MEP Cost	@	25.0%	-	67.28	20.0%	-	67.28
<b>Total Cost</b>					<b>336.41</b>			<b>403.66</b>

## 2.9 Recommendation for Tunnel Type

From above comparative study, it is recommended to use Twin Tube Uni-directional tunnel for Khellani Bypass Tunnel.

## 2.10 Construction Time and Construction Cost

The overall construction time is based on the assumptions and calculations. The construction time of Goha – Khellani Tunnel & Its Approach Road is estimated to 21prox.. **36** months. The estimation of the construction time is based on the assumptions that construction will be done from both the tunnel portals as it would be accessible during the entire year, it is also assumed that full project including road & bridges construction works will be done for all the 36 months of the year at all other construction faces (Eastern & Western portals).

The construction cost evaluation is based on the unit rates and quantities determined. **Total Project Cost of Package-II is determined of Rs. 749.274 Cores.** These costs are civil construction cost including other charge like contingency, supervision charge, escalation and maintenance cost etc. as per detailed rate analysis.

**Table 5: Summary of Estimate of Khellani Tunnel & its approach road**

Item No.	Description	Total Amount (Rs. in Crores)
BILL NO. 1	TUNNEL	483.56
BILL NO. 2	SITE CLEARANCE	0.010
BILL NO. 3	EARTH WORKS	3.702
BILL NO. 4	SUB-BASES AND BASES COURSES	0.492
BILL NO. 5	BITUMINOUS COURSES	0.486
BILL NO. 6	CROSS DRAINAGE WORKS(CULVERTS)	2.204
BILL NO. 7	BRIDGE,VIADUCT & ROTARY	42.219
BILL NO. 8	TRAFFIC SIGNS, MARKINGS ,	0.242
BILL NO. 8A	PROTECTION AND DRAINAGE WORK	5.201
BILL NO. 8B	MISCELLANEOUS(Lighting,Tree Plantation,Tree Guard,Rain water Harvesting)	0.092
BILL NO. 9	Major Junctions	1.412
<b>a) Sum</b>		<b>539.615</b>
<b>GST @ 12% Payable on Civil Cost only (on a)</b>		<b>64.754</b>
<b>b)Sub Total</b>		<b>604.369</b>
Contingencies @ 2.8% of (a)		15.109
Construction Supervision Charges @ 3% of (a)		16.188
Agency Charge @ 3% of (a)		16.188
Escalation @ 5% taken for 2nd during construction payable to Contractor of (a)		30.218
<b>c) Total Cost including Centages</b>		<b>682.074</b>
d)Maintenance During 10 Years @ 0.25% for the First 5 Years, 0.5% for the next 5 Years (on b)		<b>22.664</b>
e)Land Acquisition+Forest Clearance		43.388
f)Environmental Impact Assessment		1.149
<b>g)Pre Construction Activity(e+f)</b>		<b>44.537</b>
<b>Total Project Cost (c+d+g)</b>		<b>749.274</b>

### **3.0 PROJECT DESCRIPTION**

The National Highway (NH-1B) is entirely within the state of Jammu and Kashmir. NH 1B linked Batote with Khanabal and is 274 km long. It has been renamed as National Highway 244 (NH 244). The Site is in Jammu province on NH 244. Here, project road deals with Goha - Khellani Tunnel. This section of project road along with the Khellani tunnel, starts at Km 12+850 where Sudhmahadev - Dranga tunnel approach road terminates. The Government of India (GOI) is planning to ease traffic volume on Jammu-Srinagar Highway and would want to connect Srinagar and border areas in J&K with alternate routes with all-weather roads. NH 244 has been selected by the GOI for this purpose.

The NHIDCL has awarded the Consultancy Services for Preparation of Detailed Project Report and providing Pre-Construction activities in respect of the following stretches on NH-244 (old NH-1B) in the State of Jammu & Kashmir. (i) Sudhmahadev - Dranga Tunnel of 23pprox.. length 4.5 Km and its approach roads on Chenani - Sudhmahadev - Goha road portion. (ii) Vailoo Tunnel of 23pprox.. length 10.00 Km under Sinthan Pass and its approach roads on Goha - Khellani - Khanabal road portion to TPF Getinsa-Eurostudios as S.L in Association with Rodic Consultants Private Limited.

This proposed section of Goha - Khellani falls on the newly proposed alternate route for the Jammu - Srinagar highway. It will divert the main traffic from NH-244 (old NH-1B) from Chenani town and traverses through newly proposed Sudhmahadev - Dranga Tunnel approach road and then through this project road of Goha - Khellani tunnel road and finally terminates again at NH-244 (old NH-1B). This entire proposed road is very shorter in length and access through many untouched villages and towns in its stretch. This road also traverses through a tunnel, so, it would very convenient to travel through it.

#### **4.0 OVERVIEW OF NATIONAL HIGHWAYS AND INFRASTRUCTURE DEVELOPMENT CORPORATION (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.

The company has set a vision to become an instrument for creation and management of infrastructure of the highest standard in the country while contributing significantly towards nation building. The company has a Mission to be a professional company which works in most efficient manner and designs, develops & delivers infrastructure projects in a time bound manner.

The endeavor of the Company is to develop, construct and maintain Highways and Infrastructure in a clean manner. The Company has also become part of the 'Swachh Bharat Abhiyan'.

## 5.0 TUNNEL ALIGNMENT

A tunnel has been proposed to bypass the congested area of Khellani town and also to avoid sharp bend of existing road. The proposed Khellani bypass tunnel will cater the traffic from Sudhmahadev – Dranga Tunnel alignment as well as traffic coming from Batote (NH-244). The tunnel alignment Eastern portal is also connecting the NH-244 for the traffic going to Doda and beyond. The tunnel is aligned keeping in view of the topography, length and the location such that tunnel passes through the region having adequate cover all around.

### ➤ Key features of Tunnel

- Length of tunnel = 1541m (Tube-1) and 1574m (Tube-2)
- Uni-Directional - Twin Tube Tunnel
- Western Portal tunnel = EL.1176.98m
- Eastern Portal of tunnel = EL. 1129.90m
- Slope of 3.0% has been provided in the tunnel

### Horizontal Alignment

The tunnel is aligned keeping in view of the topography, length and the location such that tunnel passes through the region having adequate cover all around. Uni-directional tunnel has been proposed for Khellani Bypass. The length of tunnel tube-1 and tube-2 is 1541m and 1574m respectively. The western portal is located about 45 m away from NH-1B on the existing village road at an El. 1176.98m. Eastern portal is located near the Khellani town near the highway (NH-1B) at an El. 1129.90m. This tunnel traverses straight towards Khellani town with no curves and acts as a Bypass to Khellani town.

### Vertical Alignment

Western portal & Eastern portal of tunnel have been kept at El. 1176.98m and El. 1129.90m respectively. Slope of 3% has been provided in the tunnel.

## 6.0 ACCESS ROAD

### 6.1 Project Description

Here the project road deals with the Khellani tunnel road and its approach road. This entire proposed project road is in the state of Jammu and Kashmir. The state occupies a total area of 222,236 square kilometers. Jammu and Kashmir borders with the states of Himachal Pradesh and Punjab to the south. Jammu and Kashmir has an international border with China in the north and east, and the Line of Control separates it from the Pakistan. Jammu and Kashmir consist of three divisions: Jammu, Kashmir Valley and Ladakh, and is further divided into 22 districts.

The project road of “Khellani Tunnel” starts near the end portion of “Goha – Khellani road” and bypasses Khellani town with the tunnel.

### 6.2 Road Junctions

#### 6.2.1 Khellani Tunnel & its Approach road

There are only 2 major junctions in the project stretch main road.

**Table 6: Details of Major Junction**

Design Chainage (Km)	Link (NH)	Type	Carriageway Width (m)	Direction L/R/Cross
29.100	NH-244	Y	7.0	L

### 6.3 Proposed Cross Drainage Structures

The details of Cross drainage Structure is tabulated below:

**Table 7: Summary of Proposed Bridges and Culverts**

Sr. No.	Type	No's of structures
		Khellani Tunnel & its Approach road
1	Major Bridges	1
2	Rotary	1
3	Box Culverts	5
4	Tunnel	1 (Twin Tube)

### 6.4 Improvement Proposals

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

- a) Proposal for Widening and Reconstruction
- b) Requirement of bypasses and realignment
- c) Geometric Improvement Design
- d) Proposed Pavement Design
- e) Traffic Control and Safety Measures
- f) Bridge and Cross Drainage Structures

## 6.5 Proposed design standards

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

**Table 8: Summary of Recommended Design Standard**

(i)	Design Speed (Km/hr) as per IRC SP:73-2018 Mountainous Terrain	60 (Ruling), 40(Minimum)
(ii)	Level of Service	B
(iii)	Roadway Widths (m) as per IRC SP:73-2018 Mountainous Terrain	11 m for 2-lanes with paved shoulders and earthen shoulder with one side hill and one side valley.
(iv)	Roadway Elements as per IRC SP:73-2018 Mountainous Terrain With Retaining wall and parapet	Carriageway 2-lane- 2X3.5m Paved Shoulder 2-lane- 2x1.5m Earthen Shoulder 1.0 m (Valley Side)
(v)	Camber as per IRC SP:73-2018	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 per Plan and Profile
(vii)	Embankment/ Cutting Slope Fill height, up to 3.0 m Fill height from 3.0 m to 6.0 m Fill height exceeding 6.0 m	In filling- 1V: 2 H In filling- 1V: 1.5 H To be designed based on soil parameters, (IRC:75-1979) In cutting- 1V:1H
(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 Mountainous Terrain (As per IRC: SP:48-1998) Clause No-6.8.2.2	With snow bound area Maximum 7% Without snow bound area Maximum 10% Adopted maximum 7%
(x)	Radii for Horizontal Curves as per IRC SP:73-2018 Mountainous Terrain	Ruling Minimum 150 m Absolute minimum 75 m
(xi)	Gradient (As per IRC: SP:73-2018) Clause 2.9.7.2 <b>Mountainous Terrain</b> Ruling Limiting <b>Steep Terrain</b> Ruling Limiting	5.00% 6.00%  6.00% 7.00%
(xii)	Minimum k factor Summit Curve Mountainous Terrain Valley Curve Mountainous Terrain	Desirable: 15 Minimum: 5 Desirable: 15 Minimum: 7
(xiii)	Bridge Clearance Vehicular underpass Light and Smaller Vehicular Underpass	5.5 m 4.0m
(xiv)	Design Flood Frequency Bridges Sewers and Ditches	100 years 60 years

## 6.6 Proposal for New construction

To meet future traffic requirement, new alignment is proposed to achieve high speed of travel with comfort and safety.

**Table 9: Proposed cross sections for Khellani tunnel & its Approach Road**

Sr. No.	Design Chainage		Design Length	TCS No	TCS Details
	From	To			
1	29+030	29+350	320	TCS-1B	TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN WITH ONE SIDE CUT & ONE SIDE FILL WITH PROTECTION AS APPLICABLE (RECONSTRUCTION)
2	29+350	29+475	125	Rotary	
3	29+475	29+490	15	TUNNEL portal	
4	29+490	31+055	1565	TUNNEL	TUNNEL APPROACH LEFT VIADUCT/ RIGHT CUT
5	31+055	31+070	15	TUNNEL portal	
6	31+070	31+245	175	MAJOR BRIDGE	
7	31+245	31+260	15	TCS-1A	TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN ONE SIDE CUT & ONE SIDE FILL WITH PROTECTION AS APPLICABLE (NEW CONSTRUCTION)
8	31+260	31+380	120	TCS-5A	TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN WITH BOTH SIDE CUT & WITH ROCK BOLTING ON RIGHT SIDE (NEW CONSTRUCTION)
9	31+380	31+410	30	TCS-3A	TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN WITH BOTH SIDE CUT (NEW CONSTRUCTION)
10	31+410	31+449	39	TCS-1A	TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN ONE SIDE CUT & ONE SIDE FILL WITH PROTECTION AS APPLICABLE (NEW CONSTRUCTION)
<b>Total Design Length Km</b>			<b>2419</b>		

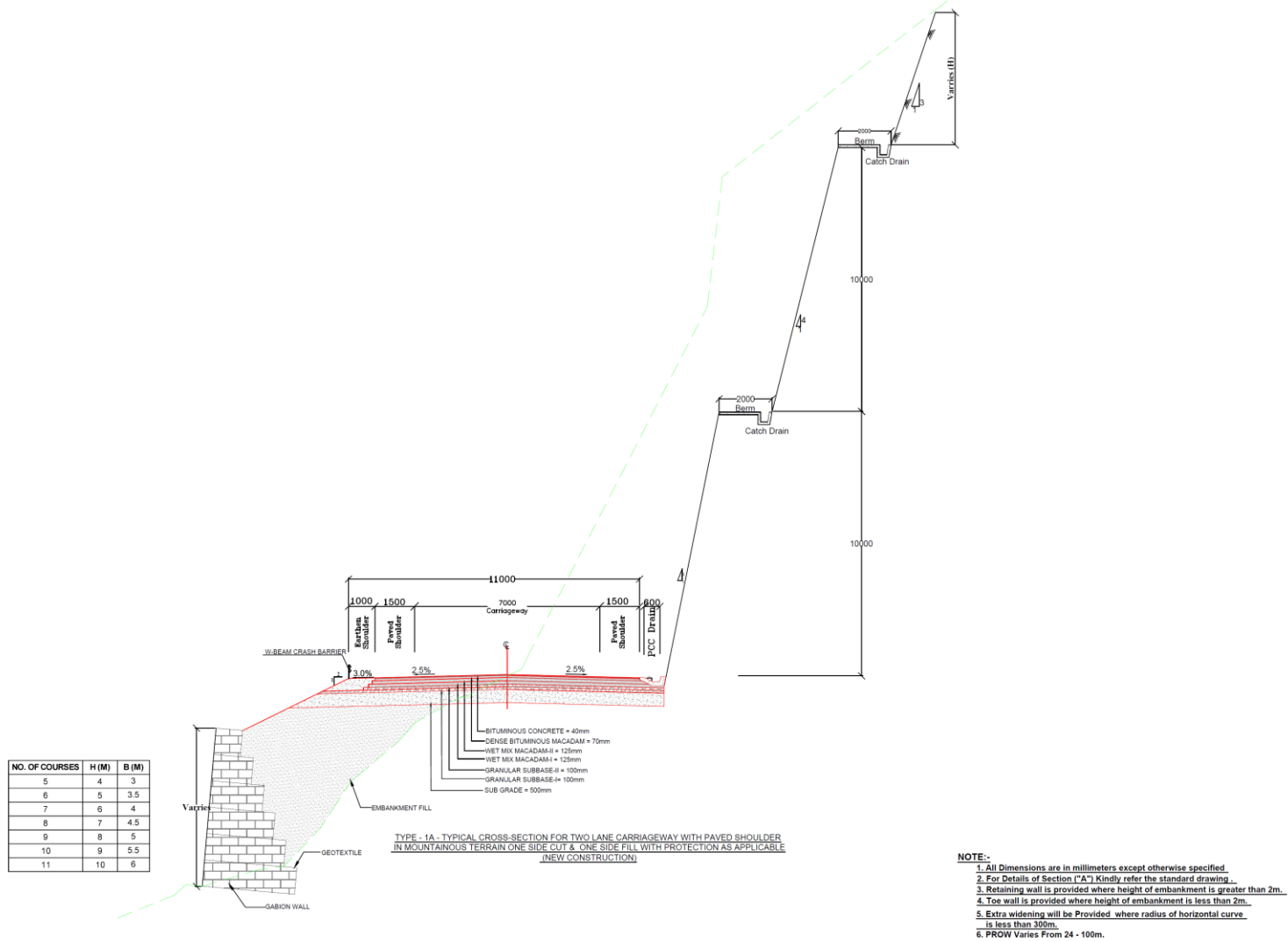
## 6.7 Typical Cross-sections

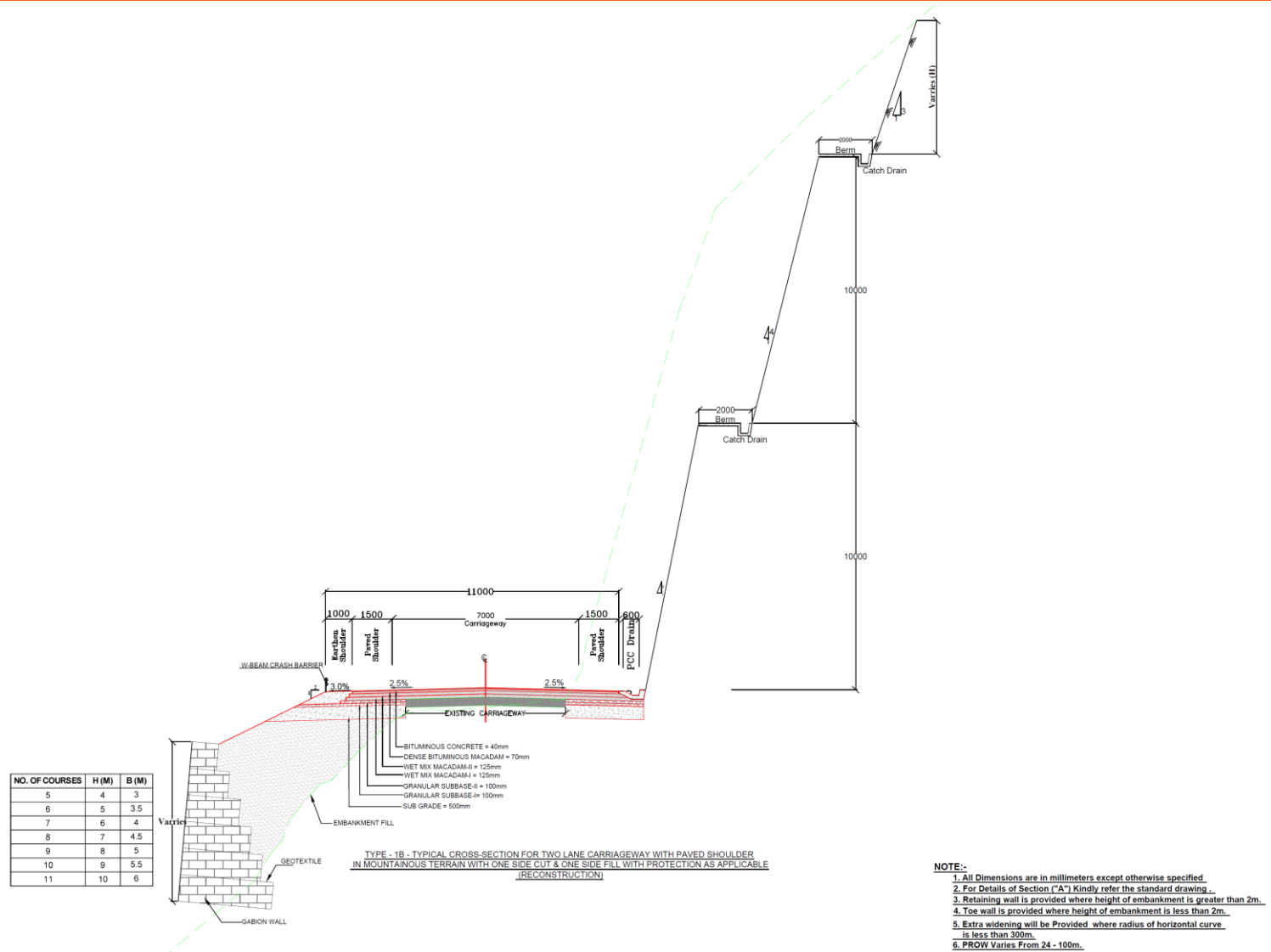
Proposed cross-sections are shown in table given below.

**Table 10: Summary of TCS for Khellani tunnel & its Approach Road**

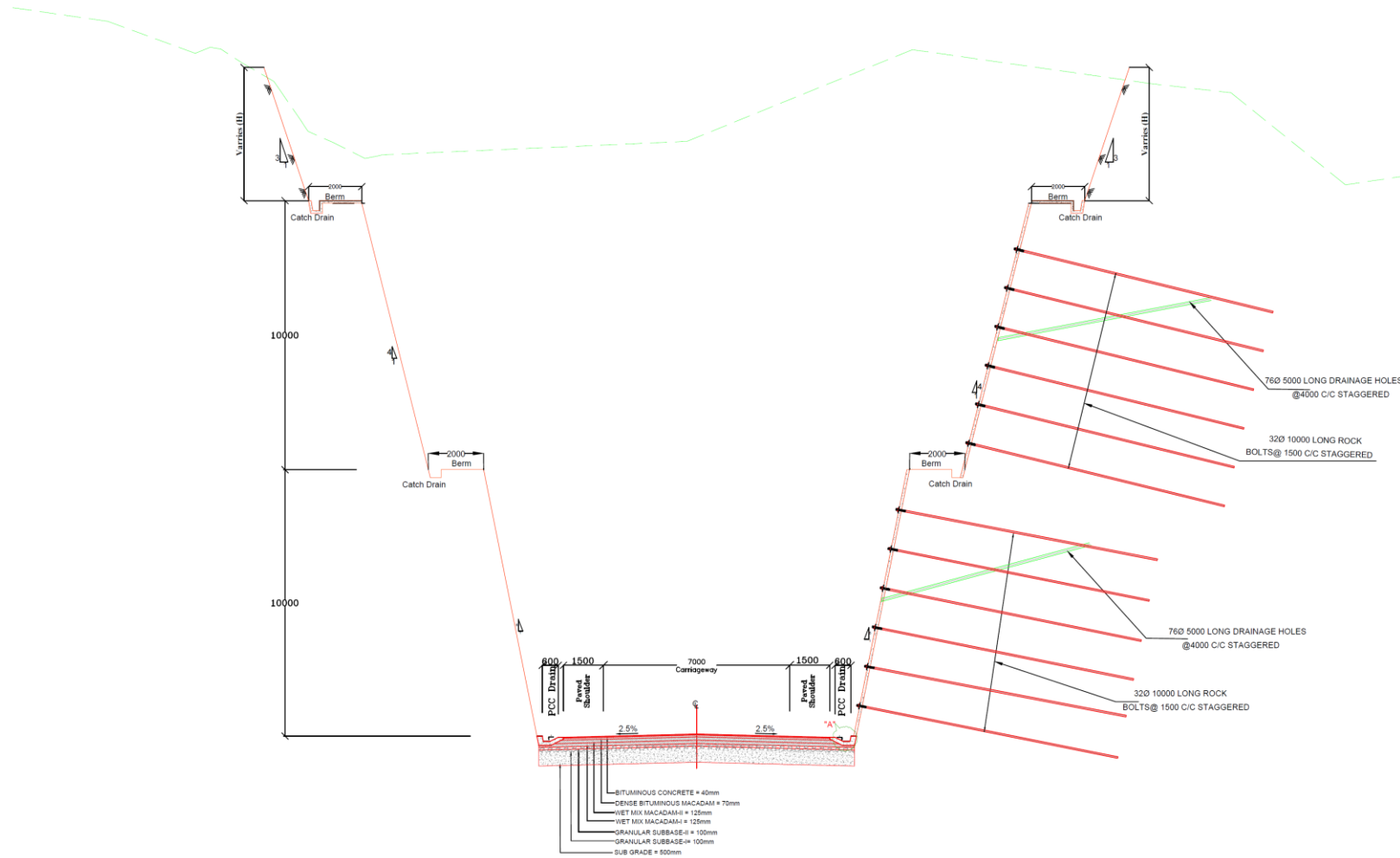
Sr. No.	Detail	TCS	Length	
			(m)	Kms
1	TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN ONE SIDE CUT & ONE SIDE FILL WITH PROTECTION AS APPLICABLE (NEW CONSTRUCTION)	TCS-1A	54	0.054
2	TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN WITH ONE SIDE CUT & ONE SIDE FILL WITH PROTECTION AS APPLICABLE (RECONSTRUCTION)	TCS-1B	320	0.32
3	TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN WITH BOTH SIDE CUT (NEW CONSTRUCTION)	TCS-3A	30	0.03
4	TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN WITH BOTH SIDE CUT & WITH ROCK BOLTING ON RIGHT SIDE (NEW CONSTRUCTION)	TCS-5A	120	0.12
5		Rotary	125	0.125
6		TUNNEL portal	15	0.015
7	TUNNEL APPROACH LEFT VIADUCT/ RIGHT CUT	TUNNEL	1565	1.565
8		TUNNEL portal	15	0.015
9		MAJOR BRIDGE	175	0.175
<b>TOTAL DESIGN LENGTH</b>			<b>2419</b>	<b>2.419</b>

**Typical Cross Section : Khellani tunnel & its Approach Road**









TYPE -5A- TYPICAL CROSS-SECTION FOR TWO LANE CARRIAGEWAY WITH PAVED SHOULDER IN MOUNTAINOUS TERRAIN WITH BOTH SIDE CUT & WITH ROCK BOLTING ON RIGHT SIDE (NEW CONSTRUCTION).

- NOTE:-**
1. All Dimensions are in millimeters except otherwise specified
  2. For Details of Section ("A") Kindly refer the standard drawing .
  3. Retaining wall is provided where height of embankment is greater than 2m.
  4. Toe wall is provided where height of embankment is less than 2m.
  5. Extra widening will be Provided where radius of horizontal curve is less than 300m.
  6. PROW Varies From 24 - 100m.

## 6.8 Pavement Design

Flexible pavement is proposed new carriageway and reconstruction. Design period of 15 years considered for new carriageway. The Pavement improvement proposal for entire project road is presented in below Table.

**Table 11: Improvement Proposal for New Pavement**

Crust Composition for New Pavement as per IRC 37 - 2018										
Homogeneous Section	Design Chainage		CBR	MSA	Crust				S.Grade	Total Thickness
	From	To			BC	DBM	WMM	GSB		
Khellani Tunnel & its Approach Road	29+030	31+449	10	20	40	70	250	200	500	1060

## 6.9 Traffic Control and Safety Measures

### 6.9.1 Road Marking & Traffic Signs

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. 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 2.0 m away from the edge of the carriageway. The location of each sign is to be decided in accordance with the guidelines there in.

## 6.10 Major Bridge/ Minor Bridge & Cross Drainage Structures

### 6.10.1 Bridges

There are 1 major bridges, 1 minor bridge, 1 Rotary and 1 culvert is proposed in Goha – Khellani project. The Brief summary of improvement proposal of bridges and cross drainage structures are given in below Table.

### 6.10.2 Culverts

Improvement proposal for culvert are given in below Table.

**Table 12: Summary of structures proposed**

Sr. No.	Description	No. of Structures
1	Box Culverts	5
2	Rotary	1
3	Major Bridges	1
4	Tunnel	Uni-Directional/Twin Tube

**Table 13: General Arrangement Structures (Khellani Tunnel & its Approach Road)**

S.No.	Type of Structure	Design Chainage	Start Chainage	End Chainage	Total Length (M)	Span Arrangement	Type of Superstructure	Deck Width (M)	Remarks
1	Rotary	29+470	29+458	29+482	24	2X12	RCC Solid Slab	13.5	2 Lane Bridge on RHS
2		29+458	29+428	29+488	60	5X12	RCC Solid Slab	13.5	2 Lane Bridge on LHS
3	Tunnel	29+899.5	29+129	30+670	1541			9.0	Tunnel tube on LHS
4		29+906.0	29+119	30+693	1574			9.0	Tunnel tube on RHS
5	Major Bridge	31+140	31+090	31+190	100	4X25	Composite Steel Girder with cast in situ deck slab	12.5	2 Lane Bridge on RHS
6		31+153	31+065	31+240	175	7X25	Composite Steel Girder with cast in situ deck slab	12.5	2 Lane Bridge on LHS

**Table 14: Culvert List**

**Khellani Tunnel & its Approach Road**

S.No.	Proposed Structure	Center Chainage	Proposed Span	Earth Fill
1	Box culvert	29+060	1x3x3	
2	Box culvert	29+332	1x3x3	
3	Box culvert	31+340	1x3x3	
4	Box culvert	31+425	1x3x3	4.0m
5	Box culvert	31+455	1x3x3	3.0m

## 7. COST ESTIMATE

Preliminary cost estimate for the project Road is finalised 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 detail analysis

**Table 15: Cost of Civil Works**

Section	Design Length (m)	Base Cost / Civil Cost excluding GST (Crore)	Civil Cost including GST @ 12% (Crore)	Construction Cost including centages (Crore)	Total Project Cost (Crore)
<b>Khellani Tunnel &amp; its Approach Road</b>	2.419	539.615	604.369	682.074	749.274

**Table 16: Summary of Estimate of Khellani Tunnel & its Approach Road**

Item No.	Description	Total Amount (Rs. in Crores)
BILL NO. 1	TUNNEL	483.56
BILL NO. 2	SITE CLEARANCE	0.010
BILL NO. 3	EARTH WORKS	3.702
BILL NO. 4	SUB-BASES AND BASES COURSES	0.492
BILL NO. 5	BITUMINOUS COURSES	0.486
BILL NO. 6	CROSS DRAINAGE WORKS(CULVERTS)	2.204
BILL NO. 7	BRIDGE,VIADUCT & ROTARY	42.219
BILL NO. 8	TRAFFIC SIGNS, MARKINGS ,	0.242
BILL NO. 8A	PROTECTION AND DRAINAGE WORK	5.201
BILL NO. 8B	MISCELLANEOUS(Lighting,Tree Plantation,Tree Guard,Rain water Harvesting)	0.092
BILL NO. 9	MAJOR JUNCTIONS	1.412
<b>a) Sum</b>		<b>539.615</b>
	<b>GST @ 12% Payable on Civil Cost only (on a)</b>	<b>64.754</b>
	<b>b)Sub Total</b>	<b>604.369</b>
	Contingencies @ 2.8% of (a)	15.109
	Construction Supervision Charges @ 3% of (a)	16.188
	Agency Charge @ 3% of (a)	16.188
	Escalation @ 5% taken for 2nd during construction payable to Contractor of (a)	30.218
	<b>c) Total Cost including Centages</b>	<b>682.074</b>
	d)Maintenance During 10 Years @ 0.25% for the First 5 Years, 0.5% for the next 5 Years (on b)	<b>22.664</b>
	e)Land Acquisition+Forest Clearance	43.388

Item No.	Description	Total Amount (Rs. in Crores)
f)	Environmental Impact Assessment	1.149
g)	Pre Construction Activity(e+f)	44.537
	<b>Total Project Cost (c+d+g)</b>	<b>749.274</b>

**Table 17: General Abstract of Cost Khellani Tunnel & its Approach Road**

Sr No	Detail	Unit	No	Length	Rate	Cost
<b>1</b>	<b>Road Work</b>					
	Site Clearance					<b>95363.800</b>
(a)	Typical Cross Section Type- 1A	Km	1	0.054	20,529,049	1108568.661
(b)	Typical Cross Section Type- 1B	Km	1	0.314	19,244,016	6042620.922
(c)	Typical Cross Section Type- 3A	Km	1	0.030	19,231,580	576947.400
(d)	Typical Cross Section Type- 5A	Km	1	0.117	20,060,380	2347064.460
(h)	Cutting & Filling					36678942.000
(i)	Extra Widening					51574.566
<b>2</b>	<b>Culvert</b>					
(i)	Construction of Culvert					<b>22043420.409</b>
	<b>Total Road Works Cost</b>					<b>68944502.218</b>
<b>3</b>	<b>Bridges Cum Via Duct</b>					
(i)	Construction of Bridges, Viaduct & Rotary					422191738.676
	<b>Total Bridge Works Cost</b>					<b>422191738.676</b>
<b>4</b>	<b>Tunnel</b>					
(i)	Construction of Tunnel					4835554636.175
	<b>Total Tunnel Works Cost</b>					<b>4835554636.175</b>
<b>5</b>	<b>Other Works</b>					
(i)	RRM Retaining Wall & Drain					3829792.140
(ii)	"W" metal beam crash barrier					1121114.000
(iii)	Gabion Wall					15110976.600
(iv)	RRM Revetment wall					5532281.520
(v)	Rock Bolts, Shotcreting and Drainage Holes					26411803.203
(vi)	Traffic Signs					2417417.600
(vii)	Junction					
a)	Major Junction					14115504.376
(viii)	Miscellaneous					923000.000
	<b>Total Other Works Cost</b>					<b>69461889.439</b>
	<b>Grand Total</b>					<b>5396152766.508</b>

### 7.1 List Clearances required for the Project

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 18: 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	Forest Department, Department of Horticulture.
5	Dismantling of structure falling within right of way	Competent Land Acquisition Authority.

## 7.2 Recommendations

- To avoid the accident due to land slide on the present Goha-Khellani Road and also to avoid poor geometry of this road, a new alignment is being proposed from the end of the Sudhmahadev-Dranga Tunnel to Khellani town.
- The tunnel will be constructed without causing significant adverse environmental impacts to the social, economic or cultural environments to bypass the congested area of khellani town.
- No household will get displaced in the project area due to the construction of this tunnel. No Displaced person (DPs) in the project area as it will not affect any CPR (Common Property resources) or any livelihood. Therefore, Resettlement Plan will not be needed for the project area.

**Table 19: Base Cost**

Section	Design Length (m)	Base Cost / Civil Cost excluding GST (Crore)	Civil Cost including GST @ 12% (Crore)	Construction Cost including centages (Crore)	Total Project Cost (Crore)
<b>Khellani Tunnel &amp; its Approach Road</b>	2.419	539.615	604.369	682.074	749.274

- The project can be constructed in 36 months period with strategic planning and through one construction package. The estimated basic cost is given in above table.
- The proposed road is required for alternate route in future from Chenani to Srinagar via Sudhmahdev, Goha, Khellani, Kishtwar, Donipawa and Khanbal.

## 8. SOCIOECONOMIC PROFILE OF THE PROJECT AREAS

### Socio-Economic profile of Jammu and Kashmir

As per details from Census 2011, Jammu and Kashmir has population of 1.25 Crores, an increase from figure of 1.01 Crore in 2001 census. Total population of Jammu and Kashmir as per 2011 census is 12,541,302 of which male and female are 6,640,662 and 5,900,640 respectively. In 2001, total population was 10,143,700 in which males were 5,360,926 while females were 4,782,774. The total population growth in this decade was 23.64 percent while in previous decade it was 29.04 percent. The population of Jammu and Kashmir forms 1.04 percent of India in 2011. In 2001, the figure was 0.99 percent. Recently as per Jammu and Kashmir census data, 96.73% houses are owned while 2.19% were rented. In all, 73.51% couples in Jammu and Kashmir lived-in single-family

Jammu and Kashmir Population 2018.

As per projection, population of Jammu and Kashmir in 2018 is 1.44 Crore.

**Table 20: Jammu and Kashmir Table Data**

Description	2001	2011
Approximate Population	1.01 Crore	1.25 Crores
Actual Population	10,143,700	12,541,302
Male	5,360,926	6,640,662
Female	4,782,774	5,900,640
Population Growth	29.04%	23.64%
Percentage of total Population	0.99%	1.04%
Sex Ratio	892	889
Child Sex Ratio	941	862
Density/km <sup>2</sup>	46	56
Density/mi <sup>2</sup>	118	146
Area (Km <sup>2</sup> )	222,236	222,236
Area mi <sup>2</sup>	85,806	85,806
Total Child Population (0-6 Age)	1,485,803	2,018,905
Male Population (0-6 Age)	765,394	1,084,355
Female Population (0-6 Age)	720,409	934,550
Literacy	55.52 %	67.16 %
Male Literacy	66.60 %	76.75 %
Female Literacy	43.00 %	56.43 %
Total Literate	4,807,286	7,067,233
Male Literate	3,060,628	4,264,671

## Jammu and Kashmir Religious Data

Jammu and Kashmir are Muslim majority state in India with approximately 68.31 % of state population following Islam as their religion. Hinduism is second most popular religion in state of Jammu and Kashmir with approximately 28.44 % following it. In Jammu and Kashmir state, Christianity is followed by 0.28 %, Jainism by 0.02 %, Buddhism by 0.90 % and Sikhism by 1.87 %. Around 0.01 % stated 'Other Religion', approximately 0.16 % stated 'No Particular Religion'.

**Table 21: Jammu and Kashmir Religious Data**

<b>Description</b>	<b>Population</b>	<b>Percentage</b>
Muslim	8,567,485	68.31 %
Hindu	3,566,674	28.44 %
Sikh	234,848	1.87 %
Buddhist	112,584	0.90 %
Christian	35,631	0.28 %
Jain	2,490	0.02 %
Other Religion	1,508	0.01 %

Marwah is a Tehsil located in Kishtwar district of Jammu & Kashmir. It is one of 4 Tehsils of Kishtwar district. There are 27 villages and 0 towns in Marwah Tehsil.

As per the Census India 2011, Marwah Tehsil has 7,106 households, population of 35,572 of which 18,364 are males and 17,208 are females. The population of children between age 0-6 is 6,953 which is 19.55% of total population.

The sex-ratio of Marwah Tehsil is around 937 compared to 889 which is average of Jammu & Kashmir state. The literacy rate of Marwah Tehsil is 43.5% out of which 54.47% males are literate and 31.79% females are literate. The total area of Marwah is 307.35 sq.km with population density of 116 per sq.km.

Out of total population, 100% of population lives in Urban area and 0 lives in Rural area. There are 0 Scheduled Caste (SC) and 1.01% Scheduled Tribe (ST) of total population in Marwah Tehsil.

## **9. DESIGN STANDARDS, METHODOLOGIES AND SPECIFICATIONS**

### **9.1 Design Standards and Methodologies**

In this Project Conventional tunneling methodology has been proposed for Tunnel Excavation.

The Design Standards to be followed in this Project are derived from the NATM methodology. Apart from its aspect as Construction methodology (Conventional Tunneling method – Drill & Blast – through a sequence of cyclic operations), the NATM can be considered as a Design methodology related to Austrian guidelines (Austrian Standard Oenorm B2203 Part 1 Underground Works – Conventional Excavation, 2001). In the NATM design and construction are closely interrelated. The design premises to be taken into account are following:

- The NATM has been envisaged and defined to optimize to minimum (cost) the design requirements for a stable lining, because it is based on the known behavior of the rock masses around the cavity subjected to peripheral loads through its continuous monitoring once excavated. The experience gained is incorporated in well-established practices and design promises.
- The NATM is, therefore, an observational method, and then the design developed has to be verified and its prediction confirmed during the construction stage, also adapted to the rock mass behavior around the excavation if required. Predictions may consist of deformations, ground displacements or convergences and loads obtained during the design stage, and design countermeasures have to be timely put on ground in case of unexpected trends for displacements (in magnitude and/or velocity) or stresses.
- The support to be designed in NATM has to be flexible, where the main component is a shotcrete thin shell sprayed in the periphery at one or several stages. Other habitual support elements are wire-mesh and fibres to reinforce sprayed concrete, bolts and steel set or lattice girders, whose spacing and density can be easily modulated. The purpose is to utilize the last tendencies in material specifications and technology of construction.
- The above mentioned is due to the contribution of the surrounding ring of rock to the

support of the cavity against its collapse, in other words, the rock formation itself forms part of the support structure, and to activate its strength a determined grade of ground deformation is required, hence the support must be flexible and has a specific time of progressive (or quick) application to be introduced in the design model. Excessive deformation can lead to undesirable impact also, i.e. loose of rock mass carrying capacity as support, so it has to be kept a delicate balance.

- For this reason, support system applied must be in full contact and deformation compatibility with the ground mass.
- Although this method was defined initially as empirical dimensioning (Rabcewicz) for its evolution parallel to the practical experience, it possesses a theoretical background with scientific root concerning to relationship between stresses and deformations in the tunnel periphery.
- During the Design stage it is crucial to anticipate the expected behavior of the rock masses, and the identification of modes of failure attending to the rock mass strength, geo-mechanical and hydraulic parameters, geometry of the excavation, level of in situ stresses estimated and groundwater features. Consequently, the rock classification conditions the design of support measures.
- Due to geological-geotechnical uncertainties derived from the limited field investigation and the huge tunnel covers, experience of Designer is a must, and adaptability of the support is a main feature. It has to be noticed that a component of Project Risk Assessment rest on the design reliability.
- In case of very poor geo-mechanical features for the rock mass or soft ground, the use of invert to close the tunnel ring is essential to avoid a quick collapse in the cavity. Nevertheless, a certain grade of deformation in case of rock may be required in order to release excessive stress concentration.
- The most usual geometry of the tunnel section excavated and lined is the horse-shoe shape with or without modifications and shall be adapted to the scheme of in situ stresses and rock mass strength and discontinuities features. Normally this shape is the most similar to the circular shape, which is the ideal case of stress distribution in the cavity periphery.

- The optimization of design during construction must take into account ground stability, safe operation and environmental factors.

**Once explained the philosophy and main aspects of the NATM methodology for design, it has been established the following steps for the design:**

- Rock formations characterization through geological available data and geotechnical investigation developed, in order to get/estimate relevant geomechanical & hydraulic parameters. This will lead to a Rock mass Classification using the most worldwide known and habitual systems like RMR rating (Bieniawski, 1989), Q quality index (Barton, 1974), Rmi Index (Palmstrom, 1995), etc. In this project it has been used mainly the RMR system, although it has been cross checked with other systems because they consider stress status. The RMR has been (and continue) widely used in the Himalayas.
- From the rock mass classification, it has been derived the Rock Mass Classes (mentioned as Ground Types in the Austrian Guidelines).
- The interaction of Rock Mass Classes, with its strength and discontinuities status & pattern related to the tunnel orientation, geometry of the excavation (full section), groundwater presence and in situ stresses along with its redistribution around the cavity, determines the rock mass behavior in the tunnel periphery and foreseen rock failure mechanism without support. Among others, potential stand-up time can be also estimated. All it comes to distinguish several Ground Behavior Types. Empirical and numerical methods can be used to evaluate terrain behavior, e.g. empirical for the evaluation of squeezing potential.
- Design of excavation stages and support measures to be applied during tunnel excavation predicted cyclic operations. It is the moment to verify and check the expected interaction between the rock mass ring and the support under stresses to come to a stable equilibrium after development of controlled deformations. Although for this stage of feasibility and preliminary design of support elements normally it is used the empirical methods associated with Rock Classification Systems, due to the diversity and variability of geological formations, and high stresses expected levels due to tunnel overburden up to 1 km, it has been developed a numerical model with FLAC3D software to check tunnel behavior with support installed and excavation

stages.

- Once set-up the selected models, their stability has to be verified through analysis for the different Ground Behavior Types. Design involves not only the support measures, but the Construction process also and impact of exceptional incidents in the time of construction.
- The above step results in a set of Excavation and Support Classes to define the Lining Section Types. Depending on the combination of design factors along tunnel alignment, the same is divided into sections or stretches with the same support Section Type. The discretization might be done following probabilistic analysis for the combination of key parameters, but in this case, it has been selected deterministic analysis.
- The geometry of excavation stages designed has to be compatible with the expected machinery and equipment to be used during the works, and with the standard support measures envisaged. The functional tunnel section has to be fixed according to the space arrangement of carriageway (clearances), hard clearances, footpath distribution, drainage system, traffic signage, safety requirements and MEP components & equipment predicted (mainly ventilation system), subjected to relevant national and international codes, recommendations and regulations, which are mentioned in the corresponding epigraph.
- Each Excavation/Support Class has its own excavation sequence, work activities cycle and support requirements, so it can be developed an estimate of quantities for Construction Works (BOQ), associated costs and tentative time program for Construction.
- Further design stages, after Tendering process and during Construction, are oriented to the better geological and geotechnical knowledge of the distribution of Rock Behavioral Types, its observation of behavior through continuous monitoring (installation of devices for deformation control, installation of instruments to follow other relevant variables like stresses, extent of plasticization ring, etc.), and the comparison of real behavior results with expected behavior. Back analysis based on the results might be developed and design optimization may be required in case of inadmissible deviation. These stages are out of the reach of this DPR.

- The design of inner concrete lining should be developed attending to the long-term conditions of tunnel behavior, which may generate a status of acting loads around the cavity even in the case of stable equilibrium reached, due to worsen conditions of rock mass ring plasticization and/or the acting of seismic loads. While the primary lining (support) is normally taken as a temporary arrangement to carry necessary loads, the final lining (inner concrete lining) must be a permanent structure safe and fully operational during the life cycle of the tunnel. In this case a pumped, cast in situ concrete lining ring, reinforced or not, executed by shutters (formwork gantries) has been envisaged in this design phase. The method used for preliminary design is also numerical, applied to same continuum media models than those of support design, although spring bedded numerical model is usually employed.
- Regarding interaction of groundwater flow and hydrostatic pressures with the tunnel, the tunnel has been designed taking into consideration that it is fully drained (no hydrostatic pressures around the cavity). The design of tunnel drainage system incorporates a geotextile felt in the periphery down to the sidewall toe, connected to side rock mass drainage pipes to collect the groundwater, and a PVC membrane to isolate the groundwater from the inner lining ring.
- Design of portal slopes shall take into consideration seismic loads for slope stability under foreseen application of protection/retaining measures. The Project area is under Seismic zone V. Normally verification of stability may comply with Eurocode-7 standard for Design Approach 3 at geotechnical check. Design Approach 1 with combination 2 could also be incorporated.
- All the designed elements and related activities must comply with material specifications & codes of practice included in IRC and IS codes, also included in MORT&H Technical Specifications. In case of omission of some specific aspect, it can be referred to international standards. It is not the purpose in this epigraph to mention all the national BIS codes related to material and work methodology specifications, because it will result in a long list. Relevant codes applied to specific construction elements will be included in the DPR's Design Report.

**The design has been founded on relevant specifications**, i.e. European Guideline EC54/2004 and international recommendations (PIARC, ITA, BS, FHWA, CEN, Austrian

Standards), in addition to IRC/MORT&H/BIS Guidelines and Codes. The main standards, reports, guidelines and recommendations consulted and/or incorporated to the present Project are following (the list is not necessarily given in order of preference of documents):

- Directive 2004/54/EC of the European Parliament and of the Council on Minimum Safety Requirements for Tunnels in the Trans-European Road Network, 2004
- Guideline for geotechnical design of underground structures with conventional excavation, Austrian Society for Geomechanics, 2009
- Sprayed Concrete Guideline. Österreichischer Betonverein. April 2013
- Austrian Standard Oenorm B2203 Part 1 Underground Works – Conventional Excavation, 2001.
- EN 1990:2002, “Eurocode 0: Basis of structural design”, European Committee for Standardization (CEN), 2002
- EN1991-1:2002 “Eurocode 1: Actions on structures”, CEN, 2002
- EN 1992-1-1 Part 1-1:2004 “Eurocode 2: Design of concrete structures– Part 1-1: General rules and rules for buildings”, CEN, 2004
- EN 1992-1-2:2004: “Eurocode 2: Design of concrete structures - Part 1-2: General rules – Structural fire design”, CEN, 2004
- EN 1997-1:2004 “Eurocode 7: Geotechnical design – Part 1: General rules”, CEN, 2004
- EN 1998-1:2004 “Eurocode 8: Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings”, CEN, 2004
- EN 1998-5:2004 “Eurocode 8: Design of structures for earthquake resistance – Part 5: Foundations, retaining structures and geotechnical aspects”, CEN, 2004
- IS 1893 (Part 1)-2002: Criteria for earthquake resistant design of structures – Part 1: General provisions and buildings
- “Seismic design and analysis of underground structures”, ITA (International Tunnel Association) WG 9 on Seismic Effects, 2001 – Tunneling and Underground Space Technology, Vol. 16, No. 4, pp 247-293

- Guidelines on “Earthquake Design and Protection of Underground Structures”, AFPS/AFTES (France), 2001
- IRC: SP: 91 – 2010 – Guidelines for Road Tunnels
- “Guidelines for the Design of Tunnels”, ITA (International Tunneling Association) WG on General Approaches to the Design of Tunnels, 1988 – Tunneling and Underground Space Technology, Vol. 3, No. 3, pp 237-249
- “Recommendations on the development process for Mined Tunnels”, ITA Report No. 17 WG 14 Mechanized Tunneling & 19 Conventional Tunneling, 2016. This report contains considerations for the selection of most appropriate Tunneling method in Projects
- “General report on Conventional Tunneling Method”, ITA Report No. 2 WG 19 Conventional Tunneling, 2009
- “TBM Excavation of Long and Deep Tunnels Under Difficult Rock Conditions”, ITA Report No. 19 WG 17 Long Tunnels at Great Depth, 2017
- “Monitoring and Control in Tunnel Construction”, ITA Report No. 9 WG 2 Research, 2011
- Guide 05.01.B “The First Road Tunnel”, PIARC, 1995
- Report 02.05.12B “Cross Section Design for Bi-Directional Road Tunnels” PIARC Technical Committee on Road Tunnel Operation (C5), 2004
- Report 3.05.11B “Cross Section Geometry in Uni-directional Tunnels”, PIARC Technical Committee on Road Tunnel Operation (C5) WG No.4, 2001
- “European Specification for Sprayed Concrete”, EFNARC (adopted by CEN/TC104/WG10), 1996
- “European Specification for Sprayed Concrete. Guidelines for Specifiers and Contractors”, EFNARC, 1999
- “Tunnel Lining Design Guide”, The British Tunneling Society (BTS) and The Institution of Civil Engineers (ICE), 2004
- Report 2017R01EN “Design Fire Characteristics for Road Tunnels”, PIARC Technical

### Committee 3.3 Road tunnels Operations, 2017

- Report 3.05.04.B “Road Safety in Tunnels”, PIARC Committee on Road Tunnels WG4 Traffic and Geometry, 1995
- Report 2007R07 “Integrated Approach to Road Tunnel Safety”, PIARC Technical Committee on Road Tunnel Operation (C3.3), 2007
- Report 2012R05EN “Road Tunnels: Vehicle Emissions and Air Demand for Ventilation”, PIARC Technical Committee on Road Tunnel Operation (C4), Dec. 2012
- Guide “Good Practice for the Operation and Maintenance of Road Tunnels”, PIARC Committee on Road Tunnel Operation (C5), 2005
- BIS - IS 13365: PART 1 “Quantitative classification system of rock mass - Guidelines: Part 1 RMR for predicting of engineering properties”, Bureau of Indian Standards (BIS), 1998.

**Regarding International Tunnel Design Manuals incorporating Construction procedures, it can be included following, among others:**

- “Technical Manual for Design and Construction of Road Tunnels – Civil Elements”, U.S. Department of Transportation, Federal Highway Administration (FHWA), 2009
- “Specification for Tunneling”, The British Tunneling Society and the Institution of Civil Engineers, Thomas Telford, London, 2000
- Engineering Manual EM 1110-2-2901 “Engineering and Design TUNNELS AND SHAFTS IN ROCK”, U.S. Army Corps of Engineers, 1997

## 9.2 Technical specifications

These Technical Specifications define the technical and quality standards specifically for NATM tunnel construction works.

The construction works shall be executed according to the quality requirements defined in the Specification. Any item of work arising from the execution of the works, not covered by the Technical Specification, shall be according to a Standard as agreed with the Employer’s Representative and the Contractor.

This Technical Specification is based on the “Specification for Tunneling, Third Edition”,

British Tunneling Society, Institution of Civil Engineers, 2010 and “MORTH Specification for Road and Bridge Works”, Ministry of Road Transport and Highways, 2000.

### 9.3 Standards and Units

Materials, equipment and methods shall comply with the Standards and Codes of Practice indicated using the versions that are current at the date for submission of tenders. The Contractor may propose the adoption of alternative standards and shall provide explanations with any proposals. The use of such standards shall be subject to the agreement of the Employer’s Representative.

Some Indian, European and British Standards and Guidelines are listed below. The list is provided for information. All Work shall follow these Standards and Guidelines.

First and foremost, the compliance of Indian Standards is required unless defined otherwise in this Specification. International (in the first step European) Standards and Guidelines shall be accessed to when no Indian Standards/Guidelines are available for the specific matter.

References to sources for Standards, Guidelines and Recommendations cited in the in Table below. The list is provided for information only.

**Table 22: References to sources of Standards, Guidelines and Recommendation**

Abbreviation	Name
ASTM	American Society for Testing and Materials, 100 Bar Harbor Drive West, Conshohocken PA 19429 – 2595, U.S.A.
BSI (BS)	British Standards Institute, 389 Chiswick High Road, London, W4 4AL UK.
DIN	Deutsches Institute für Normung e.V. Beuth Verlag GmbH, Burggrafenstrasse 6 D-10787, Berlin, Germany.
EFNARC	European Federation of Producers and Applicators of Special Building Products, Association House, 235 Ash Road, Aldershot, Hampshire, GU12 4DD, United Kingdom.
EN, ENV	European Committee for Standardisation, Central Secretariat, Rue de Stassart 36 B-1050, Brussels.
IRC	The Indian Road Congress, Jamnagar House, Shahjahan Road, New Delhi- 110011.
IS	Bureau of Indian Standards, Manak Bhavan, 9 Bahdur Shah Zafar Marg, New Delhi – 110002.
ISO	International Organization for Standardisation 1, rue de Varembé CP 56, CH- 1211 Geneva 20, Switzerland.
ÖNORM:	Austrian Standard Institute, Heinestrae 38, 1020 Wien, Austria

Abbreviation	Name
RVS (Austrian Code for Road Construction)	Austrian Association on Road, Rail and Transport (FSV), Karlsgasse 5, 1040 Wien, Austria
ÖGG	Austrian Society for Geomechanics, Bayerhamerstrasse 14, 5020 Salzburg, Austria

#### 9.4 Listing of Standards

The list is provided for information only.

**Table 23: Indian Standards**

ID of Standard	Description
IS 10262-2009	Guidelines for concrete mix design proportioning
IS 1077-1992	Common Burnt Clay Building Bricks
IS 11171-1985	Dry-Type Power Transformers
IS 1199-1959	Methods of sampling and analysis of concrete
IS 12269-1987	53 grade ordinary Portland cement
IS 12330-1988	Specification for sulphate resisting Portland cement
IS 1248	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories
IS 1278-1972	Filler rods and wires for gas welding
IS 1343-1980	Code of Practice for Prestressed Concrete
IS 1542-1992	Sand for plaster
IS 1554-1988	(Part 1): PVC insulated (heavy duty) electric cables: Part 1 For working voltages up to and including 1 100 V
IS 1566-1982	hard-drawn steel wire fabric for concrete reinforcement
IS 1885-1993	Electrotechnical Vocabulary: Part 32 Electric cables
IS 1651-1991	Stationary cells and batteries, lead-acid type (with tubular positive plates)
IS 8130-1984	Conductors for insulated electric cables and flexible cords
IS 1786-2008	High strength deformed steel bars and wires for concrete reinforcement-
IS 1791-1985	General Requirements for Batch Type Concrete Mixers
IS 1905-1987	Code of practice for structural safety of buildings; masonry walls
IS 2062-2011	Hot Rolled Medium and High Tensile Structural Steel
IS 2116-1980	Sand for masonry mortars
IS/IEC 60947-1-2007	Low-voltage Switchgear and Control gear: Part 1 General Rules
IS 2180-1988	heavy duty burnt clay building bricks
IS 2309-1989	Code of practice for the protection of buildings and allied structures against lightning
IS 2386-1963	(Part 1 & 8): methods of tests for aggregates for concrete
IS 2502-1963	Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
IS 2505-1992	Concrete vibrators - Immersion type - General requirements
IS 2514-1963	Concrete vibrating tables
IS/IEC 60947-2-2003	Low-Voltage Switchgear and Control gear - Part 2: Circuit Breakers
IS 13118-1991	High-Voltage Alternating-Current Circuit-Breakers

<b>ID of Standard</b>	<b>Description</b>
IS/IEC 60947-3-1999	Low voltage switchgear and control gear: Part 3 Switches, disconnectors, switch-disconnectors and fuse combination units
IS 269-1989	Ordinary and low heat Portland cement (33 GRADE)
IS 2705-1992	Current transformers
IS 2750-1964	Steel Scaffoldings
IS 2751-1979	Code of Practice for Welding of Mild Steel Plain and Deformed Bars for Reinforced Concrete Construction
IS 280-2006	Mild Steel Wire for General Engineering Purposes
IS 13925-1-2012	Shunt capacitors for ac power systems having a rated voltage above 1000 V Part 1: General
IS 2961-1973	Chrome retan finished upper leather
IS 8130-1984	Conductors for insulated electric cables and flexible cords
IS 3043-1987	Code of practices for earthing
IS 3085-1965	Method of Test for Permeability of Cement Mortar and Concrete
IS 3156-1992	Voltage transformers
IS 3231-1986	Electrical relays for power systems protection
IS 3427-1997	A.C. Metal Enclosed Switchgear and Control gear for Rated Voltages Above 1 kV and Up to and Including 52 kV
IS 3443-1980	Crane rail sections
IS 3558-1983	Code of practice for use of immersion vibrators for consolidating concert
IS 3597-1998	Concrete pipes - Methods of test
IS 5578-1984	Guide for marking of insulated conductors
IS 11353-1985	Guide for Uniform System of Marking and Identification of Conductors and Apparatus Terminals
IS 3764-1992	Code of safety for excavation work
IS 383-1970	Coarse and Fine Aggregates from Natural Sources for Concrete
IS 3954-1991	Hot Rolled Steel Channel Sections for General Engineering Purposes – Dimensions
IS 4031-1989	Methods of physical tests for hydraulic cement
IS 4032-1985	Method of chemical analysis of hydraulic cement
IS 4081-1986	Safety code for blasting and related drilling operations
IS 4138-1977	Safety code for working in compressed air
IS 432-1982	Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement
IS 456-1978	Plain and Reinforced Concrete - Code of Practice
IS 457-1957	Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and Other Massive Structures
IS 458-2003	Precast Concrete Pipes (with and without Reinforcement)
IS 4756-1978	Safety code for Tunneling work
IS 4880 (Part 1-7)	Code of practice for design of tunnels conveying water
IS 4925-2004	Concrete Batching and Mixing Plant
IS 4988-1968	(Part 1-5): Glossary of terms and classification of earth moving machinery
IS 5082-1998	Wrought aluminum and aluminum alloy bars, rods, tubes and sections for electrical purposes

<b>ID of Standard</b>	<b>Description</b>
IS 516-1959	Method of Tests for Strength of Concrete
IS 5525-1969	Recommendation for detailing of reinforcement in RCC
IS 5640-1970	Method of test for determining aggregate impact value of soft coarse aggregates
IS 5819-1970	Recommended Short-circuit Ratings of High Voltage PVC Cables
IS 5831-1984	PVC insulation and sheath of electric cables
IS 5878-1971	(Part 1-7): Code of Practice for Construction of Tunnels
IS 5892-2004	Concrete transit mixers & agitators
IS 6430-1985	Mobile air compressor for construction purposes
IS 6461-1972	Glossary of terms relating to cement concrete: Part I Concrete aggregates
IS 6461-1972	Glossary of Terms Relating to Cement Concrete - Part III: Concrete Reinforcement
IS 650-1991	Standard Sand for Testing of Cement
IS 694-2010	Polyvinyl Chloride Insulated Unsheathed and Sheathed Cables/Cords with Rigid and Flexible Conductor for Rated Voltages Up to And Including 450/750 V
IS 7098-1988	Crosslinked polyethylene insulated PVC sheathed cables: Part 1 For working voltage up to and including 1100 V
IS 7245-1974	Concrete payers
IS 7251-1974	Concrete finishers
IS 7293-1974	Safety code for working with construction machinery
IS 7319-1974	perforated concrete pipes
IS 783-1985	Code of Practice for Laying of Concrete Pipes
IS 7861-1981	(Part 2): Code of practice for extreme weather concreting: Part II Recommended practice for cold weather concreting
IS 7861-1981	(Part 1): Code of practice for extreme weather concreting Part 1 Recommended practice for hot weather concreting
IS 800-2007	General Construction in Steel - Code of Practice
IS 8041-1990	Specification for rapid hardening Portland cement (2nd revision)
IS 8112-1989	High strength ordinary Portland cement (43 grade)
IS 814-2004	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel
IS 816-1969	Code of practice for use of metal arc welding for general construction in mild steel
IS 817-1992	(Part 1): Training of Welders - Code of Practice: Part 1 Manual metal arc welding
IS 818-1968	Code of Practice for Safety and Health Requirements in Electric and Gas Welding and Cutting Operations
IS 2062-2011	Hot Rolled Medium and High Tensile Structural Steel
IS 8623-1993	Low-Voltage Switchgear and Control gear Assemblies
IS/IEC 60898-2002	Electrical accessories-Circuit-breakers for overcurrent protection for household and similar installations: Part 1 Circuit-breakers for ac operation
IS 9012-1978	Recommended practice for shotcreting
IS 9103-1999	Concrete Admixtures
IS 9284-1979	Method of test for abrasion resistance of concrete

ID of Standard	Description
IS 9417-1989	Recommendations for welding cold worked bars for reinforced concrete construction

**Table- 24 : European Standards (for Information)**

Eurocode 1	Basis of design and actions on structures
Eurocode 2	Design of concrete structures
Eurocode 3	Design of steel structures
Eurocode 5	Design of timber structures
Eurocode 7	Geotechnical design
Eurocode 8	Design of structures for earthquake resistance
BS EN ISO 62:2008	Plastics. Determination of water absorption
BS EN 196:2005	Methods of testing cement
BS EN 197-1:2011	Cement. Composition, specifications and conformity criteria for common cements
BS EN 197-1:2004	Cement – Part 1: Composition, specifications and conformity criteria for common cements
BS EN 206-1:2001	Specification, performance, production and conformity
BS EN 295-7:1996	Requirements for vitrified clay pipes and joints for pipe jacking
BS EN 338:2010	Structural timber. Strength classes
BS EN 450-1:2005	Fly ash for concrete – Part 1: Definitions, specifications and conformity criteria A1:2007
BS EN 471:2004	High-visibility warning clothing for professional use - Test methods and requirements
BS EN 480:2006	Admixtures for concrete, mortar and grout. Test methods
BS EN ISO 527-3:1996	Plastics. Determination of tensile properties. Test conditions for films and sheets
BS EN 681-2:2000	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Thermoplastic elastomers
BS EN 771-3:2011	Specification for masonry units. Aggregate concrete masonry units (dense and light-weight aggregates)
BS EN 772-2:1998	Methods of test for masonry units. Determination of percentage area of voids in masonry units (by paper indentation)
BS EN 791:1996	Drill rigs – safety
BS EN 815:1997	Safety of unshielded Tunneling boring machines and rodless shaft boring machines for rock
BS EN 932-6:1999	Tests for general properties of aggregates. Definitions of repeatability and reproducibility
BS EN 933-1:2012	Tests for geometrical properties of aggregates. Determination of particle size distribution. Sieving method
BS EN 934-2:2009	Admixtures for concrete, mortar and grout – Part 2: Concrete admixtures – Definitions and requirements, conformity, marking and labelling
BS EN 1008:2002	Mixing water for concrete – Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete
BS EN 1011-1:2009	Welding - Recommendations for welding of metallic materials - General

	guidance for arc welding
BS EN 1011-2:2001	Welding. Recommendations for welding of metallic materials. Arc welding of ferritic steels
BS EN 1062-7:2004	Paints and varnishes. Coating materials and coating systems for exterior masonry and concrete. Determination of crack bridging properties
BS EN 1090-2:2008	Execution of steel structures and aluminum structures. Technical requirements for steel structures
BS EN 1097	Tests for mechanical and physical properties of aggregates
BS EN 1367	Tests for thermal and weathering properties of aggregates
BS EN ISO 1461:2009	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
BS EN 1537:2000	Execution of special geotechnical work – rock anchors
BS EN 1542:1999	Products and systems for the protection and repair of concrete structures. Test methods. Measurement of bond strength by pull-off
BS EN 1562:2012	Founding. Malleable cast irons
BS EN 1563:2012	Founding. Spheroidal graphite cast iron
BS EN 1744	Tests for chemical properties of aggregates
BS EN 1849-2:2010	Flexible sheets for waterproofing. Determination of thickness and mass per unit area. Plastic and rubber sheets
BS EN 1928:2000	Flexible sheets for waterproofing. Bitumen, plastic and rubber sheets for roof waterproofing. Determination of water tightness
BS EN ISO 3506-2:2009	Mechanical properties of corrosion-resistant stainless-steel fasteners – Nuts
BS EN ISO 4624:2003	Paints and varnishes. Pull-off test for adhesion
BS EN ISO 9001:2008	Quality management systems. Requirements
BS EN 10025:2004	Hot rolled products of structural steels
BS EN 10080:2005	Steel for the reinforcement of concrete. Weldable reinforcing steel. General
BS EN 10164:2004	Steel products with improved deformation properties perpendicular to the surface of the product – technical delivery conditions
BS EN 10226-1:2004	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
BS EN ISO 11925-2:2011	Reaction to fire tests. Ignitability of products subjected to direct impingement of flame. Single-flame source test
BS EN 12110:2002	Tunneling machines – Air locks – Safety requirements
BS EN 12111:2002	Tunneling machines – Road headers, continuous miners and impact rippers – Safety requirements
BS EN 12310-2:2000	Flexible sheets for waterproofing. Determination of resistance to tearing (nail shank). Plastic and rubber sheets for roof waterproofing
BS EN 12317-2:2010	Flexible sheets for waterproofing. Determination of shear resistance of joints. Plastic and rubber sheets for roof waterproofing
BS EN 12336:2005	Tunneling machines - Shield machines, thrust boring machines, auger boring machines, lining erection equipment - Safety requirements

BS EN 12350	Testing fresh concrete
BS EN 12390	Testing hardened concrete
BS EN 12504-1	Testing concrete in structures – Part 1: Cored specimens – Taking, examining and testing in compression
BS EN 12588:2007	Lead and lead alloys. Rolled lead sheet for building purposes
BS EN 12620:2002	Aggregates for concrete
BS EN 12878:2005	Pigments for the coloring of building materials based on cement and/or lime. Specifications and methods of test
BS EN 12889:2000	Trenchless construction and testing of drains and sewers
BS EN 13055-1:2002	Lightweight aggregates. Lightweight aggregates for concrete, mortar and grout
BS EN 13139:2002	Aggregates for mortar
BS EN 13263-1:2005	Silica fume for concrete – Part 1: Definitions, requirements and conformity criteria
BS EN 13492:2004 (E)	Geosynthetic barriers - Characteristics required for use in the construction of liquid waste disposal sites, transfer stations or secondary containment
DIN EN 13670-1:2011	Execution of concrete structures
BS EN 13791:2007	Assessment of in-situ compressive strength in structures and pre-cast concrete components
BS EN 14487-1:2006	Sprayed concrete – Part 1: Definitions, specifications and conformity
BS EN 14487-2:2006	Sprayed concrete – Part 2: Execution
BS EN 14488-1:2005	Testing sprayed concrete – Part 1: Sampling fresh and hardened concrete
BS EN 14488-2:2006	Testing sprayed concrete – Part 2: Compressive strength of young sprayed concrete
BS EN 14488-3:2006	Testing sprayed concrete – Part 3: Flexural strengths (first peak, ultimate and residual) of fibre reinforced beam specimens
BS EN 14488-4:2005	Testing sprayed concrete – Part 4: Bond strength of cores by direct tension
BS EN 14488-5:2006	Testing sprayed concrete – Part 5: Determination of energy absorption capacity of fibre reinforced slab specimens
BS EN 14488-7:2006	Testing sprayed concrete – Part 7: Fibre content of fibre reinforced concrete
BS EN 14889-1:2006	Fibers for concrete – Part 1: Steel fibres. Definitions, specifications and conformity
BS EN 14889-2:2006	Fibers for concrete – Part 2: Polymer fibres. Definitions, specifications and conformity
BS EN 15167-1:2006	Ground granulated blast furnace slag for use in concrete, mortar and grout – definitions, specifications and conformity criteria
BS EN 60204	Safety of machinery. Electrical equipment of machines
BS EN 61672-1:2003	Electroacoustics. Sound level meters. Specifications
DD CEN/TS	Geosynthetic barriers. Test method for determining the resistance to

14416:2005	roots
PD	CLC/TR
50426:2006	Assessment of inadvertent initiation of bridge wire electro-explosive devices by radio-frequency radiation. Guide

**Table- 25 : British Standards (for information)**

BS 143 and 1256:2000	Threaded pipe fittings in malleable cast iron and cast copper alloy
BS 1134:2010	Assessment of surface texture. Guidance and general information
BS 4190:2001	ISO metric black hexagon bolts, screws and nuts. Specification
BS 4449:2005	Steel for the reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product
BS 4482:2005	Steel wire for the reinforcement of concrete products. Specification
BS 4483:2005	Steel fabric for the reinforcement of concrete
BS 4921:1988	Specification for sherardized coatings on iron or steel
BS 5228-1:2009	Code of practice for noise and vibration control on construction and open sites. Noise
BS 5228-2:2009	Code of practice for noise and vibration control on construction and open sites. Vibration
BS 5607:1998	Code of practice for the safe use of explosives in the construction industry
BS 5911-1	Concrete pipes and ancillary concrete products. Specification for unreinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints (complementary to BS EN 1916:2002)
BS 5975:2008	Code of practice for temporary works procedures and the permissible stress design of falsework
BS 6100	Building and civil engineering. Vocabulary. (various dates)
BS 6164:2011	Code of practice for health and safety in Tunneling in the construction industry
BS 6319	Testing of resin and polymer cement compositions for use in construction (various dates)
BS 6472:2008	Guide to evaluation of human exposure to vibration in buildings (1–80 Hz)
BS ISO 4866:2010	Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their effects on structures
BS 7385-2:1993	Evaluation and measurement for vibration in buildings. Guide to damage levels from ground borne vibration (Part 2)
BS 7668:2004	Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification
BS 7671:2011	Requirements for electrical installations
BS 7973-1:2001	Spacers and chairs for steel reinforcement and their Specification. Product performance requirements
BS 7973-2:2001	Spacers and chairs for steel reinforcement and their Specification. Fixing and application of spacers and chairs and tying of reinforcement
BS 7979:2001	Specification for limestone fines for use with Portland cement
BS 8102:2009	Code of practice for protection of below ground structures against water from the ground
BS 8500-1:2006	Concrete – Complementary British Standard to BS EN 206-1. Method of

	specifying and guidance for the specifier
BS 8500-2:2006	Concrete. Complementary British Standard to BS EN 206-1. Specification for constituent materials and concrete
BS 8666:2005	Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification

**Table 26 : International Standards (for Information)**

ASTM D 1777	Standard Test Method for Thickness
ASTM D 3776	Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
ASTM D 4491a	Standard Test Method for Water permittivity
ASTM D 4751	Standard Test Method for Apparent opening size of a Geotextile
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 3786	Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D 3787	Standard Test Method for Bursting Strength of Textiles-Constant-Rate-of-Traversal (CRT) Ball Burst Test
ASTM D 4157	Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)
EFNARC-1996	European Specification for Sprayed Concrete
ASTM C-39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C-78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C-94/C	Standard Specification for Ready-Mixed Concrete
ASTM C-172/C	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C-685/C	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
EFNARC Three Point Bending Test on Square Panel with Notch 2011	Testing Sprayed Concrete - Flexural tensile strength of fiber concrete on sprayed test specimen.
Austrian concrete society publications	Guide line on shotcrete and testing methods
Austrian concrete society publications	Inner lining concrete

ISCE -2004	Recommendation for design and construction of steel fiber reinforced concrete, Publications of Japan society of civil Employer’s Representatives
DIN 67524 (Part 1/02)	Lighting of street tunnels and underpasses
DIN 67524-2008	Tunnel illumination
DIN 5035	Artificial lighting
RABT (2006)	Guidelines for equipment and operation of road tunnels

## **10. TRAFFIC SURVEYS AND ANALYSIS**

### **10.1 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, pavement design, economic and financial analysis etc. Towards this the consultant has undertaken detailed traffic surveys, analysis, forecasting and carry out planning requirements. Various steps followed in this regard are described in the subsequent paragraphs.

### **10.2 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.

### **10.3 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:

- Classified Volume Count (CVC) Survey
- Axle Load Spectrum Survey

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 37:2012, IRC: 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 enough 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.

## **10.4 Traffic Surveys Methodology**

### **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 two strategic locations have 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 15- minute interval over 24 hrs. a day for 7 days. The counts were recorded in the approved formats as per IRC specifications.

## **10.5 Traffic Survey Analysis at Goha – Khellani Existing Road.**

### **Traffic Homogeneous Section**

The traffic homogeneous sections have been identified based on the major traffic generator locations along the project corridor. All the traffic survey assessments have been carried out at Kalota. 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:

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. The traffic homogeneous section in the road section is as follows:

**Table 27 : Traffic Homogenous Section**

Sr. No.	Homogeneous Section	Existing Length
1	Goha – Khellani existing road at Kalota	22681 m

### 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 26th October 2018 to 1st November 2018. Traffic survey locations were finalized by consultation with client officials. Reasoning with detailed justification for selection of each traffic survey location is given in below Table

**Table 28 : Traffic Survey Locations Justification/Rational**

Sr.No.	Chainages	Justification/Rational
<b>Classified Volume Count Surveys (CVC)</b>		
1	Kalota	Kalota has been selected to get the idea of traffic in homogeneous section of Goha – Khellani existing road

### Analysis of Traffic Surveys - Base Year Traffic Estimation

- 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 2017 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 was 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, cross-section, planning 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.

- **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.

**Table 29 : Classification of Vehicles Recommended PCU Equivalents Factors**

Sr.No	Vehicle Type	PCU Value
<b>Fast Moving Vehicles</b>		
1	Cars/Utility Vehicles/Jeeps/Vans & 3 Wheelers	1.0
2	2 Wheelers	0.5
3	LCV Passenger/LCV Goods/Mini-Bus	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
<b>Slow Moving Vehicles</b>		
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

### Analysis of Classified Volume Count Survey

- **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:

- **Kalota**

Classified Volume count survey was carried out at Kalota.

Total ADT at this station were recorded as 3024 in terms of number and 4657 in terms of PCU. Fast moving vehicles were recorded as 99.89% of the total traffic (in No.). The directional distribution for all vehicles observed is 49.70 percent flow towards Kishtwar direction and 50.30 percent towards Sudhmahadev direction. Summary of classified traffic volume count survey results is shown in Table below.

**Table 30 : Summary of Classified Volume Count Survey at all count stations**

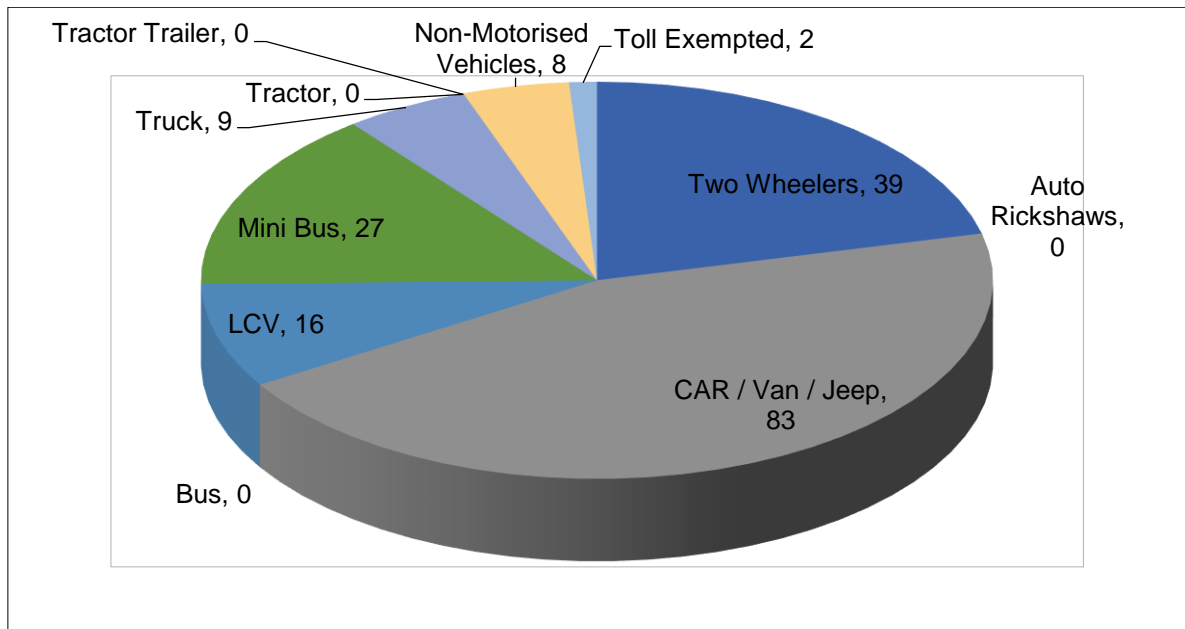
Location	Total AADT		Total ADT		Directional Distribution (%)	
	No.	PCU	No.	PCU	Towards Kisthwar	Towards Sudhmahadev
Kalota	184	199	184	198	49.46	50.55

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.

• **Traffic Composition**

The traffic compositions observed in survey location of Kalota are presented graphically in Figure below.

**Composition of Traffic at Kalota Village**



• **Estimation of Seasonal Correction Factor**

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 i.e. 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 below.

**Table- 31 : Seasonal Correction Factors (SCF) Based on Fuel Consumption**

For Whole Section	Petrol	Diesel
	0.95	1.04

Traffic Survey Analysis has been attached in **Annexure-II**

- **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).

**Table- 32 : Annual Average Daily Traffic In Both Directions**

Description	Direction	Fast Passenger Vehicles		Fast Commercial Vehicles			Slow Modes	Total Traffic	Tollable Traffic		
		Two-Wheeler	Car / Jeep / Van	Bus	LCV	Truck	Toll Exempted Vehicle			Cycle	Mini LCV
				Mini-Bus		2 Axle Truck	Fire Tender/Govt Heavy Vehicle				
<b>PCU</b>		<b>0.5</b>	<b>1.0</b>	<b>1.5</b>	<b>1.5</b>	<b>3.0</b>	<b>3.0</b>	<b>0.5</b>	<b>1.0</b>		
<b>AADT (Vehicles)</b>	<b>To Khellani</b>	19	41	14	2	4	1	4	6	91	67
	<b>To Hambel</b>	20	42	14	2	5	1	4	5	93	68
	<b>Combined</b>	<b>39</b>	<b>83</b>	<b>27</b>	<b>4</b>	<b>9</b>	<b>2</b>	<b>8</b>	<b>11</b>	<b>184</b>	<b>135</b>
<b>AADT (PCU)</b>	<b>To Khellani</b>	10	41	20	3	12	3	2	6	98	83
	<b>To Hambel</b>	10	42	20	3	16	3	2	5	101	86
	<b>Combined</b>	<b>19</b>	<b>83</b>	<b>41</b>	<b>6</b>	<b>28</b>	<b>6</b>	<b>4</b>	<b>11</b>	<b>199</b>	<b>169</b>

## 10.6 Traffic Survey Analysis at Khellani on NH-244.

### Traffic Homogeneous Section

The traffic homogeneous sections have been identified based on the major traffic

generator locations along the project corridor. All the traffic survey assessments have been carried out at Khellani on NH - 244. 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:

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. The traffic homogeneous section in the road section is as follows:

**Table- 33 : Traffic Homogenous Section**

Sr. No.	Homogeneous Section	Proposed Length
1	Khellani tunnel & its Approach Road	2.419 m

#### **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 26th October 2018 to 1st November 2018. Traffic survey locations were finalized by consultation with client officials. Reasoning with detailed justification for selection of each traffic survey location is given in below Table

**Table 34 : Traffic Survey Locations Justification/Rational**

Sr.No.	Chainages	Justification/Rational
<b>Classified Volume Count Surveys (CVC)</b>		
1	Khellani	Khellani has been selected to get the idea of traffic in homogeneous section of Goha – Khellani tunnel

#### **Analysis of Traffic Surveys - Base Year Traffic Estimation**

- **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 2017 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 was 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, cross-section, planning 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.

- **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.

**Table 35 : Classification of Vehicles Recommended PCU Equivalent Factors**

Sr.No	Vehicle Type	PCU Value
<b>Fast Moving Vehicles</b>		
1	Cars/Utility Vehicles/Jeeps/Vans & 3 Wheelers	1.0
2	2 Wheelers	0.5
3	LCV Passenger/LCV Goods/Mini Bus	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
<b>Slow Moving Vehicles</b>		
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

**Analysis of Classified Volume Count Survey**

- **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:

- **Khellani**

Classified Volume count survey was carried out at Khellani.

Total ADT at this station were recorded as 3024 in terms of number and 4657 in terms of PCU. Fast moving vehicles were recorded as 99.89% of the total traffic (in No.). The directional distribution for all vehicles observed is 49.70 percent flow towards Kishtwar direction and 50.30 percent towards Sudhmahadev direction. Summary of classified traffic volume count survey results is shown in Table below.

**Table 36 : Summary of Classified Volume Count Survey at all count stations**

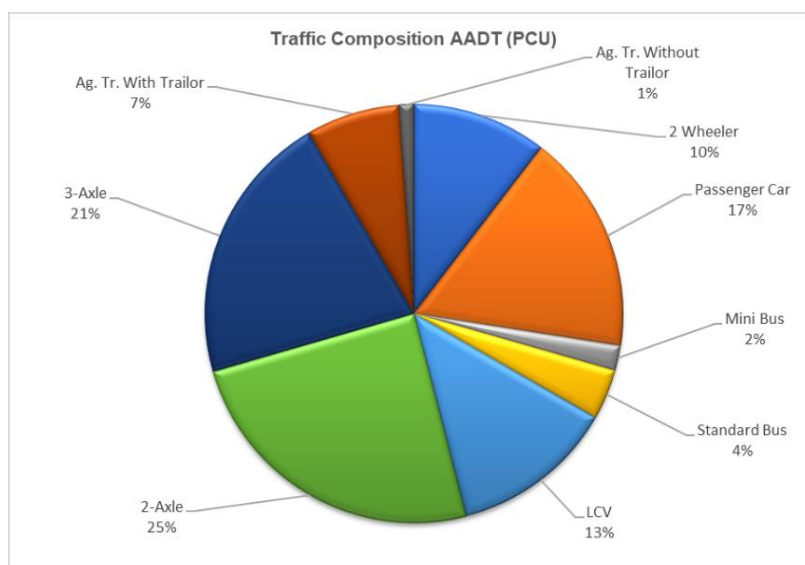
Sr. No.	Location	Total AADT (No)	Total AADT (PCU)	Total ADT (No)	Total ADT (PCU)	Directional Distribution (%)	
						Towards Kishtwar	Towards Sudhmahadev
1	Khellani	2947	4538	3024	4657	49.70	50.30

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.

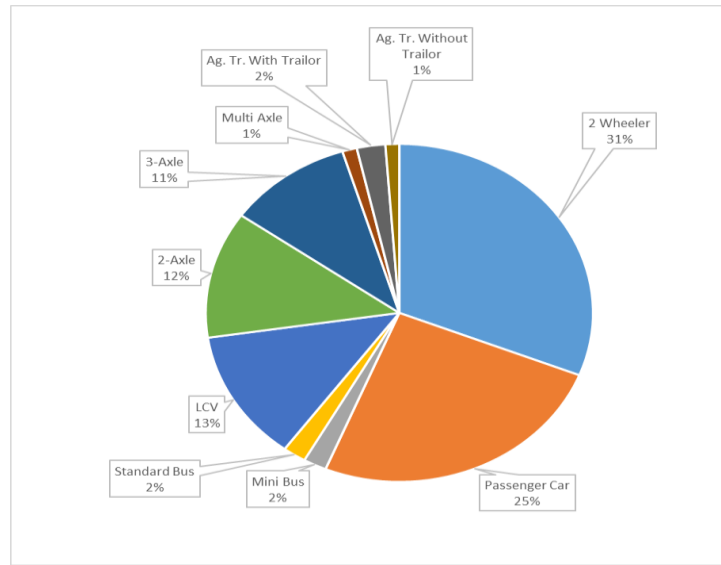
- **Traffic Composition**

The traffic compositions observed in survey location of Khellani are presented graphically in Figure below.

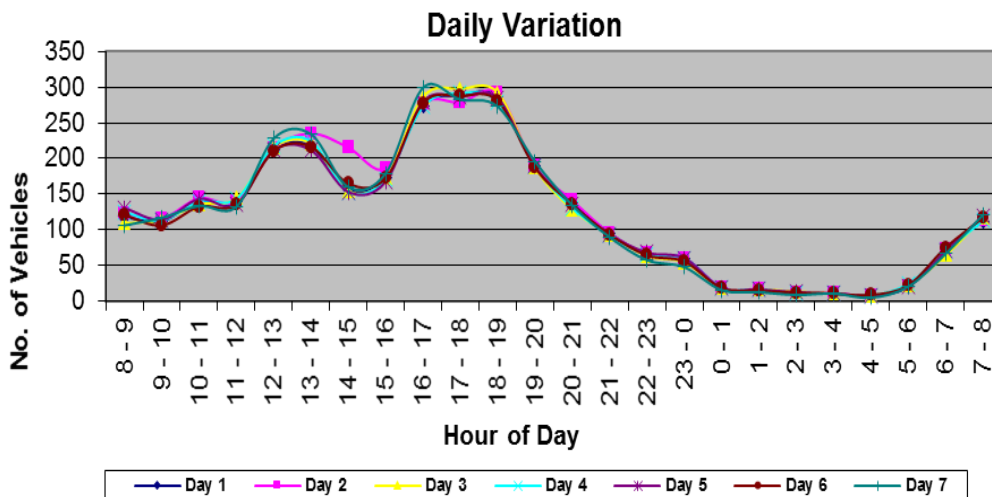
**Composition of Traffic by PCU at Khellani Town**



**Composition of Traffic by Volume at Khellani Town**



**Daily and Hourly Variation of Traffic at Khellani Town**



**• Estimation of Seasonal Correction Factor**

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 i.e. 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 below.

**Table 37 : Seasonal Correction Factors (SCF) Based on Fuel Consumption**

For Whole Section	Petrol	Diesel
	0.95	1.04

Traffic Survey Analysis has been attached in **Annexure-II**

- 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).

**Table 38 : Average Daily Traffic (ADT) to Annual Average Daily Traffic (AADT)**

PCU Equivalents	0.5		1		1.5		3		1.5		3		3		4.5		4.5		1.5		Total All Vehicles	
	FAST MOVING VEHICLES																					
Vehicle Type	2 Wheeler		Passenger Car		Bus				LCV		Truck						Agricultural Tractor					
					Mini Bus		Standard Bus		4 Tyre		2-Axle		3-Axle		Multi Axle		With Tractor		Without Tractor			
Direction	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN
Day 1	445	463	392	369	27	29	27	23	184	195	171	176	146	156	18	12	31	37	16	19	1457	1478
Day 2	478	477	386	370	28	30	22	28	185	192	172	178	152	153	18	20	33	36	19	17	1493	1501
Day 3	463	461	370	358	27	29	28	26	175	194	182	189	149	156	16	18	36	32	14	19	1460	1482
Day 4	412	478	367	379	27	29	36	28	188	182	180	188	141	163	21	12	37	36	16	18	1426	1513
Day 5	453	464	360	379	24	30	31	36	184	182	172	175	160	145	20	21	36	35	17	18	1457	1486
Day 6	465	439	351	388	27	30	23	28	175	178	185	182	163	144	20	19	36	34	16	17	1462	1460
Day 7	461	438	371	358	29	25	28	26	192	182	175	181	160	166	19	17	33	35	18	16	1485	1444
Total	3178	3219	2595	2600	191	204	197	197	1283	1307	1236	1269	1072	1083	131	117	243	246	113	121	10238	10363
Total Up/Down	6397		5196		395		394		2590		2506		2155		248		488		234		20602	
Average	453	459	370	371	27	29	28	28	183	186	176	181	153	154	18	16	34	35	16	17	1458	1476
AADT No.	914		743		57		57		370		358		308		36		70		34		2947	
AADT PCU	457		743		86		171		555		1074		924		162		315		51		4538	

### 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 identified locations. The data collected from the Axle Load Survey has been compiled and analyzed through “Fourth power” pavement damage rule to arrive at the vehicles damage factor (VDF). The survey is analyzed to obtain Vehicle Damage Factor (VDF) and is presented below:

**Table 39 : Adopted VDF by Homogeneous Sections**

Khellani Village	
Vehicle Type	VDF
LCV	0.459
2 Axle Truck	4.932
3 Axle Truck	0.765
Bus	0.619
Multi axle	3.930

Vehicle Damage Factor of 2 Axle Truck is more because there were maximum empty number of 3 Axle and Multi Axle Trucks whose weights were measured during Axle Load Survey.

**Table 40 : 2-Axle Truck**

<b>Total</b>	<b>60</b>	
Empty	2	3.33%
Loaded	58	96.67%
<b>3-Axle</b>		
<b>Total</b>	<b>68</b>	
Empty	64	94.12%
Loaded	4	5.88%
<b>Multi -Axle</b>		
<b>Total</b>	<b>5</b>	
Empty	3	60%
Loaded	2	40%

The equivalent single axle loads (ESALs) have been calculated assuming that the project road will be opened to traffic in the beginning of year **2021**.

The equivalent single axle loads (ESALs) have been calculated assuming that the project road will be opened to traffic in the beginning of year 2021. VDF Details are provided in table below:

**Table 41 : MSA Calculation (Khellani on NH-244)**

Year	Standard Bus	LCV	2 Axle	3 Axle	MAV	Yearly Design ESA	Cumulative Design ESA	MSA	Design Period
<b>VDF</b>	0.62	0.46	4.93	0.76	3.93				
2019	114	370	358	308	36	347906		Base Year	
2020	120	407	376	323	38	366541			
2021	126	448	395	340	40	386231			
2022	132	488	414	357	42	406742			
2023	139	532	435	374	44	428387	428387	<b>0.428</b>	<b>1-year</b>
2024	145	580	457	393	46	451232	879619		

Year	Standard Bus	LCV	2 Axle	3 Axle	MAV	Yearly Design ESA	Cumulative Design ESA	MSA	Design Period
2025	153	632	480	413	48	475347	1354966		
2026	160	689	504	433	51	500808	1855774		
2027	168	744	529	455	53	527233	2383007	<b>2.383</b>	<b>5-year</b>
2028	177	803	555	478	56	555090	2938096		
2029	186	868	583	502	59	584459	3522555		
2030	195	937	612	527	62	615426	4137981		
2031	205	1012	643	553	65	648081	4786062		
2032	215	1083	675	581	68	681841	5467903	<b>5.468</b>	<b>10-year</b>
2033	226	1159	709	610	71	717384	6185287		
2034	237	1240	744	640	75	754806	6940093		
2035	249	1327	781	672	79	794208	7734300		
2036	261	1420	821	706	83	835696	8569996		
2037	274	1505	862	741	87	878431	9448427	<b>9.448</b>	<b>15-year</b>

**Table 42 : Adopted MSA as per IRC Recommendation**

Section	Design Chainage		Calculated MSA	Adopted Design MSA
	From	To	(2022-2036)	(2022-2036)
Khellani Tunnel & its Approach Road	29/030	31/449	9.448	20

MSA is calculated here as 9.448 for 15 years but according to clause 5.4.1 of IRC SP:73-2018, Flexible pavement is subjected to the condition that design traffic shall not be less than 20 MSA. So, it's adopted as 20 MSA.

## 10.7 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:

**Table 43 : Comparative Analysis**

Growth Rate of Economic Indicators for the State of Jammu and Kashmir													
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

Growth Rate of Economic Indicators for the State of Jammu and Kashmir													
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 (%)
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
<b>Average yearly growth rate (%)</b>				<b>4.50</b>			<b>1.23</b>			<b>5.78</b>			<b>6.05</b>

Sr. no.	Period	2 Wheelers	Cars/jeeps	Buses	Trucks			LCV and Mini LCV
					2 Axle	3 Axle	M Axle	
1	Up to 2020	10.0	10.0	5.0	5.0	5.0	5.0	10.0
2	2021 -2025	9.0	9.0	5.0	5.0	5.0	5.0	9.0
3	2026 – 2030	8.0	8.0	5.0	5.0	5.0	5.0	8.0
4	2031 – 2035	7.0	7.0	5.0	5.0	5.0	5.0	7.0
5	Beyond 2035	6.0	6.0	5.0	5.0	5.0	5.0	6.0

**Table 44: Summary of Projected Total AADT Traffic PCU Volume / day**

Homogeneous Section	Year 2019	Year 2022	Year 2029	Year 2031	Year 2036
Khellani Tunnel & its Approach Road (Ch. 29+030 to km 31+449)	4538	5903	10404	12053	17000

## 10.8 Capacity Analysis

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 LOSB should be adopted for the design purpose. On other roads under exceptional circumstances, LOSC could also be adopted for design. For LOS C, Design service volume can be taken as 40 % higher than those for LOS B. For augmentation of the facilities and up gradation of the project highway, the design service volume for the mountainous/hilly terrain condition and level of Service B & C is shown in Table:

**Table 45: Design Service Volume for Different Lane Configurations**

Lane Configuration	Design Service Volume (PCUs per day) Level of Service B	Design Service Volume (PCUs per day) Level of Service C
2-Lane with 1.5m Paved Shoulder	9000	10000
4-Lane with 1.5m Paved Shoulder	10000	20000

## 10.9 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 Two-laning with paved shoulders. Based on the estimated Capacity & Design Service Volume, the number of lanes required for the project road is worked out for LOS B & LOS C which is presented in Table below.

**Table 46: Lanning Requirement for the Project Corridor**

Homogeneous Sections	LOS B	LOS C
	2-Lane with Paved Shoulder	2-Lane with Paved Shoulder
Khellani Tunnel & its Approach Road (Ch. 29+030 to km 31+449)	2018	2028

It is revealed from the capacity analysis results and considering future traffic growth, the Project road requires 2-lane configuration.

## **11. FINANCIAL AND ECONOMIC ANALYSIS**

Financial Study is carried out for Khellani Tunnel & its Approach Road including Khellani bypass tunnel from km 29+030 (from end point of Goha – Khellani road) to km. 31+449. This section is of 2.419 km proposed length consist of tunnel (T1) length about 1.565 Km. The commercial viability is assessed for 20 years concession period by making financial analysis (BOT / Annuity analysis) as given below.

Construction Cost – 749.274 Cr. at 3 Years Construction Period

For above alternatives viability has been assessed for all possible modes i.e. BOT & PPP.

### **11.1 Approach**

The viability of any BOT / Annuity package depends on working cash flows available to service the debt and equity. This working cash flow is basically dependent upon the following:

- a) Capital Cost
- b) Traffic Forecast
- c) User Fee Structure
- d) Operation and Maintenance Expenses
- e) Interest on Debt
- f) Tax

Infrastructure projects are typically capital intensive and are characterised by long payback periods. To look at such projects on a commercial format, it becomes necessary to adopt measures, which significantly improve the financial viability of the project. Such steps include optimising capital costs and drawing up a user fee structure based on benefit analysis and revenue optimisation principles.

In this ultimate analysis, the extent to which such projects raise non-budgetary resources depend on the ability of the project to service investments at commercial terms. Presently, average returns on equity are structured to range from 12% to 13% per annum on an IRR basis.

Likewise, debt instruments placed with financial institutions provide an average return

of around 9% to 12% per annum. To raise the resources for such project, it is necessary that the project is expected to give the lucrative returns at healthy debt-equity ratio.

The main objective of Financial Analysis is to examine the viability of implementing the project on a BOT / PPP basis. The analysis attempts to ascertain the extent to which the investment can be recovered through toll revenue and the gap, if any, be funded through Grant / Subsidy. This covers aspects like financing through debt and equity, loan repayment, debt servicing, taxation, depreciation, Annuity etc. The viability of the project is evaluated on the basis of Project FIRR (Financial Internal Rate of Return on total investment). The FIRR is estimated on the basis of cash flow analysis, where both costs and revenue have been indexed to take account of inflation. Financial analysis has been carried out for debt equity ratio of 70:30.

## 11.2 Capital Cost

The construction is expected to be executed completely in 36 months; year-wise progress will be 30% in first year, 40% in Second year, 30% in Third year.

### A. Base Cost

The civil construction cost for the project road is considered as base cost. The construction is expected to be executed completely in 36 months; year-wise progress will be 30% in first year, 40% in Second year, 30% in Third. Total Project cost showing these additional provisions are tabulated below:

**Table 47 : Phasing of Cost**

Section	Proposed Length (km)	Base Cost (Cr.)	Phasing of Cost
I	2.419 including tunnel length of 1.565	546.524	30% In First Year, 40% in Second Year, 30% in Third.

### B. Cost Escalation

The price escalation provision assumes an increase compound base of 5% per annum on construction cost based on 2012 rates. This is in line with conventional trend of inflation rates.

### C. Interest During Construction

A Debt Equity ratio of 70:30, which is commonly used, for infrastructure projects, has been considered for financial analysis of this project. For the loan repayment in Annuity,

a repayment schedule of 15 years has been adopted. The interest on long term debt has been taken as 11.75%. The rate for calculation of IDC has also been taken as 11.75%.

#### **D. Landed Project Cost**

In base construction cost, provision for physical contingency (2.8% of the base construction cost) has been made to arrive at the Engineering procurement cost (EPC). In addition to the above, a provision of 1.0% Administrative Charge, 1.0% Quality Control Charges, 0.5% Road Safety Charge, 2% Supervision Charges and 5% Escalation charges on total cost have been made to get the project cost.

**Table 48 : This financial implication increases the TPC of Civil Construction Cost.**

<b>Sr. No.</b>	<b>Item of Works</b>	<b>Cost (cr.)</b>
<b>A</b>	Civil Works (Including GST @ 12%)	604.4
<b>B</b>	Financial Cost (B)	144.91
	<b>Cost (A + B)</b>	<b>749.274</b>

### **11.3 Operation and Maintenance Costs**

Maintenance during defect liability period is considered for 10 Years as a tunnel project and its approaches of Goha-Khellani road. Cost of O&M is calculated based on the article 14 of EPC agreement- 0.25% for the first 5 Years, 0.5% for the remaining 5 years of Rs. 31.30 Cr..

#### **1. Location of Toll Plazas**

A Toll Plaza has already been proposed on Sudhmahadev-Dranga between Km 0.00 - km 12.85 project. So, no Toll plaza is proposed for this project.

#### **2. Traffic Assumptions and Forecast**

Light vehicles especially Two/Three wheelers and slow-moving vehicles are exempted from user fee as per guide lines for toll roads. Tollable traffic has been assessed leaving slow moving and light vehicles except light commercial vehicles, car, mini buses, trucks and Tractor with trailers.

#### **3. Concession Period**

The guiding principle for determining project specific concession period is the carrying capacity of the respective highway at the end of the proposed concession period. As such, the concession period is proposed based on volume of present and projected traffic. In

other ways concession period ends in the year when capacity of respective highway exhaust to cater project traffic volume.

Table provided below shows existing traffic and the year when traffic exceeds the capacity of the highway, calculated for "**LEVEL OF SERVICE B (LOS B)**" and warrants capacity augmentation.

**Table 49 : Lane Capacity and Augmentation Required for the Project Corridor**

Homogeneous Sections	LOS B	LOS C
	2-Lane with Paved Shoulder	2-Lane with Paved Shoulder
Khellani Tunnel & its Approach Road (CH. Km 29+030 to km 31+449)	2018	2028

**A. Advertisement Revenue**

The advertisement has been not recommended on the project road due to safety concern to the road users. So, revenue generation from the advisement is not taken in to consideration for this project.

**11.4 Financial Model Input and Analysis**

**A. Grant and Its Treatment**

It shall be equal to the sum specified in the bid and as accepted by the authority but in no case greater than the equity and shall be further restricted to a sum not exceeding 40% of TPC i.e. maximum 40% of TPC (Total Project Cost). It shall be due and payable to the Concessionaire as per PPP guidelines. Further it shall be disbursed proportionately along with the loan funds. For analysis, VGF of 40% have been adopted to ensure minimum 12% IRR.

**B. Proposed Sources of Finance**

In general, the developer shall crystallize the sources of finance by optimizing his equity returns keeping in view the project cash flows, terms, and conditions of various financing options available. Further the market standing, and financial strength of the Developer would largely determine the terms and conditions of finance offered to the Developer by various lending agencies. For the study, following sources of finance have been taken:

- Equity: To be provided by the Developer

- Subsidy / Grant for viability of funding, to be provided by the client.
- Debt: To be arranged by the Developer / Concessionaire

### **C. Expenses**

Expenses can broadly be classified based on the phases in which they are incurred, viz. construction period expenses and operation & maintenance period expenses.

### **D. Construction Period Expenses**

- Preliminary and pre-operative expenses
- Contingency allowance
- Interest during construction period
- Finance Charges

### **E. Operation and Maintenance Period Expenses**

- Toll collection expenses
- Administrative expenses for day-to-day operation including insurances
- Maintenance expenses, which include routine and periodic maintenance
- Interest expenses incurred for servicing term loans
- Tax

### **F. Financial Viability**

To assess whether the project is a profitable proposition, the returns to investors are measured by the post-tax project FIRR and the equity FIRR, which is estimated from the cash-flow statements, based on discounted cash-flow technique. The returns expected by the investors are a function of the value of equity issues on the Indian stock Markets, Interest rates on commercial loans, the risk profile of the investment and alternative investment opportunities. To qualify the project in terms of attractive financial returns, the following criteria are adopted:

- Post tax IRR on Project Investment : minimum 12%
- Post tax IRR on Equity : minimum 12%

- DSCR : >1.0
- BCR : >1.3
- NPV @ 12% : must be positive

### **11.5 Recommendation & Conclusion on Type of Financing**

Project road section is financially not viable based on the forecasted traffic and MORT&H user fee with 40% government subsidy and maximum concession period of 20 years.

Therefore, EPC contract option is being proposed for the entire project section with single package.

### **11.6 Economic Analysis**

An infrastructure project is subjected to economic appraisal to ensure that the investment proposed would yield appropriate return to the national economy. It is therefore important that decisions about investments in roads are made on objective judgments and therefore, Economic appraisal has been carried out for each traffic homogenous section of entire Project road.

The basic purpose of the economic analysis is to enable the decision-makers in the Government to decide whether the project is worthy of investment keeping in view the benefits to the society. The Proposal for project road i.e. Khellani tunnel & its approach road section is new road alignment of length 2.419 km including a tunnel of length 1564.5 m. The proposed tunnel is Uni-directional twin tunnel. In order to assess the benefits accrued to the society; both the options of 'Existing' and 'Proposed' have to be compared. For this purpose, the entire existing Road has been considered along with its proposed maintenance and improvement proposals.

#### **A. Economic Analysis Approach**

The economic evaluation has been carried out within the broad framework of social cost benefit analysis. The objective is to determine the best improvement scheme out of several proposals, which will lead to minimizing total transport costs and maximizing benefits to the road users.

The benefits accruing to society from the proposed improvement are mainly reduced vehicle operating cost, reduced travel time cost and reduced accident costs. Total

transport costs comprise of two basic components as shown in below **Table**.

**Table- 50 : Total Transport Costs**

<b>Road Supplier Costs</b>	<b>Road User Costs</b>
Construction Costs	Vehicle Operating Costs (VOC) both MT & NMT
Maintenance Costs	Travel Time Costs
Replacement Costs: Costs of Environmental Impact Mitigation Measures, Costs of Rehabilitation and Resettlement (R&R) measures	

These costs are generated using HDM – IV for every year of the analysis period (cost-benefit stream) from which economic indicator parameters that essential for viability of project namely Net Present Value (NPV), Economic Rate of Return (EIRR) and Benefit Cost Ratio (B/C) are the final economic outputs.

NPV is the present value of Net Benefits (NB) during the project period. EIRR is the discount rate at which the NPV of the Net Benefit (NB) is zero. Net Benefit is the cumulative sum of the difference between yearly benefit and yearly costs incurred after discounting.

$$NB = \sum_{n=1}^M (Benefit(n) - Cost(n))$$

Savings from vehicle emission reduction and less energy consumption due to improved facility are also important economic savings which are possible to calculate but these quantities are not converted to economic cost inside the software. So these benefits are not included.

The appraisal period (including the construction period) has been taken as 30 years after which a residual value of investment is assumed as 10%.

## **11.7 Project Economic Evaluation using HDM - 4**

Economic evaluation for Goha - Khellani road section is carried out by consideration of two alternatives In HDM – 4.

### **A. Alternative 1: Existing**

For without project consideration, project road will carry existing traffic on it without any improvement and maintenance in present condition. But here at present there is no

connecting road and the alignment is totally newly proposed.

## **B. Alternative 2: Proposed**

For with project consideration, Project road is constructed with Uni-directional twin tube tunnel with approached consist of divided two lane and undivided two lane. In this alternative, project road improvements are made by proposing totally new alignment with tunnel, structures and road.

### **11.8 Project Cost and Scheduling**

Project road is proposed to undertake new construction. Accordingly, economic analysis of the project road is being carried out as follows:

**Table- 51 : Section Details**

Homogeneous Section	Existing Chainage		Improvement
	From	To	
Extended portion from Sudhmahadev-Dranga tunnel approach road to Khellani town including Khellani bypass tunnel	29+030	31+449	Undivided two-lane carriageway with paved shoulder including Khellani bypass tunnel,

The Economic analysis was carried out for 30-year benefit period (2022-2052). For performing economic evaluation, a ‘project’ is formulated in which comparison is made proposed.

### **11.9 Capital Cost**

Total capital cost is Rs. 749.274 Crore for project road portion. For economic evaluation base costs have been taken as factor cost of civil works and other cost related to land acquisition social environmental and utility relocations that mean Capital cost is the total construction cost of civil works for the project improvement.

The construction cost for each homogeneous section is tabulated in **Table** for the year 2020 at which Project will start to implement. Therefore, the project cost of present year is increased with 5 % inflation rate for two successive years. The construction cost of project will be utilized in four phases i.e. 30 % in first year and 40 % in second year, 30% in third.

The cost estimate for each section has been calculated separately based on the quantities

worked out for major items of work to be executed in the project on the basis of preliminary engineering design of roads, structures and the adopted rates. A conversion factor of 0.85 has been used to convert financial cost into economic costs.

The economic cost for each package is as under:

**Table 52 : Total Project Cost**

<b>Homogeneous Section</b>	<b>Financial Cost (Cr.)</b>	<b>Economical Cost (Cr.)</b>
Extended portion from Sudhmahadev-Dranga tunnel approach road to Khellani town including khellani bypass tunnel	144.91	147.567

### 11.10 Maintenance Cost

#### For Two lanes with Paved shoulder road

Routine maintenance cost	-	Rs. 5, 50,000 per km per year
Periodic maintenance cost	-	Rs 8,55,000 per km (40mm BC+80mm DBM), Shoulder
Routine maintenance cost	-	Rs 6,50,000 per km per year Tunnel

### 11.11 Project Benefits

Project Benefits mainly occurs due to Reduction in Vehicle operating cost and travel time savings.

The vehicle operating cost (VOC) components are

- Fuel
- Lubricants
- Tyres
- Spare Parts
- Maintenance Labour
- Wages of Crew
- Fixed costs including overheads, administration, interest on borrowed capital
- Depreciations
- Travel time cost

## **12. ENVIROMENTAL SCREENING AND PRELIMINARY ENVIROMENTAL ASSESSMENT**

The project road and Tunnel is considered to help in providing better connectivity from Goha to Khellani in Doda District and is envisaged to provide better riding quality to the users, that reduces the travel time and distance. Some of the likely social impacts that affect the present environment are:

- Nearby communities and the natural environment.
- Peoples and properties falling in the direct path of road development.
- People indirectly affected by way of disruption of livelihood.
- Breakages in the accustomed travel paths and community linkages.
- Disturbances to natural environment due to soil erosion.
- Changes to streams and underground water.
- Interference with animal and plant life.
- Other impacts
- The environmental impacts as below may be direct, indirect or cumulative:
  - Impacts on soil
  - Impacts on water resources
  - Impacts on air quality
  - Impacts on flora and fauna
  - Impacts on communities and their economic activity
  - Impacts arising from land acquisition and resettlement
  - Impacts on indigenous people
  - Impacts on cultural heritage
  - Impacts on aesthetic and landscape
  - Impacts on the noise environment
  - Impacts on human safety
  - Other impacts

### **12.1 Scope**

1. In order to make these roads people friendly and environment friendly, it is necessary that the steps are taken from the beginning and plans/ designs/ alignments are finalized in such a way that to the extent possible the adverse impacts are avoided at the designing stage itself. Where avoidance is not possible then the social and

environmental adverse impacts should be suitably compensated by adopting mitigation measures. The displaced persons must be compensated and rehabilitated so that the adverse impact is minimized, and the living conditions of the people improve, and the environment also improves. These steps are:

2. Avoiding at the designing stage especially while completing the alignments
3. Mitigating the adverse impacts at designing stage and construction /operation phase.
4. Compensating the affected people/environment and rehabilitation and resettlement measures

The EA steps are screening and scoping, determining of baseline conditions, analysis of potential environmental impacts, considerations of alternatives, development of mitigative and compensatory measures, designing of monitoring and evaluation plans and documentation. At various stages, the key steps involved in environmental assessments are as given below:

**Stages in Road planning**

**EA Activity**

Concept	-	Screening, Scoping, Consultation
Pre-feasibility	-	Determining baseline condition
Feasibility	-	Selection of preferred solution
Engineering design	-	Assessment of alternative design/ methods development of environmental management plan
Construction	-	Effects and compliance
Operation & Maintenance	-	Monitoring, Evaluation, Reporting

**12.2 Objective**

The overall aim of conducting various studies is to supply input of Environmental concerns to be detailed in Tunnel and highway design. The goal is to minimize the adverse Environmental Impact with the best possible engineering solutions at the most optimal cost. This needs complete co-ordination between the engineering, environmental teams during the entire design process.

For the Environmental impact study, a reconnaissance survey was conducted using environmental survey formats and analysis is made showing project affected areas, trees, sensitive areas, cultural heritage sites, waterways and any other factors needing mitigation, Characteristics of the existing environment are defined providing the basis for project impact comparisons. An analysis of potential impacts magnitude and duration of impact on physical (air, water etc.), natural and social environment through public consultations is made.

Specifically, from social impact assessment point of view congested areas and likely impacts are found and options are suggested to be considered for integration in the engineering design while proposing junction improvement, road barriers, silent zones near the schools and hospitals etc.

### **12.3 Policy and Legal Framework**

This session presents a review of the international agreements and commitments, existing institutions and legislations relevant to the project at the National and State level. The environmental assessment process needs to adopt environmental regulations and guidelines of Government of India (GoI) and ADB's World Bank Safeguards.

#### **i. International Agreements and Commitments**

India is party to various international agreements/conventions/treaties for conservation of environment at global level. Important among them have briefly described and analyzed vis- a- vis the project development.

#### **ii. Ramsar Convention on Wetlands, 1971:**

Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an inter-governmental treaty, which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Out of 19 designated wetlands of International Importance in India, none of them is in project influence area.

#### **iii. Convention on Protection of the World Cultural and Natural Heritage, 1972:**

The United Nations Educational, Scientific and Cultural Organization (UNESCO), which seeks to encourage the identification, protection and preservation of cultural and natural heritage around the world considered to be of outstanding value to humanity has

embodied these objectives in an international treaty called the Convention concerning the Protection of the World Cultural and Natural Heritage in 1972. There are Twenty-six world cultural heritage and natural sites in India. None of them is in project influence area.

**iv. Vienna Convention for Protection of the Ozone layer, 1985 and Montreal Protocol on Substances Depleting the Ozone layer, 1987:**

The Vienna Convention outlines states responsibilities for protecting human health and the environment against the adverse effects of ozone depletion, and established the framework under which the Montreal Protocol was negotiated. The Montreal Protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform) are to be phased out by 2010. The project does not envisage production and consumption of ODS.

**v. United Nations Framework Convention on Climate Change (UNFCCC), 1994:**

As per the convention the reduction/limitation requirements of Green House Gases (GHG) only to developed countries. The only reporting obligation for developing countries relates to the construction of a GHG inventory (GHG sources and sinks, potential vulnerability to climate change, adaptation measures and other steps being taken to address climate change). India acceded to the Kyoto Protocol but has not ratified it and hence the carbon emission limits are not binding upon India.

**vi. Convention on Biological Diversity (CBD) 1992:**

The Convention on Biological Diversity (CBD) is dedicated to promoting sustainable development and came into force in 1992 Rio Earth Summit. India signed the CBD in 1994. Member Parties have committed themselves to achieve by 2010, a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth.

## **12.4 Country's Legal Framework and Regulatory Requirements**

The implementation of the Goha to Khellani in Doda District Tunnel & Approach Road will comply with the environmental acts, policies, rules, and regulations of the Government of India which has a comprehensive coverage of environmental issues and

requirements. This environmental legal framework imposes command and controls on certain activities deemed detrimental to the environmental integrity and encompass the conservation of various components of the biological and physical environment and environmental assessment procedures and requirements for public consultation. The policies and requirements which are most relevant in the context of this project are provided in Table below.

**Table 53 : Summary of Environmental Legislations Applicable to the Project**

Sr. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Authority
1	Environment Protection Act-1986	To protect and improve overall environment	Yes	It is umbrella legislation and notifications; rules and schedules are promulgated under this act.	MOEFCC. Gol; J&K State Gov. SPCB
2	Environment Impact Assessment Notification, 14th Sep-2006	To accord environmental clearance to new development activities listed in schedule of EIA notification.	No	None of the Projects are located either in eco- sensitive areas or 1000m above mean sea level.	MoEF. SEIAA
4	Office memorandum dated 18.05.12, by MoEF in view of Apex Court order dated 27.2.2012	Conserve top soil, aquatic biodiversity, hydrological regime etc. by haphazard and unscientific mining of minor minerals	Yes	In case of renewal of quarries and opening of new borrow areas	SEIAA
5	National Environment Appellate Authority Act (NEAA) 1997	Address Grievances regarding the process of environmental clearance.	Yes	Grievances if any will be dealt with, within this act.	NEAA
6	Jammu and Kashmir Forest (Conservation) Act, 1997	To check deforestation by restricting conversion of forested areas into non- forested areas	Yes	Kishtwar Dense forest Area fall under Tunnel and Approach Construction.	State Forest Dept. and MOEFCC regional Office.
7	Jammu and Kashmir Forest (Conservation &	To restore tree, cover equal to or more for trees likely	Yes	Significant Tree cutting is involved in Projects.	DFOs, FCC

Sr. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Authority
	Afforestation) Rules, 2000. Felling of Trees	to be cut			
8	Air (Prevention and Control of Pollution) Act, 1981	To control air pollution by controlling emission of air Pollutants as per the prescribed standards.	Yes	For construction; for obtaining NOC for establishment of hot mix plant, workers' camp, construction camp, etc.	J&KSPCB
9	Water (Prevention and Control of Pollution) Act 1974	To control water pollution by controlling discharge of pollutants as per the prescribed standards	Yes	This act will be applicable during construction for (establishments of hot mix plant, construction camp, workers' camp, etc.	J&KSPCB
10	Permission of Abstraction of Ground water	To conserve and augment the groundwater resources	No	All infrastructure projects used Chasma (Springs Water) Local Concerned Official permission required if Applicable.	CGWA
11	Noise Pollution (Regulation and Control Act) 1990	The standards for noise for day and night have been promulgated by the MoEF for various land uses.	Yes	Vehicular noise on project routes required to assess for future years and necessary protection measure need to be considered in design.	SPCB
12	Explosive Act 1984	Safe transportation, storage and use of explosive material	Yes	In case of opening new Quarries, Blasting	Chief Controller of Explosives
13	Mines & Minerals Development Act, 1957	To regulate excavation, production, storage, collection, distribution, transportation, manufacturing, possession, purchase and sell of any minor mineral including soil	Yes	Project requires sand, aggregates, soil and other minor minerals in large quantity.	District Collector and State Mines Dept.
14	Central Motor	To check vehicular	Yes	These rules will be	Motor Vehicle

Sr. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Authority
	Vehicle Act 1988 and Central Motor Vehicle Rules 1989	air and noise pollution.		applicable to road users and construction Machinery.	Department
15	National Forest Policy 1952 National Forest Policy (Revised) 1988	To maintain ecological stability through conservation and restoration of biological diversity.	Yes	This policy will be applicable as project intervention needs forest land to be acquired.	Forest Dept. Gol and Govt. of J&K
16	Construction and Demolition Waste Management Rules, 2016	To ensure all such waste are disposed in environmentally acceptable manner and prevent from land and water pollution			Municipal Corporation and SPCB
17	Solid Waste Management Rules, 2016 and Plastic Waste Management Rules 2016	Mandated the source segregation of waste in order to channelize the waste to wealth by recovery, reuse and recycle.		Domestic wastes food leftovers, vegetable peels, plastic, house sweepings, clothes, ash, paper, cardboard, plastic, wastes like batteries, bulbs, tube lights etc.	SPCB
18	Hazardous and other Wastes (Management and Trans Boundary Movement) Rules, 2016.	To ensure that transport storage, use, and disposal of such waster do not pollute land and water environment and do not causes danger to health		Hazardous wastes from construction and demolition like tar and tar products (bitumen, felt, waterproofing compounds, etc.), wood dust from treated wood, lead having products, chemical admixtures, sealants, adhesive solvents, paints etc	SPCB
19	Batteries (Management and Handling) Rules, 2001 as amended 2010.	Notified with an aim of channelizing the used lead acid batteries for environmentally sound recycling.		Applicable to all the projects when disposal of used lead-acid battery is involved.	
	E-waste	to channelize the E-		Due to use and	SPCB

Sr. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Authority
	(Management and Handling) Rules, 2011	waste for environmentally sound recycling which is largely controlled by the un-organized sector who are adopting crude practices that results into higher pollution and less recovery,		disposal of electrical and electronic wastes generated in the building, like PC, printers, cartridges, CDs, Xerox machine etc. collectors	
21	The Building and Other Construction Workers (regulation of employment and conditions of service) Act, 1996	To regulate the employment and conditions of construction workers and to provide for their safety, health and welfare measure and for other matter incidental thereto	Yes	A large number of construction workers skilled, semiskilled or unskilled will be employed temporarily during Construction Phase of the project	Ministry of Labor and Employment Government of India
22	Bonded Labour (Abolition) Act, 1976 and Rules, 1976	Abolition of bonded labor.	Yes	- Do-	- Do-
23	Contract Labour (Regulation and Abolition) Act 1970 and rules, 1971	Prevent exploitation of contract labor and also to introduce better conditions of work.	Yes	- Do-	- Do-
24	Employees Provident Funds and Miscellaneous Provisions Act 1952	Promote and secure the well-being of the employees where contractors employ more than 20 persons during Construction	Yes	- Do-	- Do-
25	Minimum Wages Act 1948 along with Central Rules 1950	Ensure that workers get at least minimum wages as fixed by the state/central Govt. whichever is higher	Yes	- Do-	- Do-
26	Public Liability and Insurance Act	Protection form hazardous materials	Yes	Contractor need to stock hazardous	- Do-

Sr. No.	Act / Rules	Purpose	Applicable	Reason for Applicability	Authority
	1991	and accidents.		material like diesel, Bitumen, Emulsions	

## EVALUATION OF IMPACTS

The environmental impact assessment process involves four basic steps, and these are:

- Identification
- Interpretation
- Evaluation
- Communication

Several techniques are available for the assessment of impacts. Each of these techniques has its own advantages and disadvantages. The selection of any of these techniques for any particular project depends largely upon the judgment of the analyst. The technique chosen should be comprehensive, easy to understand, systematic and flexible. Considering these criteria, for present project, the matrix method is proposed to be considered for evaluation and assessment.

Potential impacts and mitigation measure

### 1. Impact on Physical Environment

#### ➤ Impact on Climate

Preparation Goha to Khellani Doda District tunnel and approach road Construction activities of the road involves various localized activities. Perceptible changes in the elements of microclimate are anticipated since there are Approx. 1000 numbers of trees that are envisaged to be cut due to the proposed road and tunnel. There will be an increase in daytime temperature on the road surface and soil due to loss of shade trees,

#### ➤ Mitigation Measures

No major impacts were anticipated due to proposed Tunnel and Approach Road activities. However minor changes in the climate due to cutting of large number of healthy trees.

➤ **Impact on Topography**

During construction phase topography along the road will change a little on account of cutting, filling and construction of project related structures etc.

➤ **Mitigation Measures**

Change in topography has been avoided to the maximum extent while finalizing the alignment and at design stage.

➤ **Geology**

Substantial quantities of crushed rock and sand will be required for the proposed project. Though the extraction of rock aggregates and fill material decreases the quantity, this impact will be limited to the location of the quarries and borrow areas only and is unlikely to cause or contribute significantly to their depletion. Hence, the impact on general geology of the region is insignificant and will be limited to the construction stage.

➤ **Mitigation Measures**

Construction material sites have been identified, where the extent of material available is in excess so that it will not affect the geological characteristics of the locality.

## **2. IMPACT ON ENVIRONMENTAL RESOURCES**

➤ **Impact on Surface Water Quality**

Minimal Impact on surface water

➤ **Construction Phase**

Since three numbers of water bodies exist within corridor of impact, the proposed Tunnel and Approach Road activities will have minor impacts on the surface water quality in the area. The level of turbidity in river water is high and construction activities will further increase this level and results in sediment deposit, interfere with photosynthesis for aquatic culture. Sometimes contamination of surface water may take place due to spills of construction materials, oil, grease, fuel and paint etc. This can be kept under check by adequate

precautionary/mitigative measures. During construction phase care would be exercised to control dust so that the water available in the reservoirs and wells especially those located very near to the ROW may not be contaminated.

➤ **Operation Phase**

It is envisaged that there is possibility of positive impacts, during operation phase, due to the proposed Tunnel and Approach Road activities. The extent of vehicles going on to the berms causing dust etc. would reduce and the drainage system will reduce any adverse effect of soil erosion.

➤ **Mitigation Measures**

The mitigation measures to check soil erosion will help to check water pollution by turbidity. Lining by stone pitching of existing watercourses around new bridges and culverts is proposed to reduce soil erosion

**3. Impact on Air Quality**

➤ **Construction Phase:**

The present air quality of the area is good, smoothening of riding surface and smooth traffic flow will minimize these impacts. However, during construction phase this level will go towards higher side and interfere with daily routine of human beings and environment. An increase in pollution load in the ambient air due to increase in traffic flow pollutant load will also increase. Since there were no polluting activities in the area as well as traffic flow is also very low, likely impacts are also low. During construction phase it is expected to increase up to certain level, but potential would be minor, because stringent control measures will be adopted during construction. Construction activities like site clearance, earth filling, material loading and unloading though the impacts are expected to be localized, and temporary and confined to the construction areas only.

➤ **Mitigation Measures**

Water will be sprinkled regularly to reduce adverse effects caused by dust and particulate matter. Vehicles delivering construction materials will be covered to reduce spills and dust. Asphalt mixing sites will be located more than 500 m

downwind from any settlement. Mixing equipment will be sealed and fitted with dust removal device.

#### **4. Impact on Noise Level**

##### **➤ Construction Phase:**

There is no problem of noise level in most of the project area. Increased in noise due to construction activities will be expected. In order to avoid the rise in noise level, construction machinery will be located away from the settlements and thus the impact will be controlled.

##### **➤ Operational Phase:**

Widening of the existing carriageway will lead to improvements in geometrics and surface of the road and it may lower the noise level. Also, smooth traffic flow will bring noise level to the acceptable limits.

##### **➤ Mitigation Measures**

Construction machinery will be located at least 500m away from the settlements. Contractor will provide earplugs & safety equipment's to workers, which will reduce impact. Noisy operations and their duration will be scheduled and prevent nighttime activities. In addition to above, the contractor will follow guidelines given in handbook of CPCB and JKSPCB.

#### **5. IMPACT ON ECOLOGICAL RESOURCES**

##### **➤ Impact on Terrestrial Ecology/Wildlife**

In the operation phase environmental quality would be considerably improved by adopting environmentally sound engineering designs maintaining the aesthetic quality through landscaping and arboriculture practices.

##### **➤ Mitigation Measures**

The divisional forest department and Forest Conservation committee requires planting of two trees against every tree to be cut, as compensation. After Forest Clearance Forest Conservation Committee Suggesting tree cutting and Plantation Schedule as per J&K afforestation policy.

➤ **Impact on Vegetation Cover and Trees**

Site clearing and earthwork operation during construction phase will result in removal of and/or damage to vegetation cover and trees. During construction phase felling of trees for fuel and poaching of fauna may take place.

➤ **Mitigation Measures**

The contractor at his cost will take requisite measures to inform the construction workers to protect natural resources and wildlife. If, however, some damage occurs, the contractor promptly revegetates disturbed vegetation cover as soon as possible. Contractor will provide fuel to the laborer's, Compensatory afforestation for trees lost will be carried out at the rate of 1:2 at locations to be agreed with NHIDCL / Forest Department.

**IMPACT ON HUMAN USE VALUES**

➤ **Induced Development (Change in Land use pattern)**

The improvement of the proposed Tunnel and Approach Road activities is expected to cause some changes in the land use. In this process, areas presently under agriculture and vegetation cover may be diverted for development and other usage. But status of the change will be insignificant.

The impact of the road improvement on the socio-economic environment will be significantly beneficial, as it is likely to stimulate the economic growth of the area. The specific benefits of the road improvement will include reduction in travel time, travel cost, reduction in the time to get agricultural goods Like Apple to market.

➤ **Mitigation Measures**

Maximum effort has been made to avoid any changes in the land use pattern.

➤ **Loss of Monuments/Historical Areas**

The present project does not have any adverse impact on monuments / historical places because project road and Tunnel passes away from these areas.

➤ **Mitigation Measures**

Maximum effort has been made to avoid any disturbance to the religious structures along the road.

➤ **Health, Safety and Hygiene for Construction Workers**

The most significant impact of the project on public health is likely to arise from construction camps. These camps are anticipated to house up to 350 people for 36 months. Given this concentration of people, the potential for disease and illness to be transmitted will increase.

➤ **Mitigation Measures**

The contractor will follow guidelines given by CPCB on construction operation, so that he takes requisite measures to locate and construct the camps in a manner that will not pollute the environment. The possible locations for siting these labour camps have been identified during field survey.

## **12.5 Muck Dumping Plans**

The dumping locations have been Identified on government land in consultation with district administration, and muck disposal plan will be prepared accordingly.

### **13. INITIAL SOCIAL ASSESSMENT**

Improved roads will bring great benefits to women and girls. Direct benefits include a decrease in travel time and an increase in reliable and convenient transport services. Indirect benefits include improved access to products and services, including social services such as health, education, as well as other government services. During construction, women will also benefit from the increased employment opportunities. However, road construction and improvements may also lead to potential negative impacts such as the spread of STIs (sexually transmitted infections), trafficking, and road safety issues. Potential negative impacts will be addressed through community awareness raising sessions that will be implemented by the NGO. The NGO will coordinate with relevant organization or mobilize its own short-term experts in carrying out the activities. In addition, the contractor will also carry out HIV/AIDS awareness program among worker camps and nearby community as mandated in their contract.

Carry out meaningful consultations with displaced persons, host communities, and concerned nongovernment organizations. Inform all displaced persons of their entitlements and resettlement options. Ensure their participation in planning, implementation, and monitoring and evaluation of resettlement programs. Pay particular attention to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and indigenous peoples, and those without legal title to land, and ensure their participation in consultations. Establish a grievance redress mechanism to receive and facilitate resolution of the concerns of displaced persons. Support the social and cultural institutions of displaced persons and their host population. Where involuntary resettlement impacts and risks are highly complex and sensitive, compensation and resettlement decisions should be preceded by a social preparation phase.

Improve, or at least restore, the livelihoods of all displaced persons through;

1. land-based resettlement strategies when affected livelihoods are land based where possible or cash compensation at replacement cost for land when the loss of land does not undermine livelihoods,
2. prompt replacement of assets with access to assets of equal or higher value,

3. prompt compensation at full replacement cost for assets that cannot be restored, and
4. additional revenues and services through benefit sharing schemes where possible.

Provide physically and economically displaced persons with needed assistance, including the following:

- if there is relocation, secured tenure to relocation land, better housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities, and extension of project benefits to host communities;
- transitional support and development assistance, such as land development, credit facilities, training, or employment opportunities; and
- civic infrastructure and community services, as required.

Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards. In rural areas provide them with legal and affordable access to land and resources, and in urban areas provide them with appropriate income sources and legal and affordable access to adequate housing.

Develop procedures in a transparent, consistent, and equitable manner if land acquisition is through negotiated settlement to ensure that those people who enter into negotiated settlements will maintain the same or better income and livelihood status.

Ensure that displaced persons without titles to land or any recognizable legal rights to land are eligible for all compensation, relocation and rehabilitation measures, except land.

Prepare a resettlement plan elaborating on the entitlements of displaced persons, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule. This resettlement plan will be approved by ADB prior to contract award.

Disclose a draft resettlement plan, including documentation of the consultation process in a timely manner, before project appraisal, in an accessible place and a form and language(s) understandable to displaced persons and other stakeholders. Disclose the final resettlement plan and its updates to displaced persons and other stakeholders.

Conceive and execute involuntary resettlement as part of a development project or program. Include the full costs of resettlement in the presentation of project's costs and benefits. For a project with significant involuntary resettlement impacts, consider implementing the involuntary resettlement component of the project as a stand-alone operation.

Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement the resettlement plan under close supervision throughout project implementation.

Monitor and assess resettlement outcomes, their impacts on the standard of living of displaced persons, and whether the objectives of the resettlement plan have been achieved by taking into account the baseline conditions and the results of resettlement monitoring. Disclose monitoring reports.

#### ➤ **SOCIAL IMPACT ON COMMUNITY**

Improved roads will bring great benefits to women and girls. Direct benefits include a decrease in travel time and an increase in reliable and convenient transport services. Indirect benefits include improved access to products and services, including social services such as health, education, as well as other government services. During construction, women will also benefit from the increased employment opportunities. However, road construction and improvements may also lead to potential negative impacts such as the spread of STIs (sexually transmitted infections), trafficking, and road safety issues. Potential negative impacts will be addressed through community awareness raising sessions that will be implemented by the NGO. The NGO will coordinate with relevant organization or mobilize its own short-term experts in carrying out the activities. In addition, the contractor will also carry out HIV/AIDS awareness program among worker camps and nearby community as mandated in their contract.

Carry out meaningful consultations with displaced persons, host communities, and concerned nongovernment organizations. Inform all displaced persons of their entitlements and resettlement options. Ensure their participation in planning, implementation, and monitoring and evaluation of resettlement programs. Pay attention to the needs of vulnerable groups, especially those below the poverty line, the landless,

the elderly, women and children, and indigenous peoples, and those without legal title to land, and ensure their participation in consultations. Establish a grievance redress mechanism to receive and facilitate resolution of the concerns of displaced persons. Support the social and cultural institutions of displaced persons and their host population. Where involuntary resettlement impacts and risks are highly complex and sensitive, compensation and resettlement decisions should be preceded by a social preparation phase.

Improve, or at least restore, the livelihoods of all displaced persons through;

- I. land-based resettlement strategies when affected livelihoods are land based where possible or cash compensation at replacement cost for land when the loss of land does not undermine livelihoods,
- II. prompt replacement of assets with access to assets of equal or higher value,
- III. prompt compensation at full replacement cost for assets that cannot be restored, and
- IV. additional revenues and services through benefit sharing schemes where possible.

Provide physically and economically displaced persons with needed assistance, including the following:

- (i) if there is relocation, secured tenure to relocation land, better housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities, and extension of project benefits to host communities;
- (ii) transitional support and development assistance, such as land development, credit facilities, training, or employment opportunities; and
- (iii) civic infrastructure and community services, as required.

Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards. In rural areas provide them with legal and affordable access to land and resources, and in urban areas provide them with appropriate income sources and legal and affordable access to adequate housing.

Develop procedures in a transparent, consistent, and equitable manner if land acquisition is through negotiated settlement to ensure that those people who enter into negotiated settlements will maintain the same or better income and livelihood status.

Ensure that displaced persons without titles to land or any recognizable legal rights to land are eligible for all compensation, relocation and rehabilitation measures, except land.

Prepare a resettlement plan elaborating on the entitlements of displaced persons, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule. This resettlement plan will be approved by ADB prior to contract award.

Disclose a draft resettlement plan, including documentation of the consultation process in a timely manner, before project appraisal, in an accessible place and a form and language(s) understandable to displaced persons and other stakeholders. Disclose the final resettlement plan and its updates to displaced persons and other stakeholders.

Conceive and execute involuntary resettlement as part of a development project or program. Include the full costs of resettlement in the presentation of project's costs and benefits. For a project with significant involuntary resettlement impacts, consider implementing the involuntary resettlement component of the project as a stand-alone operation.

Pay compensation and provide other resettlement entitlements before physical or economic displacement. Implement the resettlement plan under close supervision throughout project implementation.

Monitor and assess resettlement outcomes, their impacts on the standard of living of displaced persons, and whether the objectives of the resettlement plan have been achieved by taking into account the baseline conditions and the results of resettlement monitoring. Disclose monitoring reports.

## 14. RECOMMENDATIONS

1. To avoid the accident due to land slide on the present Goha-Khellani Road and also to avoid poor geometry of this road, a new alignment is being proposed from the end of the Sudhmahadev-Dranga Tunnel to Khellani town.
2. The tunnel will be constructed without causing significant adverse environmental impacts to the social, economic or cultural environments to bypass the congested area of khellani town.
3. No household will get displaced in the project area due to the construction of this tunnel. No Displaced person (DPs) in the project area as it will not affect any CPR (Common Property resources) or any livelihood. Therefore, Resettlement Plan will not be needed for the project area.
4. The process of land acquisition must be initialised immediately after the approval of the alignment, to expedite the construction of tunnel.
5. The project can be constructed in 36 months period with strategic planning and through one construction package. The estimated basic cost is given below table.

**Table- 54 : Cost Estimate**

Section	Design Length (m)	Base Cost / Civil Cost excluding GST (Crore)	Civil Cost including GST @ 12% (Crore)	Construction Cost including centages (Crore)	Total Project Cost (Crore)
<b>Khellani Tunnel &amp; its Approach Road</b>	2.419	539.615	604.369	682.074	749.274

**Table- 55 : MSA Calculation - Annexure - I**

								Khellani on NH-244	
Year	Standard Bus	LCV	2 Axle	3 Axle	MAV	Yearly Design ESA	Cumulative Design ESA	MSA	Design Period
<b>VDF</b>	0.62	0.46	4.93	0.76	3.93				
2019	114	370	358	308	36	347906			Base Year
2020	120	407	376	323	38	366541			
2021	126	448	395	340	40	386231			
2022	132	488	414	357	42	406742			
2023	139	532	435	374	44	428387	428387	<b>0.428</b>	
2024	145	580	457	393	46	451232	879619		
2025	153	632	480	413	48	475347	1354966		
2026	160	689	504	433	51	500808	1855774		
2027	168	744	529	455	53	527233	2383007	<b>2.383</b>	<b>5-year</b>
2028	177	803	555	478	56	555090	2938096		
2029	186	868	583	502	59	584459	3522555		
2030	195	937	612	527	62	615426	4137981		
2031	205	1012	643	553	65	648081	4786062		
2032	215	1083	675	581	68	681841	5467903	<b>5.468</b>	<b>10-year</b>
2033	226	1159	709	610	71	717384	6185287		
2034	237	1240	744	640	75	754806	6940093		
2035	249	1327	781	672	79	794208	7734300		
2036	261	1420	821	706	83	835696	8569996		
2037	274	1505	862	741	87	878431	9448427	<b>9.448</b>	<b>15-year</b>

**Table- 56 : Traffic Survey Analysis - Annexure-II**

PCU Equivalents	0.5		1		1.5		3		1.5		3		3		4.5		4.5		1.5		Total Fast-Moving Vehicles		Total All Vehicles					
Vehicle Type	FAST MOVING VEHICLES																											
	2-Wheeler		Passenger Car		Bus				LCV		Truck						Agricultural Tractor											
					Mini-Bus		Standard Bus		4 Tyre		2-Axle		3-Axle		Multi Axle		With Tractor		Without Tractor									
Direction	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN				
Day 1	445	463	392	369	27	29	27	23	184	195	171	176	146	156	18	12	31	37	16	19	1457	1478	1457	1478				
Day 2	478	477	386	370	28	30	22	28	185	192	172	178	152	153	18	20	33	36	19	17	1493	1501	1493	1501				
Day 3	463	461	370	358	27	29	28	26	175	194	182	189	149	156	16	18	36	32	14	19	1460	1482	1460	1482				
Day 4	412	478	367	379	27	29	36	28	188	182	180	188	141	163	21	12	37	36	16	18	1426	1513	1426	1513				
Day 5	453	464	360	379	24	30	31	36	184	182	172	175	160	145	20	21	36	35	17	18	1457	1486	1457	1486				
Day 6	465	439	351	388	27	30	23	28	175	178	185	182	163	144	20	19	36	34	16	17	1462	1460	1462	1460				
Day 7	461	438	371	358	29	25	28	26	192	182	175	181	160	166	19	17	33	35	18	16	1485	1444	1485	1444				
Total	3178	3219	2595	2600	191	204	197	197	1283	1307	1236	1269	1072	1083	131	117	243	246	113	121	10238	10363	10238	10363				
Total Up/Down	6397		5196		395		394		2590		2506		2155		248		488		234		20602		20602					
Average	453	459	370	371	27	29	28	28	183	186	176	181	153	154	18	16	34	35	16	17	1458	1476	1458	1476				
AADT No.	914		743		57		57		370		358		308		36		70		34		2947		2947					
AADT PCU	457		743		86		171		555		1074		924		162		315		51		4538		4538					

PCU Equivalents	0.5		1		1.5		3		1.5		3		3		4.5		4.5		1.5		Total Fast-Moving Vehicles		Total All Vehicles					
Vehicle Type	FAST MOVING VEHICLES																											
	2-Wheeler		Passenger Car		Bus				LCV		Truck						Agricultural Tractor											
					Mini Bus		Standard Bus		4 Tyre		2-Axle		3-Axle		Multi Axle		With Tractor		Without Tractor									
Direction	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN				
Day 1	456	475	402	378	28	30	28	24	189	200	175	180	150	160	18	12	32	38	16	19	1494	1516	1494	1516				
Day 2	490	489	396	379	29	31	23	29	190	197	176	183	156	157	18	20	34	37	19	17	1531	1539	1531	1501				
Day 3	475	473	379	367	28	30	29	27	179	199	187	194	153	160	16	18	37	33	14	19	1497	1520	1497	1520				
Day 4	423	490	376	389	28	30	37	29	193	187	185	193	145	167	22	12	38	37	16	18	1463	1552	1463	1552				
Day 5	465	476	369	389	25	31	32	37	189	187	176	179	164	149	20	22	37	36	17	18	1494	1524	1494	1524				
Day 6	477	450	360	398	28	31	24	29	179	183	190	187	167	148	21	19	37	35	16	17	1499	1497	1499	1497				
Day 7	473	449	380	367	30	26	29	27	197	187	179	186	164	170	19	17	34	36	18	16	1523	1481	1523	1481				
Total	3259	3302	2662	2667	196	209	202	202	1316	1340	1268	1302	1099	1111	134	120	249	252	116	124	10501	10629	10501	10591				
Total Up/Down	6561		5329		405		404		2656		2570		2210		254		501		240		21130		21092					
Average	465	472	381	381	28	30	29	29	188	192	182	186	157	159	20	18	36	36	17	18	1503	1521	1503	1521				
ADT No.	938		762		58		58		380		368		316		37		72		35		3024		3024					
ADT PCU	469		762		87		174		570		1104		948		167		324		53		4657		4657					