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Chapter-1: Executive Summary

The Government of India has taken initiatives in construction, up-gradation and development of its road network along the international borders with different countries. In this context, The **National Highways and Infrastructure Development Corporation Limited (NHIDCL)** have been constituted by the Government of India in the year 2014 with the purpose of up-gradation and development of National Highways and Strategic Roads including interconnecting roads in parts of the country which share international boundaries with neighboring countries.

NHIDCL is a fully owned company of the **Ministry of Road Transport & Highways, Government of India**. The company promotes surveys, designs, builds, operates, maintains and upgrades the National Highways.

NHIDCL also proposes to improve **road connectivity** and efficiency of the **international trade corridor**, by expanding about 500 KMs of roads in the **North Bengal and Northeastern region of India** to enable efficient and safe transport regionally with other **South Asia Sub-regional economic Cooperation (SASEC) member countries**.

Keeping in view the growing importance of road network of the country is physical, social and economic and environment fabric, the **National Highways and Infrastructure Development Corporation Limited** with active support of **Ministry of Road Transport & Highways, Government of India** initiated a comprehensive Detailed Project Study for the 86 Km section of NH-44A. **M/s Lion Engineering Consultants, Bhopal** has been entrusted for providing Consultancy Services for Feasibility Study and Detailed Project Report for Two Laning with Paved Shoulder of **Manu – Simlung Section of NH-44A** in the State of **Tripura** on EPC mode, vide Letter to Proceed NHIDCL/DPR/Tripura/Manu-Simlung/NH-44A dated 23.12.2015. The commencement date for the project is 28.12.2015 and the period for completion of assignment is 09 Months. The description of the road given in **Table No. 1.1**:

Table 1.1 Details of Road Section In Tripura State.

Sr. No.	Name of Road	SH No.	Total length
1	Manu – Simlung Section	NH-44A	Km 85+860

For easy and fast development and existing site. Condition project road is divided in 4 packages listed below in Table no. 1.2

Table 1.2 Details of Road Section In Tripura State.

Package No.	Name of Road	District	Length as per agreement (KM)	Length as per Design(KM)
1	Manu- Chalengeta- Lalcherra Section of NH-44A	Dhalai	86.00 Km	16.290
2	Lalcherra – Chandipur - Kanchanpur Section of NH-44A	Dhalai/North Tripura		30.307
3	Kanchanpur- Vaghmun Section of NH-44A	North Tripura		20.248
4	Vaghmun – Simlung Section of NH-44A	North Tripura		19.015
Total Length (in Kms)			86.00	85.860

This report deals with the first Package i.e. **Kanchanpur- Vaghmun Section** which needs to be upgraded to Two Lane with paved Shoulders and the details of this road is given in **Table No. 1.3.**

Table 1.3 Details of Project Road

Sr. No.	Name of Road	SH No.	Chainage (in Km)		Length as per Topographic Survey (in Km)	Length as per Design (in Km)
			From (in Km)	To (in Km)		
1	Kanchanpur – Vaghmun Section	NH-44A	Km 87+000	Km 110+119	23.119	20.248

1.1. Project Road

Project road is located in Tripura State Tripura is a landlocked state in North East India, where the seven contiguous states – Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura – are collectively known as the Seven Sister States. Spread over 10,491.69 km² (4,050.86 sq mi), Tripura is the third-smallest among the 29 states in the country, behind Goa and Sikkim. It extends from 22°56'N to 24°32'N, and 91°09'E to 92°20'E. Its maximum extent measures about 184 km (114 mi) from north to south, and 113 km (70 mi) east to west. Tripura is bordered by the country of Bangladesh to the west, north and south; and the Indian states of Assam to the north east; and Mizoram to the east. It is accessible by national highways passing through the Karimganj district of Assam and Mamit district of Mizoram.

The project road starts from Km. 87.000 of NH-44A in Kanchanpur Village, Tripura and terminates on Km. 110.119 near Talakshi village.

The project road traverses through North Tripura District in Tripura. Total length of the project road section is running between Latitudes of 24.039469° N; Longitudes of 92.202608° E and Latitudes of 23.947594° N; Longitudes of 92.313738° E.

The location plan of the project road section is illustrated in **Figure 1.1**.

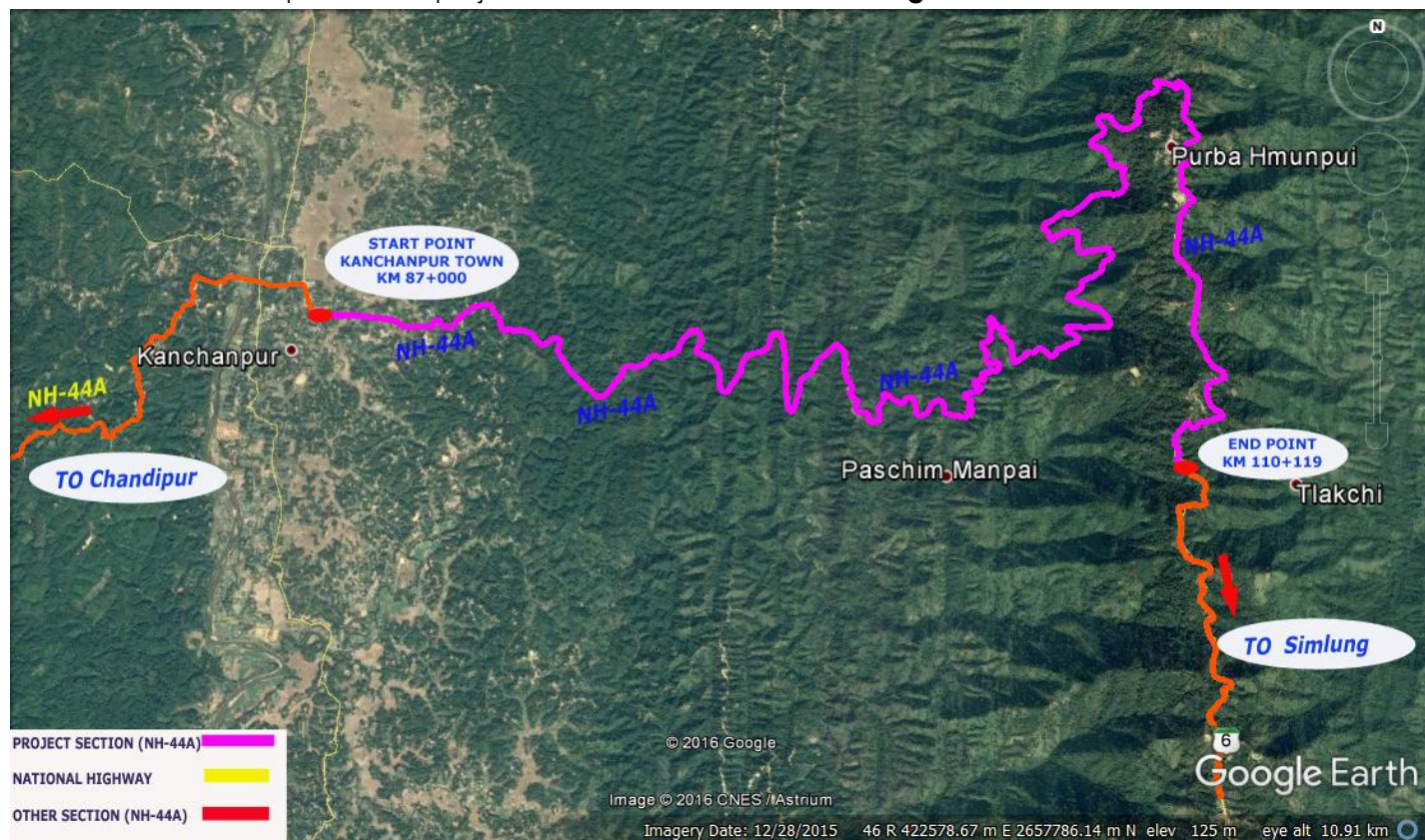


Figure 1.1: Location Plan

Summary of the existing features of the project are shown in **Table 1.4**.

Table 1.4: Summary of the existing features of the project road

SL. No.	Particulars	Existing Details	Remarks
1	Start Point	The project road starts from Km. 87.000 of NH-44A in Kanchanpur Village.	
2	End Point	Terminates on Km. 110+119 near Talakshi village.	
3	Total Length	23.119 Km	Design Length is 20.248 Km.
4	Districts	1 No.	North Tripura
5	Terrain	Plain, Rolling & Hilly Terrain	
6	Right of Way(m)	5.50 m to 19 m	

SL. No.	Particulars	Existing Details	Remarks
7	Carriage way	3.00 – 7.00 m Carriageway with 1.0-1.5m earthen shoulder throughout the project road section	
8	Major/Minor Bridge	0 Nos. (00 Major & 00 Minor)	
9	FCW	1 No.	
10	Pipe Culverts	28 Nos.	
11	R.C.C. Slab	8 Nos.	
12	Arch Culvert	0 No.	
13	Minor Junctions	10 Nos.	
14	Major Junction	00 Nos.	
15	Villages/Towns	03 Nos.	
16	Existing Drainage System	NIL	
17	Miscellaneous Services	Fuel Stations: No Fuel stations were observed on the road section. Telephone Facilities: Telephone facility is available in all villages on the road. Police Station: No Police stations were observed on the road section.	

1.2. SOCIO-ECONOMIC PROFILE

Project Description

Socio Economic Profile chapter illustrates a brief of the socio – economic profile of the project influenced area (PIA) for NH-44A having a length of 32.961 Kms. The road primarily connects districts viz, Dhalai and North Tripura. This highway segment serves as the artery, provides connectivity to existing National Highway-44 & Proposed National Highway-44A in Tripura State. Also it provides interstate connectivity between Tripura & Mizoram.

Demographic Profile

DISTRICT NORTH TRIPURA



History:

Tripura a hilly, picturesque, princely state was first conquered by the Britishers in 1761. However, no political agent was appointed till 1871 and the Maharaja ruled hill territory "Hill Tipperah" almost independently. The State acceded to the Indian union on 13.08.1947, the agreement of merger being signed on 09.09.1949. The administration was formally taken over on 15.10.1949. Tripura, initially a one district state, was trifurcated into three Districts w.e.f. 01.09.1970. The North Tripura District started functioning in the office of the Sub-divisional officer at Kailashahar and partly at Kumarghat, later the whole office was shifted to Kailashahar. The Collectorate was shifted to the newly constructed complex at Gournagar on 13.11.1987, subsequently North Tripura District has been bifurcated and a new District namely "DHALAI DISTRICT" has been inaugurated on 14.04.1995 with district head quarter at Ambassa. On 21.01.2012 the decision to further bifurcate North

Tripura District was accepted and the district "UNAKOTI DISTRICT" has been created with its headquarter at Kailashahar & North Tripura district headquarter shifted to Dharmanagar.

Geography:

It is Located at Latitude-24.3, Longitude-92.0. North Tripura District is sharing border with Karimganj District to the North, Mamit District to the East, Dhalai District to the South. It is sharing Border with Assam State to the North, Mizoram State to the South. North Tripura District occupies an area of approximately 2821 square kilometres. It's in the 60 meters to 43 meters elevation range. This District belongs to Eastern India.

Demographics:

According to the 2011 census North Tripura district has a population of 693,281, roughly equal to the nation of Bhutan or the US state of North Dakota. This gives it a ranking of 503rd in India (out of a total of 640). The district has a population density of 341 inhabitants per square kilometre (880/sq mi). Its population growth rate over the decade 2001-2011 was 17.32%. North Tripura has a sex ratio of 967 females for every 1000 males, and a literacy rate of 88.29%.

Sino-Tibetan languages spoken in North Tripura district include:

- Garo language
- Darlong language
- Ralte language

1.3. TRAFFIC SURVEYS AND ANALYSIS

To comprehensively appreciate the traffic and travel characteristics on the project corridor from Manu – Simlung via Kanchanpur. The type of surveys, locations and duration, as identified at the inception stage of the study have been followed during data collection exercise with minor modifications on account of the project corridor.

The traffic characteristics on the project road for the base year are essential for formulating improvement programs. The objectives of the traffic study are:

- Traffic estimation in terms of volume on various sections.
- Growth factor estimation for traffic forecasting.
- Capacity assessment based on traffic forecasting for next 30 years.
- Pavement and intersection design

Average Annual Daily Traffic and it Composition

The Average Annual Daily Traffic (AADT) obtained from the volume count surveys for all the locations are given in **Table no. 1.5**. To study the variation in the intensity of traffic, consultants have analyzed the variation of traffic along the project road. The following observations are made from the analysis for each location along the project stretch.

**Table 1.5 : Annual Average Daily Traffic (AADT)
(24.07.2016 to 30.07.2016)**

Categories	PCU Factor	Km. 0+200 at Manu town Location-1		Km. 87+080 after Kanchanpur town Location-2		Average of all locations	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
Car/Jeep/Van	1.0	751	751	540	540	646	646
3 Wheeler	1.0	973	973	797	797	885	885
Mini Bus	1.5	8	12	7	11	8	12
Standard Bus	3.0	5	15	1	3	3	9
LCV / Tempo	1.5	400	600	22	333	311	467
2-Axle	3.0	67	201	26	78	47	141
3-Axle	3.0	30	90	2	6	16	48
MAV (4-6)	4.5	0	0	0	0	0	0
Two Wheeler	0.5	1484	742	1426	713	1455	728
Animal Cart	6.0	0	0	0	0	0	0
Cycle	0.5	764	382	605	303	685	343
Tractor with trolly	4.5	0	0	0	0	0	0
Tractor	1.5	0	0	0	0	0	0
Hand Cart	6.0	20	60	10	30	15	45
Total Traffic		4502	3826	3636	2814	4071	3324

Traffic growth rate during the design life in percentage

It is learnt that the National Highways and Infrastructure Development Corporation Limited (NHIDCL) did not carried out traffic volume count on the project road. Therefore, no previous data has been provided to Consultant.

IRC:37-2012 stated" If the data for the annual growth rate of commercial vehicles is not available or if it is less than 5 per cent, a growth rate of 5 per cent should be used".

Hence traffic growth rate is adopted 5% for projection of present traffic.

Vehicle Damage Factor

As per IRC: 37-2012 clause 4.4.6 stated" where the sufficient information on axle loads is not available the default values of vehicles of vehicle damage factor as given in table 4.2 may be used".

As per table 4.2 for CVPD more than1500 adopted VDF should be 2.5 for Hilly terrain.

Hence, The Adopted VDF is 2.5.

Cumulative Mean Standard Axles (CMSA)

Summary of CMSA (Design traffic)		
Year	Section-1	Design year
2016 to 2020	Construction Period & Project Clearance	
2021	0.73	1
2022	1.50	2
2023	2.30	3
2024	3.15	4
2025	4.04	5
2026	4.97	6
2027	5.95	7
2028	6.98	8
2029	8.06	9
2030	9.20	10
2031	10.39	11
2032	11.64	12
2033	12.95	13
2034	14.33	14
2035	15.78	15
2036	17.30	16
2037	18.90	17
2038	20.57	18
2039	22.33	19
2040	24.18	20
2041	26.12	21
2042	28.16	22
2043	30.30	23
2044	32.55	24
2045	34.91	25

As per IRC SP:37-2015, Adopted MSA is 30.

1.4. PAVEMENT DESIGN

As per plate No.-7 of IRC-37:2012 the Pavement Design is:-

Design crust thickness for the flexible pavement as arrived is given below in table 1.6

Table 1.6

Homogenous Section (Km)			CBR (%)	MSA	Adopted Pavement Composition In Widening Position (mm)			
From	To	Length (in Km)		Adopted	BC	DBM	WWM	GSB
0+000	20+247	20.247	10	30	40	95	250	200

CBR Results

As Per test results the average CBR is >10%. So, the value of adopted CBR is 10%.

1.5. IMPROVEMENT PROPOSAL

Development to 2 Lane with paved shoulder option is planned for the development of project road.

TCS Schedules: Tentative TCS schedules based on horizontal alignment plan

S.no	Ex. Ch.		Design Ch.		Design Length (km)	TCS as per IRC SP :73-2015
	From	To	From	To		
1	87.000	87.930	46.597	47.520	0.923	2.2
2	87.930	88.620	47.520	48.120	0.600	2.19(New)
3	88.620	89.760	48.120	49.220	1.100	2.17(New)
4	89.760	90.870	49.220	50.320	1.100	2.19(New)
5	90.870	91.000	50.320	50.420	0.100	2.16(New)
6	91.000	92.920	50.420	52.320	1.900	2.19(New)
7	92.920	93.020	52.320	52.420	0.100	2.17(New)
8	93.020	94.890	52.420	54.300	1.880	2.19(New)
9	94.890	95.420	54.300	54.720	0.420	2.14(New)
10	95.420	95.720	54.720	55.020	0.300	2.20(New)
11	95.720	95.920	55.020	55.120	0.100	2.14(New)
12	95.920	96.010	55.120	55.220	0.100	2.20(New)
13	96.010	96.200	55.220	55.320	0.100	2.15(New)
14	96.200	96.380	55.320	55.520	0.200	2.20(New)
15	96.380	96.660	55.520	55.670	0.150	2.14(New)
16	96.660	96.900	55.670	55.920	0.250	2.20(New)
17	96.900	98.550	55.920	57.020	1.100	2.14(New)
18	98.550	98.850	57.020	57.320	0.300	2.20(New)
19	98.850	99.220	57.320	57.620	0.300	2.14(New)
20	99.220	99.300	57.620	57.720	0.100	2.20(New)
21	99.220	99.550	57.720	57.970	0.250	2.14(New)
22	99.300	99.650	57.970	58.070	0.100	2.20(New)
23	99.550	99.770	58.070	58.120	0.050	2.14(New)
24	99.650	99.870	58.120	58.220	0.100	2.20(New)
25	99.770	100.050	58.220	58.420	0.200	2.14(New)
26	99.870	100.370	58.420	58.720	0.300	2.20(New)
27	100.050	101.100	58.720	59.270	0.550	2.14(New)
28	100.370	101.650	59.270	59.820	0.550	2.20(New)
29	101.100	102.220	59.820	60.270	0.450	2.14(New)
30	102.220	102.420	60.270	60.470	0.200	2.20(New)
31	102.420	102.720	60.470	60.720	0.250	2.14(New)
32	102.720	102.880	60.720	60.870	0.150	2.20(New)
33	102.880	103.010	60.870	61.020	0.150	2.14(New)
34	103.010	103.350	61.020	61.320	0.300	2.20(New)
35	103.350	103.520	61.320	61.420	0.100	2.14(New)
36	103.520	104.200	61.420	62.070	0.650	2.20(New)

37	104.200	105.510	62.070	62.970	0.900	2.14(New)
38	105.510	105.600	62.970	63.070	0.100	2.20(New)
39	105.600	105.900	63.070	63.270	0.200	2.14(New)
40	105.900	106.090	63.270	63.470	0.200	2.19(New)
41	106.090	106.250	63.470	63.570	0.100	2.14(New)
42	106.250	106.380	63.570	63.670	0.100	2.19(New)
43	106.380	106.900	63.670	64.070	0.400	2.14(New)
44	106.900	107.300	64.070	64.470	0.400	2.19(New)
45	107.300	107.700	64.470	64.820	0.350	2.14(New)
46	107.700	108.100	64.820	65.220	0.400	2.19(New)
47	108.100	108.300	65.220	65.420	0.200	2.14(New)
48	108.300	108.480	65.420	65.570	0.150	2.19(New)
49	108.480	108.730	65.570	65.720	0.150	2.14(New)
50	108.730	109.020	65.720	66.020	0.300	2.19(New)
51	109.020	109.750	66.020	66.470	0.450	2.14(New)
52	109.750	110.119	66.470	66.845	0.375	2.19(New)
Total Design Length					20.248	

MAJOR & MINOR BRIDGES

Provision has been made for the following structures in the estimate.

S. No.	Type	Major Bridge	Minor Bridge	Total
1	Reconstruction	-	-	-
2	Retain & Repair	-	-	-
3	Retain	-	-	-
4	Under Construction	-	-	-
	Total	-	-	-

HPC & SLAB CULVERTS

A summary of all the types of culverts proposed are:-

S. No.	Type	Retain With Repair	Widening	Reconstruction	New construction	Total
1	Pipe	-	-	-	-	-
2	Slab	-	-	-	-	-
3	BOX	-	-	30	41	71
Total		-	-	30	41	71

Drainage and Protection works

Lined drains are proposed to be constructed in urban areas .

Major & Minor Junctions

Detailed Estimates has been prepared for major and minor junctions as per site requirement.

Traffic Safety features, Road Furniture and road markings

Detailed Estimates has been prepared for traffic safety features, road furniture and road markings as per site requirement.

1.6. PROJECT FACILITIES

Bus Shelter

Considering the overall safety of traffic and minimum hindrance to through traffic, 03 nos. pick-up bus shelters have been proposed both side along the project road.

Sr. No.	Design Chainage	Side	Location
1	48.390-48.490	LHS	Kanchanpur
2	63.990-64.090	RHS	Manpui
3	66.390-66.490	RHS	Talakshi

Service Roads

In keeping the view of low traffic and least habitation in the enroute villages; there is no requirement of service road in the towns/villages.

Toll Plaza

No toll plaza is proposed on road section.

Landscaping

The landscaping and tree plantation along the project road shall be done as per IRC: SP: 21 -2009. In the topographic survey it is seen that there are many trees lying within the ROW along the alignment of project road. These trees are proposed to be cut as per actual requirement at site in a phased manner. It is proposed to have a new plantation at 10m c/c on both side of project corridor.

1.7. Cost Estimates

The cost estimates have been prepared for reconstruction/widening of the existing two lane carriageway including strengthening of the existing pavement, strengthening / widening of existing bridge structures, construction of new bridges, rehabilitation and reconstruction/ widening of cross drainage structures, longitudinal drains, junction improvements, road furniture, street lighting, bus shelters etc.

The rates for the items of work have been assessed from SOR, PWD-NH tripura -2017 and escalation of 5% per year is adopted.

Proposed typical cross section for project highway is given in table 1.7 & table 1.8 below:

Table No. 1.8: Type of Typical Cross Section

Sr. No.	Description	Design Length (Km.)	Proposed TCS Type
		HS-I (Km)	
1	Reconstruction in Two-Lane Carriageway with Paved Shoulder in Open Country (Plain/Rolling Terrain)	0.923	TCS-2.2
2	Two-Lane with with paved shoulder in Hilly Terrain with Hill side Drain on Both sides and breast wall on one side in open Country area (Box cut)	6.820	TCS-2.14(New)
3	Two-Lane with with paved shoulder in Hilly Terrain with Hill side Drain and breast wall on both sides in open Country area (Box cut)	0.100	TCS-2.15(New)
4	Two-Lane with with paved shoulder in Hilly Terrain with Hill side Drain on Both sides in open Country area (Box cut)	0.100	TCS-2.16(New)
5	Two Lane Road with Paved shoulders in Hilly Terrain with Trapezoidal drain on hill side and retaining wall on valley side	1.200	TCS-2.17(New)
6	Two Lane Road with Paved shoulders in Hilly Terrain with Hill side drain	7.405	TCS-2.19(New)
7	Two Lane Road with Paved shoulders in Hilly Terrain with Hill side drain and breast wall	3.700	TCS-2.20(New)
	Total	20.248 km	

The summary of cost estimate is presented in table 1.9 below:

Table No. 1.9: Cost Estimate Abstract

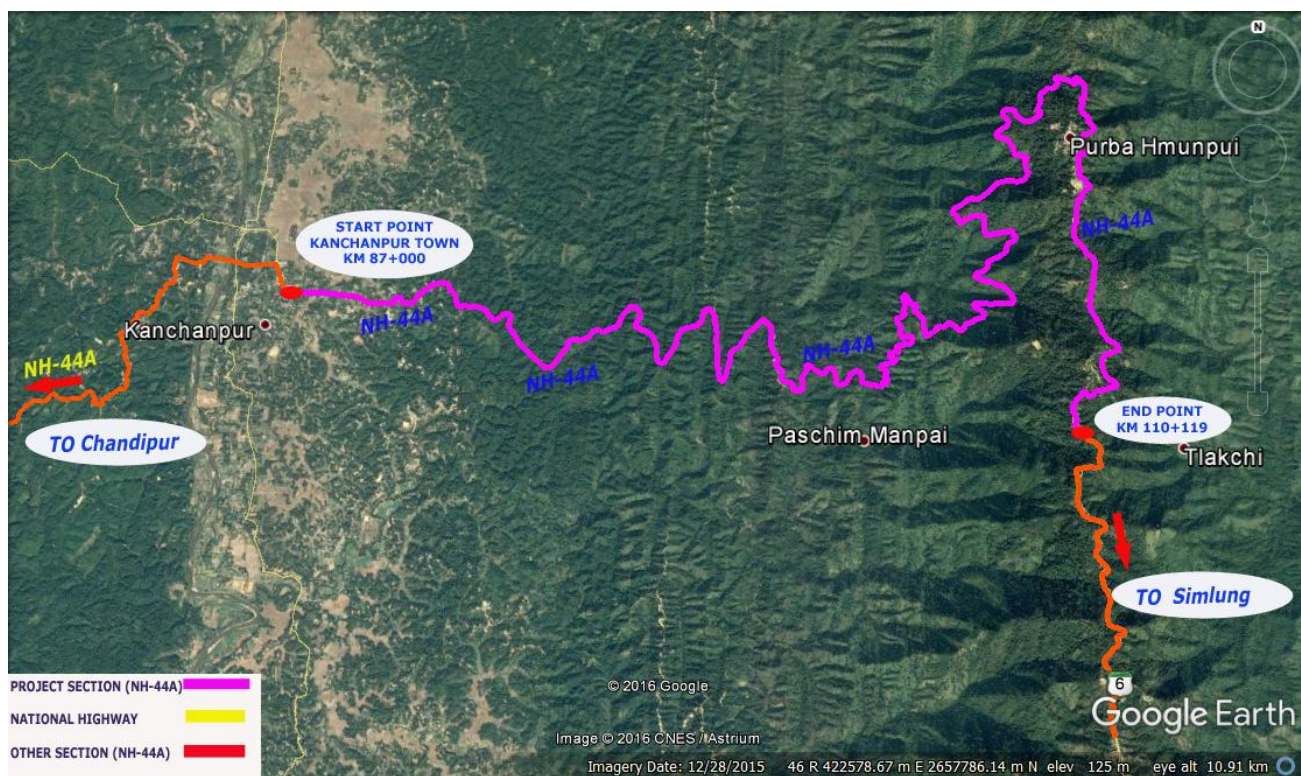
S. No.	Item	Total (Rs.)	Total in Crores
A	CIVIL WORK FOR RECONSTRUCTION OF PROJECT ROAD		
1	SITE CLEARANCE	2,978,322	0.30
2	EARTHWORK	372,900,697	37.29
3	GRANULAR SUB-BASE, BASE-COURSE	1,279,376,340	127.94
4	BITUMINOUS COURSES	432,464,592	43.25
	SUB TOTAL (A)	2087719952	208.77
B	CROSS DRAINAGE STRUCTURES		
5	RECONSTRUCTION OF Culverts	290,906,580	29.09
	SUB TOTAL OF CROSS DRAINAGE STRUCTURES (B)	290906580	29.09
C	OTHER ITEMS		
6	TRAFFIC SIGNS MARKING AND ROAD APPURTENANCES	50,122,571	5.01
7	Slope protection	3,908,960	0.39
8	Catch Water Drains	34,224,328	3.42
9	Hill Side Dains	48,400,442	4.84
10	Breast wall & Retaining Wall	499,444,838	49.94
	SUB TOTAL OF OTHER ITEMS (C)	636,101,139	63.61
D	Total (D= A+B+C)	3,014,727,671	301.47
E	Add Contingency Charges @ 2.8 % on F (G)	84,412,375	8.44
F	Total Civil Cost (F= D+E)	3,099,140,046	309.91
	Cost Per Km	153,059,070	15.31
G	Add 3% Supervision Charges on F (G)	92,974,201	9.30
H	Add 3% Agency Charges on F (H)	92,974,201	9.30
I	Add 0.25% QC Charges on F (I)	7,747,850	0.77
J	Add 0.25% Road Safety Cell Audit Charges (J)	7,747,850	0.77
K	Add Price Escalation @ 5% per annum for 2.5 years Construction Period i.e total 12.5% on F	387,392,506	38.74
L	Add Post Construction Maintainence During DLP Payable @ 5% for 4 Years to EPC Contrator on F	154,957,002	15.50
M	Grand Total (M= F+G+H+I+J+K+L)	3,842,933,657	384.29
	Total Project Cost	3,842,933,657	384.29
	Cost per Km.	189,793,247	18.98

Chapter-2:

PROJECT DESCRIPTION

The project road segment is identified for Improvement and Up gradation to 2- Lane with paved shoulders configuration from Kanchanpur – Vaghmun – NH-44A for a length of about 23.119 km (as per topographic survey) the road primarily connects blocks viz, Kanchanpur, vaghmun and other important Villages. The project road starts from Km. 87.000 of NH-44A in Kanchanpur village, Tripura and terminates on Km. 110.119 near Talakshi village. Location of project road section is shown as **figure 2.1**; Start & End point of the Project road have been shown in **figure 2.2 to 2.4**.

Figure 2.1: Location Map of Kanchanpur – Vaghmun -Road Section



2.1 Start Point

The project road starts from Km. 87.000 of NH-44A in Kanchanpur Village.



Figure 2.3: Aerial View of Start Point

2.2 End Point

The Project road terminates on Km. 110.119 near Talakshi village.



Figure 2.4: Aerial View of End Point

2.3 Importance

- The population of Manu (Km. 0.000), **Mainama** (Km. 3.27), **Chailengata** (Km. 7.20), **Lalcherra** (Km. 11.0), **Chandipur** (Km. 30.50), **Kanchanpur** (Km. 40.150), **Vanghmun** (Km. 62.50), **Tumlaihipara** and **Simlung** (Km. 73.111) will get directly benefited by Implementation of Project Road.
- Project Road has a vital importance from view of connectivity with National Highway no. 44 and Tripura-Mizoram Border. As the project road is directly connected to both NH-44 which shows the growing importance of the highway. Therefore, up gradation of project road is very important in keeping the view of growing importance and commercial traffic attraction from other adjoining roads to the project road.

2.4 Junctions

The project road crosses different categories roads such as National Highways, State Highways, & Village roads. There are **00 numbers of Major Junctions** and **10 numbers of Minor Junctions** exists along the project road. The details of all identified junctions will be enumerated in subsequent reports to be submitted. Some junctions located during reconnaissance survey on project road are depicted in **Table no. 2.1**.

Table – 2.1
List of junctions located on Project Road

S.No.	Existing Chainage	Design Chainage	Type of Junction	Remark
1	87+075	43+480	T-Type	Uricherra Village
2	87+370	43+780	T-Type	School
3	87+425	43+830	T-Type	Village Road
4	87+505	43+910	T-Type	Village Road
5	88+075	44+435	Y-Type	Asst. Director of ARDD office
6	88+235	44+550	T-Type	Village Road
7	88+995	45+390	T-Type	Village Road
8	104+835	59+345	T-Type	Depta Cherra
9	106+400	60+505	Y-Type	Sukna Cherra
10	109+650	63+175	Y-Type	Tlakshi Village

2.5 Towns / Villages along the Project Highway

2 Numbers of villages/ town are situated by the side of the project stretch. List of such villages is given below in table no.2.2. form:

Table – 2.2
List of Villages/Towns on the Project Highway

Sr. No.	Village/Town	Village Chainage (in Km.)	
		From	To
1	Kanchanpur Village	87+000	87+800
2	Manpui Village	106+600	106+800

2.6 Existing Road alignment

The assigned road segment of National Highway runs broadly in S-E direction from Kanchanpur to Vagmun. The road passes through plain/rolling/hilly terrain throughout the stretch.

Existing alignment is very poor in respect of geometrics along the project road. The condition of the shoulders and the embankment is very poor along the overall project road. The condition of the culverts/bridges along the project road is poor which needs reconstruction.

Table 2.3 Vertical Geometry Details

Start Ch.	End Ch.	Type of Terrain
87+000	88+450	Plain/Rolling
88+450	110.119	Hilly

2.7 Pavement

The width of carriageway along the project highway section is generally found Single lane to Double lane. The riding surface condition of existing carriage way is in general fair condition except few locations it is poor. The existing condition of pavement and lane configuration is presented in Table 2.4.

Table 2.4: Summary of Existing Cross-section details

Carriageway Width	Length (in km)	Type
6.50m	0.400	BT
3.75m	14.119	BT
7.00m	8.600	BT
Total	23.119 km	

Condition	Length(km)	% of total length
Fair	19.599	84.48%
Poor	3.600	15.52%
Very Poor	0.000	0.00%
Total	23.119 km	100%

DRAINAGE

No sign of any drain has been found on the entire road.

2.8 EXISTING ROW:

Revenue maps reveal that the existing Right of Way (ROW) of the project road varies between 3m to 22m. The chainage wise existing ROW details are shown below:

S.No.	From Ch	To Ch	Ex. ROW
1	43407	43500	5.0
2	43500	43600	5.4
3	43600	43700	5.4
4	43700	43800	6.1
5	43800	43900	6.5
6	43900	44000	5.6
7	44000	44100	5.1
8	44100	44200	4.3
9	44200	44300	4.6
10	44300	44400	6.9
11	44400	44500	6.9
12	44500	45000	9.5
13	45000	45100	5.6
14	45100	45200	4.5
15	45200	45300	6.3
16	45300	45400	7.1
17	45400	45500	7.3
18	45500	45600	3.9
19	45600	45700	5.6
20	45700	46000	4.8
21	46000	46100	4.6
22	46100	46200	4.5
23	46200	46300	5.0
24	46300	46400	7.2

25	46400	46500	4.8
26	46500	46600	6.3
27	46600	46700	6.9
28	46700	46800	6.7
29	46800	46900	6.3
30	46900	47100	5.5
31	47100	47200	6.0
32	47200	47300	5.2
33	47300	47400	7.5
34	47400	47500	6.0
35	47500	47600	6.8
36	47600	47700	6.3
37	47700	47800	7.6
38	47800	47900	6.5
39	47900	48000	5.9
40	48000	48100	7.2
41	48100	48200	12.0
42	48200	48300	9.4
43	48300	48400	7.6
44	48400	48500	8.3
45	48500	48600	5.4
46	48600	48700	9.9
47	48700	48800	10.6
48	48800	48900	5.2
49	48900	49000	6.3
50	49000	49100	9.0
51	49100	49200	7.9
52	49200	49300	6.9
53	49300	49400	7.6
54	49400	49500	6.1
55	49500	49600	7.4
56	49600	49700	11.3
57	49700	49800	7.1
58	49800	49900	4.5
59	49900	50000	5.3
60	50000	50100	6.3
61	50100	50200	6.6
62	50200	50300	7.0
63	50300	50400	9.3
64	50400	50500	7.2
65	50500	50600	6.8
66	50600	50700	14.3
67	50700	50800	5.2
68	50800	50900	5.3
69	50900	51000	6.4

70	51000	51100	6.9
71	51100	51200	8.1
72	51200	51300	8.4
73	51300	51400	10.1
74	51400	51900	7.6
75	51900	52000	16.2
76	52000	52100	13.3
77	52100	52200	11.8
78	52200	52300	11.5
79	52300	52400	10.5
80	52400	52500	10.3
81	52500	52600	14.8
82	52600	52700	15.2
83	52700	52800	10.8
84	52800	52900	12.3
85	52900	53000	15.4
86	53000	53100	11.4
87	53100	53200	9.9
88	53200	53300	12.9
89	53300	53400	12.0
90	53400	53500	23.8
91	53500	53600	8.1
92	53600	53700	10.7
93	53700	53800	8.8
94	53800	53900	11.0
95	53900	54000	11.9
96	54000	54100	12.6
97	54100	54200	11.0
98	54200	54300	8.8
99	54300	54400	12.1
100	54400	54500	11.2
101	54500	54600	12.0
102	54600	54700	12.0
103	54700	54800	10.7
104	54800	54900	17.8
105	54900	55000	8.5
106	55000	55100	10.5
107	55100	55200	12.0
108	55200	55300	11.7
109	55300	55400	8.3
110	55400	55500	11.6
111	55500	55600	8.8
112	55600	55700	13..2539
113	55700	55800	9.2
114	55800	55900	11.9

115	55900	56000	10.1
116	56000	56100	12.5
117	56100	56200	15.7
118	56200	56300	13.9
119	56300	56400	13.6
120	56400	56500	11.9
121	56500	56600	9.6
122	56600	56700	14.9
123	56700	56800	11.6
124	56800	56900	12.1
125	56900	57000	12.4
126	57000	57100	12.6
127	57100	57200	10.4
128	57200	57300	9.6
129	57300	57400	15.4
130	57400	57500	10.7
131	57500	57600	14.0
132	57600	57700	16.0
133	57700	57800	14.9
134	57800	57900	18.4
135	57900	58000	12.5
136	58000	58100	11.1
137	58100	58200	15.5
138	58200	58300	8.4
139	58300	58400	10.0
140	58400	58500	10.8
141	58500	59400	12.3
142	59400	59500	12.6
143	59500	59600	14.8
144	59600	59700	19.0
145	59700	59800	17.8
146	59800	59900	14.4
147	59900	60000	13.0
148	60000	60100	10.2
149	60100	60200	7.6
150	60200	60300	10.8
151	60300	60400	10.6
152	60400	60500	8.9
153	60500	60600	10.4
154	60600	60700	10.3
155	60700	60800	10.8
156	60800	60900	7.7
157	60900	61000	9.8
158	61000	61100	8.4
159	61100	61200	9.4

160	61200	61300	6.9
161	61300	61400	3.9
162	61400	61500	5.2
163	61500	61600	8.4
164	61600	61700	9.5
165	61700	61800	10.3
166	61800	61900	4.7
167	61900	62000	6.6
168	62000	62100	13.3
169	62100	62400	10.7
170	62400	62500	11.1
171	62500	62600	13.5
172	62600	62700	12.9
173	62700	62800	10.6
174	62800	62900	8.1
175	62900	63000	11.9
176	63000	63100	15.6
177	63100	63200	10.4
178	63200	63300	8.9
179	63300	63400	11.5
180	63400	63500	9.8
181	63500	63600	7.3
182	63600	63700	10.2
183	63700	63800	9.5
184	63800	63855	9.9

2.9 Cross drainage structures

There are 37 nos. structures found in 23.119 km length and. The summary and proposed improvement for existing bridges and culverts are given Improvement Proposal of this Volume.

Table 2.5 - Summary of Structures

Major Bridge	Minor Bridge	R.C.C.Slab	Flush Cause way	Hume Pipe Culvert	Box Culvert
0 Nos.	0 Nos.	8 Nos.	1 Nos.	28 Nos.	0 Nos.

Table: 2.6 - List of Existing Structures

List -1 Culverts Details:-

Sl. No.	Existing Change	Type of structures (RCC Box, Pipe, Slab Box, Masonry Arch)	Span Arrangement (No. X Length) (m)
1	87+235	RCC SLAB	1X4.50

2	87+380	RCC SLAB	1X1.55
3	92+175	RCC SLAB	1X1.55
4	92+975	RCC SLAB	1X1.50
5	93+740	RCC SLAB	1X1.55
6	96+195	HPC	1X.090
7	96+515	HPC	1X.090
8	97+000	HPC	2X0.90
9	97+110	HPC	1X0.90
10	97+335	HPC	1X.090
11	97+485	HPC	1X0.90
12	97+705	RCC SLAB	1X1.00
13	97+745	RCC SLAB	1X1.50
14	98+840	HPC	1X0.90
15	99+550	HPC	1X0.90
16	100+060	HPC	1X0.90
17	100+135	FCW	1X1.50
18	100+965	HPC	1X0.90
19	101+085	HPC	1X0.90
20	102+735	HPC	1X0.90
21	102+870	RCC SLAB	1X2.00
22	103+030	HPC	1X0.90
23	104+240	HPC	1X0.90
24	104+340	HPC	1X0.90 N/V
25	104+525	HPC	1X0.90
26	104+890	HPC	1X0.90
27	104+945	HPC	1X0.90
28	105+620	HPC	1X0.90
29	105+850	HPC	1X0.90
30	106+000	HPC	1X0.90
31	106+075	HPC	1X0.90

32	108+615	HPC	1X0.90 N/V
33	108+800	HPC	1X0.90
34	109+120	HPC	1X0.90
35	109+325	HPC	1X0.90
36	109+380	HPC	1X0.90
37	109+535	HPC	1X0.90

List -2 Bridge Details:-

Sl. No.	Existing Change	Type of structures (RCC Box, Pipe, Slab Box, Masonry Arch)	Span Arrangement (No. X Length) (m)
NIL			

2.10 Road Length passing through Forest Area

No continuous stretch was identified as forest area. However, Some Plots has been identified under the jurisdiction of forest department & it was incorporated in forest diversion proposal.

2.11 RAIL-ROAD CROSSING:

There is no railway crossing encounter on project corridor.

2.12 ONGOING DEVELOPMENT PLANS

No development plan reported for this road during preliminary survey.

2.13 ENCROACHMENTS

There are no major encroachments observed anywhere on the road. Few temporary encroachments were observed at Village portions of the road.

2.14 SOIL STRATA

Table 2.7 shows variations in Soil of Project Road.

Table2.7

Ex. Start Ch.	Ex. End Ch.	Length (km)	Total Length (km)	Type of Soil	Remark
87+000	110.119	22.750	22.750	Yellow Sandy soil	Both Side

2.15 SERVICE ROADS

There are no service roads along the road.

2.16 LAND ACQUISITION

As per revenue maps of project road section there is a requirement of land acquisition.
Details of land acquisition are shown below:-

Summary of Land Acquisition

S.No.	Type of Land	Area to be Acquired
1	Government Land	2.3417
2	Private Land	18.7887
3	Forest Land	47.2078
Total Land to Be Acquired		68.3382

Note:- This details are taken from the official website of revenue department, Tripura. It will be verified with records of concerning Tehsil office.

2.17 TRAFFIC

This Road connects Tripura state with Mizoram state, also the road is being used for connecting local villages located on either side of road. The traffic mostly consists of Two wheelers and passenger vehicles like cars, three wheelers etc because as on today the road is not connected the project road (Manu - Simlung) is not fully constructed. When Project road will be constructed commercial traffic will increase on a large scale because of interstate connectivity, other vehicles using the road are Local public buses and bicycles.

2.18 TRAFFIC SURVEY LOCATON

The traffic survey shall be conducted at

- A)** Classified Volume Count Survey At
 - 1. Km 0+200 (at Manu town)
 - 2. Km 87+080 (after Kanchanpur town)
- B)** OD & Axle Load Spectrum Survey
 - 1. At Km 0+200 (at Manu town)
 - 2. (Before Kanchanpur town)

2.19 TRAFFIC DATA

Traffic data indicating of traffic count at key stations has been collected.

2.20 BYPASSES AND REALIGNMENTS:

No Bypasses & Realignments required on project road section.

2.21 MISCELLANEOUS SERVICES

Various services available along the existing highway are as follows:-

Fuel Stations: - No Fuel stations were observed on the Project Highway section.

Police Station: - No Police Stations were observed on the project Road section.

2.22 ENVIRONMENTAL IMPACT, REHABILITATION AND SENSITIVITY

This road mainly passes through Forest & populated area with some stretches in Agricultural fields in some part. Project for road widening, rehabilitation shall not cause any adverse effect on ecology and environment of the adjoining area. Whole project road section passes through Forest area.

2.23 TREES WITHIN ROW

There are many trees within the ROW along both sides of the highway. These include Delonix regia (Gulmohar), Teakwood, Ber, Bargad, Supari, eucalyptus, Neem, Ashok, Pipal, Mango, and Local Trees etc.

2.24 RESOURCES

Labour: - Enough unskilled labour is available in the region.

Borrow Areas: - Soil from road way cutting will be reused as subgrade soil as existing CBR is greater > or = to 10%.

Bitumen: - The bitumen supply to this area, in general, comes from Nearest Refinery; required quantity supply can be arranged from there.

2.25 UTILITIES

Electrical Poles: - Electrical poles are fixed both on the left hand side / right hand side mainly in village area of the road.

Optical Fiber Cables (OFC): - As per local inquiry, OFC cable has been laid on both side of project highway sections.

Water Supply Main Lines: - As per local inquiry water supply exists in main settlements along the road.

Chapter-3:

SOCIO ECONOMIC PROFILE

3.1 Introduction

National Highway & Infrastructure Development Corporation Limited has taken initiatives in the up-gradation and development of its road network in the State. Having a glorious history in the development of National Highways, State Highways, and Major District Roads at various locations in the state of NHIDCL.

This project is project in EPC (Engineering Procurement Construction) The engineering and construction contractor will carry out the detailed engineering design of the project, procure all the equipment and materials necessary, and then construct to deliver a functioning facility or asset to their clients. Companies that deliver EPC Projects are commonly referred to as EPC Contractors. Scheme

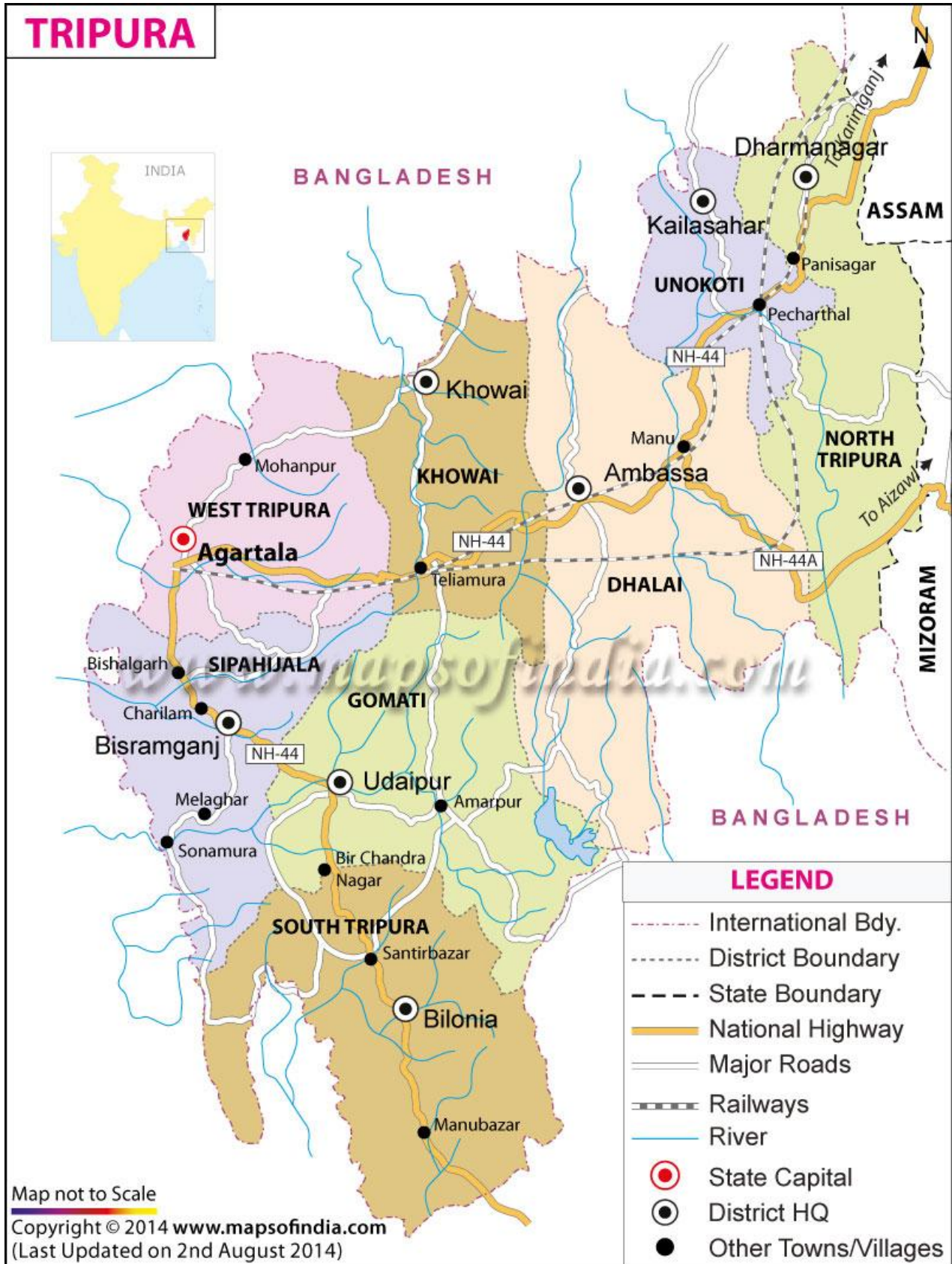
This report deals with. **Kanchanpur – Vagmun Section (NH-44A)** which needs to be upgraded to Two Lane with paved Shoulders and the details of this road is given in Table No. 3.1

Table 3.1 Details of Project Road

Sr. No.	Name of Road	SH No.	Chainage (in Km)		Length as per Topographic Survey (in Km)	Length as per Design (in Km)
			From (in Km)	To (in Km)		
1	Kanchanpur - Vagmun Section	NH -44A	Km 87+000	Km 110+119	23.119	20.248

3.2 Objective

The main objective of the consultancy service is for carrying out Feasibility study for finalizing alignment, cost and proper structuring and implementation for National Highway in Tripura State. NHIDCL accordingly proposes to procure the services of feasibility/DPR Consultants for carrying out suitable study for selection of the alignment, field investigation, hydraulic studies, providing detailed structural design, evaluate detailed cost analysis, LA and R&R plan, utility shifting & relocation plan, environmental analysis and implementation of Project under EPC Mode.



3.3 Historical Background

Although there is no evidence of lower or middle Paleolithic settlements in Tripura, Upper Paleolithic tools made of fossil wood have been found in the Haora and Khowai valleys. The Indian epic, the Mahabharata; ancient religious texts, the Puranas; and the Edicts of Ashoka – stone pillar inscriptions of the emperor Ashoka dating from the third century BCE – all mention Tripura. An ancient name of Tripura is Kirat Desh (English: "The land of Kirat"), probably referring to the Kirata Kingdoms or the more generic term Kirata. However, it is unclear whether the extent of modern Tripura is coterminous with Kirat Desh. The region was under the rule of the Twipra Kingdom for centuries, although when this dates from is not documented. The Rajmala, a chronicle of Tripuri kings which was first written in the 15th century, provides a list of 179 kings, from antiquity up to Krishna Kishore Manikya (1830–1850), but the reliability of the Rajmala has been doubted.

The boundaries of the kingdom changed over the centuries. At various times, the borders reached south to the jungles of the Sundarbans on the Bay of Bengal; east to Burma; and north to the boundary of the Kamarupa kingdom in Assam. There were several Muslim invasions of the region from the 13th century onward,[17] which culminated in Mughal dominance of the plains of the kingdom in 1733,[17] although their rule never extended to the hill regions. The Mughals had influence over the appointment of the Tripuri kings.

Tripura became a princely state during British rule in India. The kings had an estate in British India, known as Tippera district or Chakla Roshnabad (now the Comilla district of Bangladesh), in addition to the independent area known as Hill Tippera, the present-day state.[17] Udaipur, in the south of Tripura, was the capital of the kingdom, until the king Krishna Manikya moved the capital to Old Agartala in the 18th century. It was moved to the new city of Agartala in the 19th century. Bir Chandra Manikya (1862–1896) modelled his administration on the pattern of British India, and enacted reforms including the formation of Agartala Municipal Corporation.

Following the independence of India in 1947, Tippera district – the estate in the plains of British India – became a part of East Pakistan, and Hill Tippera remained under a regency council until 1949. The Maharani Regent of Tripura signed the Tripura Merger Agreement on 9 September 1949, as a result of which Tripura became a Part C state of India. It became a Union Territory, without a legislature, in November 1956 and an elected ministry was installed in July 1963. The geographic partition that coincided with the independence of India resulted in major economic and infrastructural setbacks for the state, as road transport between the state and the major cities of India had to follow a more circuitous route. The road distance between Kolkata and Agartala before the partition was less than 350 km (220 mi), and increased to 1,700 km (1,100 mi), as the route now avoided East Pakistan. The geo-political isolation was aggravated by an absence of rail transport.

Some parts of the state were shelled by the Pakistan Army during the Indo-Pakistani War of 1971. Following the war, the Indian government reorganised the North East region to ensure effective control of the international borders – three new states came into existence on 21 January 1972: Meghalaya, Manipur, and Tripura. Since the partition of India, many Hindu Bengalis have migrated to Tripura as refugees from East Pakistan; settlement by Hindu Bengalis increased at the time of the Bangladesh Liberation War of 1971. Hindu Bengalis migrated to Tripura after 1949 to escape religious persecution in Muslim majority East Pakistan. Before independence, most of the population was indigenous;.[23]:9 Ethnic strife between the Tripuri tribe and the predominantly immigrant Bengali community led to scattered violence, and an insurgency spanning decades. This gradually abated following the establishment of a tribal autonomous district council and the use of strategic counter-insurgency operations, aided by the overall socio-economic progress of the state. Tripura remains peaceful, as of 2012.

3.4 Geography, Forests & Agriculture

Geography:

Tripura is a landlocked state in North East India, where the seven contiguous states – Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura – are collectively known as the Seven Sister States. Spread over 10,491.69 km² (4,050.86 sq mi), Tripura is the third-smallest among the 29 states in the country, behind Goa and Sikkim. It extends from 22°56'N to 24°32'N, and 91°09'E to 92°20'E. Its maximum extent measures about 184 km (114 mi) from north to south, and 113 km (70 mi) east to west. Tripura is bordered by the country of Bangladesh to the west, north and south; and the Indian states of Assam to the north east; and Mizoram to the east. It is accessible by national highways passing through the Karimganj district of Assam and Mamit district of Mizoram.

Forests:

The state of Tripura, with a geographical area of 10491 km² is predominantly hilly (60%) & is surrounded on three sides by a deltaic basin of Bangladesh. The state is situated between 22o57' & 24o32'N and 91o10' & 92o20'E with tropic of cancer passing through it. The State is situated in the south-western extremity of North-East region of the country. It shares border (1001 km in perimeter) with Bangladesh, Assam and Mizoram. International border with Bangladesh is 856 km, which is almost completely open and porous.

The forests in the state are mainly tropical evergreen, semi evergreen, and moist deciduous. Sizeable area is covered with bamboo brakes which virtually form a “Sub climax” resulting from shifting cultivation from time immemorial. The details of forest resources are given below.

(a) Forest Area: 6292.681Km²

(b) % of forest area to geographical area (10491 Km²) 59.98%

Legal classification of forests.

District wise % Forest Area w.r.t. Geo. Area & Per Capita in Tripura.

District	Geographical Area	2011 Assessment				Percent of GA
		Very Dense Forest	Mod. Dense Forest	Open Forest	Total	
Dhalai	2,402	3	1,262	647	1,912	79.60
North Tripura	2,039	10	963	541	1,514	74.25
South Tripura	3,057	73	1,387	1,013	2,473	80.90
West Tripura	2,993	23	1,074	981	2,078	69.43
Total	10,491	109	4,686	3,182	7,977	76.04

Agriculture:



The chief occupation of the population in the state is agriculture. The main activity of more than three-fourths of the workers is agriculture. About 24.3% area is available for agriculture use. The principal crops are paddy, wheat, jute, sugar cane, potato, turmeric, coconut and oil seeds. Agriculture is being practiced in about 2.5 lakh hectares.

Stress on agricultural development during the last decades was given for the increase in production of food grains. By providing essential inputs in the form of improved seeds, fertilizers, plant protection chemicals and by increasing substantially the area of cultivation under HYV programme, it has been possible for the state to raise production of food grains.

Significant steps have been taken to bring larger and larger areas under the plant protection scheme. It is irrigation,

The one input which can do a lot for diversification, multiple cropping and increasing yield of crops. But the progress on this front has not been satisfactory. Another important input is seed.

Initially the state government faced considerable difficulties in bringing seed from outside the state due to high cost. But now, large-sized seed multiplication firms have been set up. Besides, a seed bank is operating. Large scale demonstration programmes are taken up covering all the branches with a view to transmitting scientific and progressive technology in the field of agriculture.

Promotion of soil and economic equality is a pre-condition for attaining substantial long-term increase in production. Measures to reduce inequalities should succeed in eliminating deterrents to work and aggregate labor utilization. But, the success mainly depends on the political climate.

The major thrust in land reforms is centred round the protection of interest of the tribals on land and restoration of alienated land to them. In September 1989 Tripura legislative Assembly passed a Bill relating to land revenue and land reforms, the important-provision of which are as follows.

1. No land belonging to tribals can be sold to a non-tribal. Even a decree by a court of law will not entitle a non-tribal to take possession of tribal land.
2. Land sold or transferred from a tribal to a non-tribal on or after 1st Jan 1969 will not be considered valid.
No court of law will be able to pass a decree transferring the title of a tribal land to a non-tribal.

3.5 Economy

Gross State Domestic Product at Constant Prices (2004-05 base) figures in crores Indian rupee	
Year	Gross State Domestic Product
2004-05	8,904
2005-06	9,482
2006-07	10,202
2007-08	10,988
2008-09	11,596
2009-10	12,248
2010-11	12,947

Tripura's gross state domestic product for 2010–11 was 129.47 billion (US\$1.9 billion) at constant price (2004–05),[67] recording 5.71 per cent growth over the previous year. In the same period, the GDP of India was 48,778.42 billion (US\$720 billion), with a growth rate of 8.55 per cent. Annual per capita income at current price of the state was 38,493 (US\$570), compared to the national per capita income 44,345 (US\$660). In 2009, the tertiary sector of the economy (service industries) was the largest contributor to the gross domestic product of the state, contributing 53.98 per cent of the state's economy compared to 23.07 per cent from the primary sector (agriculture, forestry, mining) and 22.95 per cent from the secondary sector (industrial and manufacturing). According to the Economic Census of 2005, after agriculture, the maximum number of workers were engaged in retail trade (28.21 per cent of total non-agricultural workforce), followed by manufacturing (18.60 per cent), public administration (14.54 per cent), and education (14.40 per cent).

Tripura is an agrarian state with more than half of the population dependent on agriculture and allied activities. However, due to hilly terrain and forest cover, only 27 per cent of the land is available for cultivation. Rice, the major crop of the state, is cultivated in 91 per cent of the cropped area. According to the Directorate of Economics & Statistics, Government of Tripura, in 2009–10, potato, sugarcane, mesta, pulses and jute were the other major crops cultivated in the state. Jackfruit and pineapple top the list of horticultural products.[71]Traditionally, most of the indigenous population practised jhum method (a type of slash-and-burn) of cultivation. The number of people dependent on jhum has declined over the years.

Pisciculture has made significant advances in the state. At the end of 2009–10, the state produced a surplus of 104.3 million fish seeds. Rubber and tea are the important cash crops of the state. Tripura ranks second only to Kerala in the production of natural rubber in the country.[74] The state is known for its handicraft, particularly hand-woven cotton fabric, wood carvings, and bamboo products. High quality timber including sal, garjan, teak and gamar are found abundantly in the forests of Tripura. Tata Trusts signed a pact with Government of Tripura in July, 2015 to improve fisheries and dairy in the state.

Per Capita Income with 2004–05 Base		
Year	Tripura	India
2004–05	24,394	24,095
2005–06	26,668	27,183

2006-07	29,081	31,080
2007-08	31,111	35,430
2008-09	33,350	40,141
2010-11	33,493	44,345

The industrial sector of the state continues to be highly underdeveloped – brickfields and tea industry are the only two organised sectors. Tripura has considerable reservoirs of natural gas. According to estimates by Oil and Natural Gas Corporation (ONGC), the state has 400 billion metres³ reserves of natural gas, with 16 billion metres³ is recoverable. ONGC produced 480 million meters natural gas in the state, in 2006-07. In 2011 and 2013, new large discoveries of natural gas were announced by ONGC. Tourism industry in the state is growing – the revenue earned in tourism sector crossed 10 million (US\$150,000) for the first time in 2009-10, and surpassed ₹ 15 million (US\$220,000) in 2010-11. Although Bangladesh is in a trade deficit with India, its export to Tripura is significantly more than import from the state; a report in the newspaper The Hindu estimated Bangladesh exported commodities valued at about 3.5 billion (US\$52 million) to the state in 2012, as opposed to "very small quantity" of import. Alongside legal international trade, unofficial and informal cross-border trade is rampant. In a research paper published by the Institute of Developing Economies in 2004, the dependence of Tripura's economy on that of Bangladesh was emphasised.

The economy of Tripura can be characterised by high rate of poverty, low capital formation, inadequate infrastructure facilities, geographical isolation and communication bottlenecks, inadequate exploration and use of forest and mineral resources, slow industrialisation and high unemployment. More than 50% of the population depends on agriculture for sustaining their livelihood. However agriculture and allied activities to Gross State Domestic Production (GSDP) is only 23%, this is primarily because of low capital base in the sector. Despite the inherent limitation and constraints coupled with severe resources for investing in basic infrastructure, this has brought consistence progress in quality of life and income of people cutting across all sections of society. The state government through its Tripura Industrial Policy and Tripura Industrial Incentives Scheme, 2012, has offered heavy subsidies in capital investment and transport, preferences in government procurement, waivers in tender processes and fees, yet the impact has been not much significant beyond a few industries being set up in the Bodhjungnagar Industrial Growth Center.

The Planning Commission estimates the poverty rate of all North East Indian states by using head count ratio of Assam (the largest state in North East India). According to 2001 Planning Commission assessment, 22 per cent of Tripura's rural residents were below the poverty line. However, Tripura government's independent assessment, based on consumption distribution data, reported that, in 2001, 55 per cent of the rural population was below the poverty line. Geographic isolation and communication bottleneck coupled with insufficient infrastructure have restricted economic growth of the state. High rate of poverty and unemployment continues to be prevalent.

3.6 Education

Schools in Tripura are run by the state government, TTAADC and private organisations, which include religious institutions. Instruction in schools is mainly in English or Bengali, though Kokborok and other regional languages are also used. Some of the special schools include Jawahar Navodaya Vidyalaya, Kasturba Gandhi Balika Vidyalaya, residential schools run by Tripura Tribal Welfare Residential Educational Institutions Society (TTWREIS), [104] missionary organisations like St. Paul's, St. Arnold's, Holy Cross, Don Bosco, St. John's etc. There are also many Preschools mostly located in cities like Kidzee Agartala at 79 tilla, GB in Agartala. The schools are affiliated to the Council for the Indian School Certificate Examinations (CISCE), the Central Board for Secondary Education (CBSE), the National Institute of Open Schooling (NIOS) or the Tripura Board of Secondary Education. Under the 10+2+3 plan, after completing secondary school, students typically enroll for two years in a junior college or in a higher secondary school affiliated either to the Tripura Board of Secondary Education or to other central boards. Students choose from one of the three streams—liberal arts, commerce or science. As in the rest of India, after passing the Higher Secondary Examination (the grade 12 examination), students may enroll in general degree programs such as bachelor's degree in arts, commerce or science, or professional degree programs such as engineering, law or medicine.

According to the Economic Review of Tripura 2010–11, Tripura has a total of 4,455 schools, of which 2,298 are primary schools. The total enrolment in all schools of the state is 767,672. Tripura has one Central University (Tripura University) and one private university (a branch of the Institute of Chartered Financial Analysts of India). There are 15 general colleges, three engineering colleges (Tripura Institute of Technology, National Institute of Technology, Agartala and NIELT, Agartala), two medical colleges (Agartala Government Medical College [107] and Tripura Medical College), three nursing or paramedical colleges, three polytechnic colleges, one law college, one Government Music College, one College of Fisheries, Institute of Advance Studies in

Education, one Regional College of Physical Education at Panisagar and one art college. Tripura University also houses the IGNOU Agartala Regional Center.

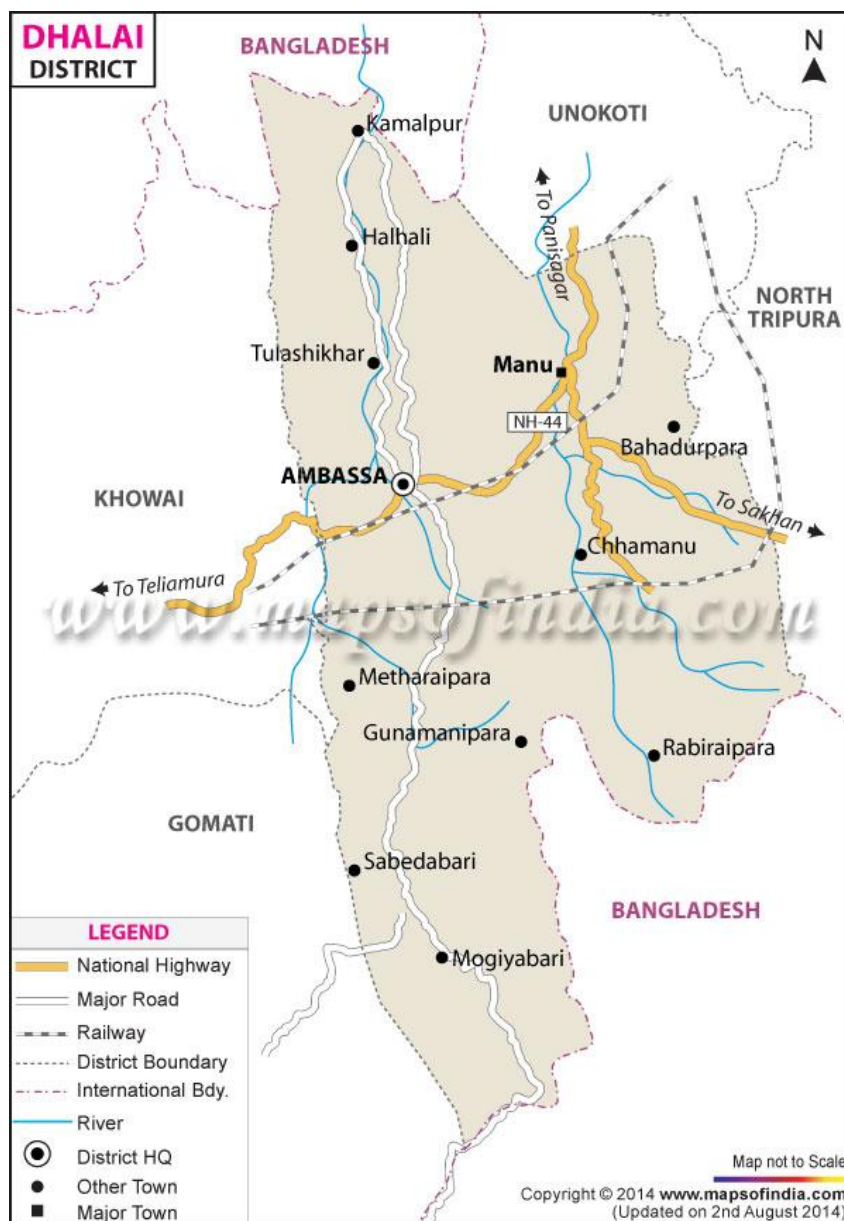
3.7 Demography

Tripura ranks second only to Assam as the most populous state in North East India. According to the provisional results of 2011 census of India, Tripura has a population of 3,671,032 with 1,871,867 males and 1,799,165 females. It constitutes 0.3 per cent of India's population. The sex ratio of the state is 961 females per thousand males, higher than the national ratio 940. The density of population is 350 persons per square kilometer. The literacy rate of Tripura in 2011 was 87.75 per cent, higher than the national average 74.04 per cent, and third best among all the states.

Tripura ranked 6th in Human Development Index (HDI) among 35 states and union territories of India, according to 2006 estimate by India's Ministry of Women and Child Development; the HDI of Tripura was 0.663, better than the all-India HDI 0.605.

In 2011, the police in Tripura recorded 5,803 cognizable offences under the Indian Penal Code, a number second only to Assam (66,714) in North East India. The crime rate in the state was 158.1 per 100,000 people, less than the all-India average of 192.2. However, 2010 reports showed that the state topped all the states for crime against women, with a rate of 46.5 per 100,000 people, significantly more than the national rate of 18.

3.8 DISTRICT DHALAI



History:

Dhalai District was created in the year of 1995 by bifurcating North Tripura District and including part of Amarpur Sub-Division of the South Tripura District. It was created keeping in view the administrative exigency of providing development & good governance to the largely Tribal & inaccessible areas. The District is named after Dhalai River which originates in the District.

Geography:

Located in the North-eastern part of Tripura, the District covers an area of about 2426 km. It is mainly located between two hills namely 'Atharamura range' and 'Sakhan Range'. More than 70% area is hilly and forest covered. The terrain is mostly undulating and hilly with small water streams (chharas), rivers and fertile valleys intervening. Major rivers originating from Dhalai are Dhalai, Khowai, Gomati

& Manu. Major hills are Atharamura, Longtharai, Kalajhari & part of Sakhan. The District headquarter at Ambassa is located at a distance of about 85 km from the State capital Agartala. The District is bordered by Bangladesh on the Northern & Southern sides. Oil and Natural Gas Corporation (ONGC) is currently exploring for natural gas reserves in the district in Salema block. The district falls in Seismic Zone 5 of India and is prone to landslides, thunderstorms and lightning strikes in summer and rainy seasons.

Economy:

In 2006 the Ministry of Panchayati Raj named Dhalai one of the country's 250 most backward districts (out of a total of 640). It is the only district in Tripura currently receiving funds from the Backward Regions Grant Fund Programme (BRGF). The district has predominantly agrarian economy with several Micro and Small scale industrial units.

Demographics:

According to the 2011 census Dhalai district has a population of 377,988, roughly equal to the nation of Maldives. This gives it a ranking of 564th in India (out of a total of 640). The district has a population density of 157 inhabitants per square kilometre (410/sq mi). Its population growth rate over the decade 2001-2011 was 22.78%. Dhalai has a sex ratio of 945 females for every 1000 males, and a literacy rate of 86.82%.

3.9 DISTRICT NORTH TRIPURA



History:

Tripura a hilly, picturesque, princely state was first conquered by the Britishers in 1761. However, no political agent was appointed till 1871 and the Maharaja ruled hill territory "Hill Tipperah" almost independently. The State acceded to the Indian union on 13.08.1947, the agreement of merger being signed on 09.09.1949. The administration was formally taken over on 15.10.1949. Tripura, initially a one district state, was trifurcated into three Districts w.e.f. 01.09.1970. The North Tripura District started functioning in the office of the Sub-divisional officer at Kailashahar and partly at Kumarghat, later the whole office was shifted to Kailashahar. The Collectorate was shifted to the newly constructed complex at Gournagar on 13.11.1987, subsequently North Tripura District has been bifurcated and a new District namely "DHALAI DISTRICT" has been inaugurated on 14.04.1995 with district head quarter at Ambassa. On 21.01.2012 the decision to further bifurcate North Tripura District was accepted and the district "UNAKOTI DISTRICT" has been created with its headquarter at

Kailashahar & North Tripura district headquarter shifted to Dharmanagar.

Geography:

It is Located at Latitude-24.3, Longitude-92.0. North Tripura District is sharing border with Karimganj District to the North, Mamit District to the East, Dhalai District to the South. It is sharing Border with Assam State to the North, Mizoram State to the South. North Tripura District occupies an area of approximately 2821 square kilometres. It's in the 60 meters to 43 meters elevation range. This District belongs to Eastern India.

Demographics:

According to the 2011 census North Tripura district has a population of 693,281, roughly equal to the nation of Bhutan or the US state of North Dakota. This gives it a ranking of 503rd in India (out of a total of 640). The district has a population density of 341 inhabitants per square kilometre (880/sq mi). Its population growth rate over the decade 2001-2011 was 17.32%. North Tripura has a sex ratio of 967 females for every 1000 males, and a literacy rate of 88.29%.

Sino-Tibetan languages spoken in North Tripura district include:

- Garo language
- Darlong language
- Ralte language

Chapter-04: TRAFFIC SURVEY & ANALYSIS

4.1 Introduction

A team has been formed under the leadership of the traffic engineer who had been carried out in accordance with the guidelines specified by IRC: 9-1972 and IRC: 102-1988.

This Road connects Tripura state with Mizoram state, also the road is being used for connecting local villages located on either side of road. The traffic mostly consists of Two wheelers and passenger vehicles like cars, three wheelers etc because as on today the road is not connected the project road (Manu - Simlung) is not fully constructed. When Project road will be constructed commercial traffic will increase on a large scale because of interstate connectivity, other vehicles using the road are Local public buses and bicycles.

4.2 Traffic Homogeneous Section

The traffic homogeneous sections have been identified based on the major traffic generators and diversion locations along the project corridor. Traffic surveys locations were selected so as to capture representative traffic volume on the homogeneous sections. With a view to capture section wise traffic flow characteristics, this project highway section has been taken as one homogeneous sections.

Homogenous Section-1: (HS-1) The project road starts from Km. 87.000 of NH-44A in Kanchanpur Village, Tripura and The Project road terminates on Km. 110.119 near Talakshi. The length of the homogenous section is 23.119 Km.

4.3 Collection and Review of Data

The data and information collected for the studies is broadly classified as follows:

- Review of all available reports and published information about the project road and the project influence area;
- Information on existing transportation system in the project influence area;
- Historical data of classified traffic volume on existing road network;
- Economic data and socio-economic parameters of the State/s and the project influence area including demographic data;
- Accident statistics; and
- Vehicle loading behavior (axle load spectrum);
- Influence of rail network on road traffic.

4.4 Traffic Surveys Schedule

It is very important to know the existing information on traffic flow, commodity movement,

traffic pattern, and turning movements at junctions in order to assess the traffic behavior on a project road. To capture traffic flow characteristics, travel pattern, speed characteristics and other characteristics related to miscellaneous requirements on the project road, the following primary traffic surveys were conducted:

- Classified Volume Count (CVC) Survey
- Origin Destination Survey
- Axle Load Survey

Traffic survey stations were selected after detailed reconnaissance survey and in line with the TOR. All traffic surveys were carried out as per IRC guidelines given in IRC: SP 19-2001, IRC: 108-1996, IRC SP: 41-1994, IRC: 102-1998, IRC 103- 1988 Pedestrian Facilities and IRC: 09-1972. All above surveys were carried out manually by employing sufficient number of trained enumerators recording information in pre-designed formats. 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.

Proper briefing and demonstration to enumerators before the start of work was carried out with; Continuous independent checking by Supervisor/Traffic engineers in the field during the survey work; Checking of filled in survey formats by Traffic engineer; and Validation of computer data entry with raw data.

All the traffic surveys, except intersection count survey, were carried out to capture the traffic in both directions. In intersection count survey, the traffic was captured in each direction of flow through intersection.

The locations for the various surveys were so selected that all the vehicles can be viewed and interpreted easily without endangering the safety of enumerators, drivers and other road users. The most important part of all traffic surveys was to exercise adequate quality control. All the above traffic surveys were carried out as per schedule finalized after considering requirements of TOR. Traffic surveys were carried out at the locations already mentioned in Inception report. Traffic survey schedule for project road is presented in Table 4.1.

Table 4.1: First Traffic Surveys Schedules

Sr. No.	Location	Chainage (Km)	Duration
Classified Volume Count Survey			
1	At Manu Town	Km-0+200	24.07.2016 to 30.07.2016

2	After Kanchanpur Town	Km-87+080	24.07.2016 to 30.07.2016
OD & Axle Load Survey			
1	At Manu Town	Km-0+200	1 day (24 july,2016)
2	Km.87+080 after Kanchanpur Town	-----	1 day (25 july,2016)

4.5 Methodology of Traffic Surveys

4.5.1 Classified Volume Count Survey

The objective of classified traffic volume count survey is to estimate traffic intensity on the project road. Classified volume count survey has been carried out at two locations as recommended in TOR. The classified volume count surveys have been carried out for 7 days, 24 hours at each location. The traffic was counted in number of vehicles by vehicle category-wise in each direction in a 15- minute interval over 24 hours a day for 7 Days. For the purpose of counts, a day was divided into three shifts of 8 hours each and different groups of enumerators with a supervisor were assigned for each shift. The counts were recorded in the formats prepared and approved as per IRC specifications. The vehicles were broadly classified into motorized and non-motorized vehicles, which were further sub divided into specific categories of vehicles. The detailed vehicle classification system is presented in Table 4.2.

Table 4.2: Vehicle Classification System Adopted

Motorized Traffic		Non-Motorized Traffic
2-Wheeler		Bi-Cycle
3-Wheeler		Cycle-Rickshaw
Passenger Car		Animal Drawn Vehicle (ADV)
Utility Vehicle (Jeep, Van etc.)		Hand Cart
		Other Non-Motorized Vehicle
Bus	Mini Bus Standard Bus	
LCV	LCV-Passenger	
Truck	MCV : 2-Axle Rigid Chassis	
	HCV : 3-Axle Rigid Chassis	
	MAV	
	Semi Articulated	
	Articulated	

The traffic count was conducted by the designated trained enumerators in three shifts in a day of eight hour each. The traffic count data was recorded at 60-minute intervals.

4.5.2 Origin – Destination (O-D) & Commodity Movement Survey

Origin and Destination of trips on the existing roads is needed to estimate the information regarding travel characteristics of different users on the project road. The traffic that will use

the proposed facility if no toll charges are collected is defined as the Candidate traffic. Origin – Destination data is also needed for identifying the major influence areas of the road, as traffic growth is dependent upon the growth in economic activity in the influencing area. The Origin- Destination survey was carried out to study the travel pattern of goods and passenger traffic along the study corridor. The O-D survey was carried out for one day (12-hour, both directions) at one location. The location of origin and destination zones has been determined in relation to each individual station and the possibility of traffic diversion to the Project road from/to other routes including bypasses. Appropriate locations were selected so as to conduct interviews without affecting movement of other vehicles. The schedule & locations of Origin – Destination Survey are given in Table 4.3.

Table 4.3: Origin – Destination (O-D) Survey Schedule & Location

Sr. No.	Location	Date of Survey	Duration of Survey
1.	At Manu Town(Km. 0+200)	24.07.2015	One day
2.	Km.87+080 after Kanchanpur Town	25.07.2015	One day

Roadside Interview Survey (RSI) Method was adopted for conducting the survey. The vehicles were stopped on random sample basis with the help of traffic police. Designated trained enumerators interviewed the drivers. A sample proportion of vehicles were interviewed from the total flow. Variable sampling flow requires a classified hourly count of all vehicles that pass in the direction being studied while interview is in progress. A volume count survey was carried out simultaneously to get the number of vehicles passing in both the directions. The O-D survey was limited Standard Bus, Mini Bus and cars in passenger vehicles category, LCV and trucks (2 axle / 3 axles, Multi – Axle Vehicle) in freight vehicle category. It was ensured that sample size is above 20% as per IRC: SP 19-2001, “Manual for Survey, Investigation and Preparation of Road Projects”.

The following pertinent information on travel was collected during the interviews:

- Origin and destination of trips;
- Trip length;
- Trip purpose;
- Travel Time;
- Vehicle Occupancy;
- Type of goods and loading in case of the goods vehicles; and
- Frequency of trips.

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

4.5.4 Axle Load Survey

Axle load survey has been conducted at two locations at Km. 0+200 at Manu town and Km.87+080 after Kanchanpur Town. Axle load survey in both directions of travel has been carried out in the project road stretch on a random sample basis for LCV, Trucks, and Standard Bus for 24 hours. The services of traffic police of Govt. of Tripura were utilized to regulate the flow of vehicles. The schedule & locations of axle load Survey is given in Table 4.4.

Table 4.4: Axle Load Survey Schedule & Locations

r. No.	Location	Date of Survey	Duration of Survey
1.	At Manu Town(Km. 0+200)	24.07.2015	One day
2.	Km.87+080 after Kanchanpur Town	25.07.2015	One day

4.6 Equivalency Factor (PCU's)

The following PCU values are taken for Traffic analysis

Table 4.5: Passenger Car Units (PCU) for Rural Highways

Vehicle Type			Equivalency Factor
Fast Moving Vehicles	2 Wheeler		0.5
	3 Wheeler		1.0
	Car/Taxi/Jeep/Van		3.0
	Bus	Mini bus	1.5
		Standard Bus	3.0
	LCV		1.5
	Truck	2 – Axle	3.0
		3 – Axle	3.0
		Multi Axle	4.5
	Agricultural Tractor	With trailer	4.5
		Without trailer	1.5
	Heavy Construction / Earth Moving Equipment		4.5
Slow Moving Vehicles	Bicycle		0.5
	Cycle rickshaw		2.0
	Bullock cart		6.0
	Hand cart		3.0

4.7 Analysis of AADT & PCU

4.7.1 Analysis of Classified Volume Count Survey

Traffic volume count at three locations has been carried out continuously for 7 consecutive days for 24 hours on each day. 7-Day 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). The analysis has been carried out in terms of total number of vehicles and also in respect to Passenger Car Unit (PCU). Location wise results of analysis are discussed below:

A. At Manu Town at Km. 0+200.

Survey was carried out at Km 0+200 at Manu Town.

ADT recorded at this station is 3753 nos. / 3192 PCU. Fast moving vehicles were recorded as 69.01% of the total traffic (in PCU).



Fig 4.1 Classified Volume Count at Ch-0+200

Peak hour traffic flow of 2073 nos. formed around 7.89% of the total traffic. Peak hour is identified during 18.00-19.00 hours.

There will be variation of traffic for each day. The daily and hourly variation of traffic observed at Km 0+200 is presented graphically in Figure 4.2.

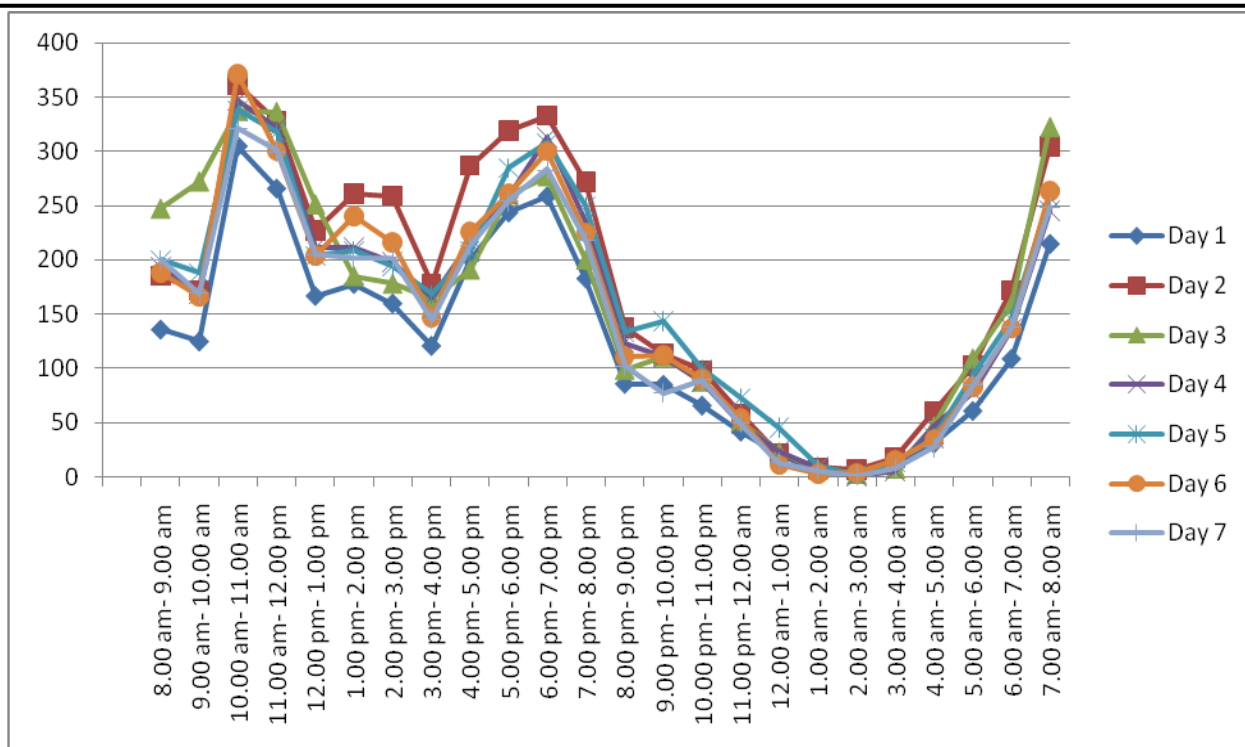


Figure 4.2: Daily and Hourly Variation at Manu Town at Km 0+200

The traffic compositions observed at Manu Town at Km 0+200 is presented graphically in Figure 4.3.

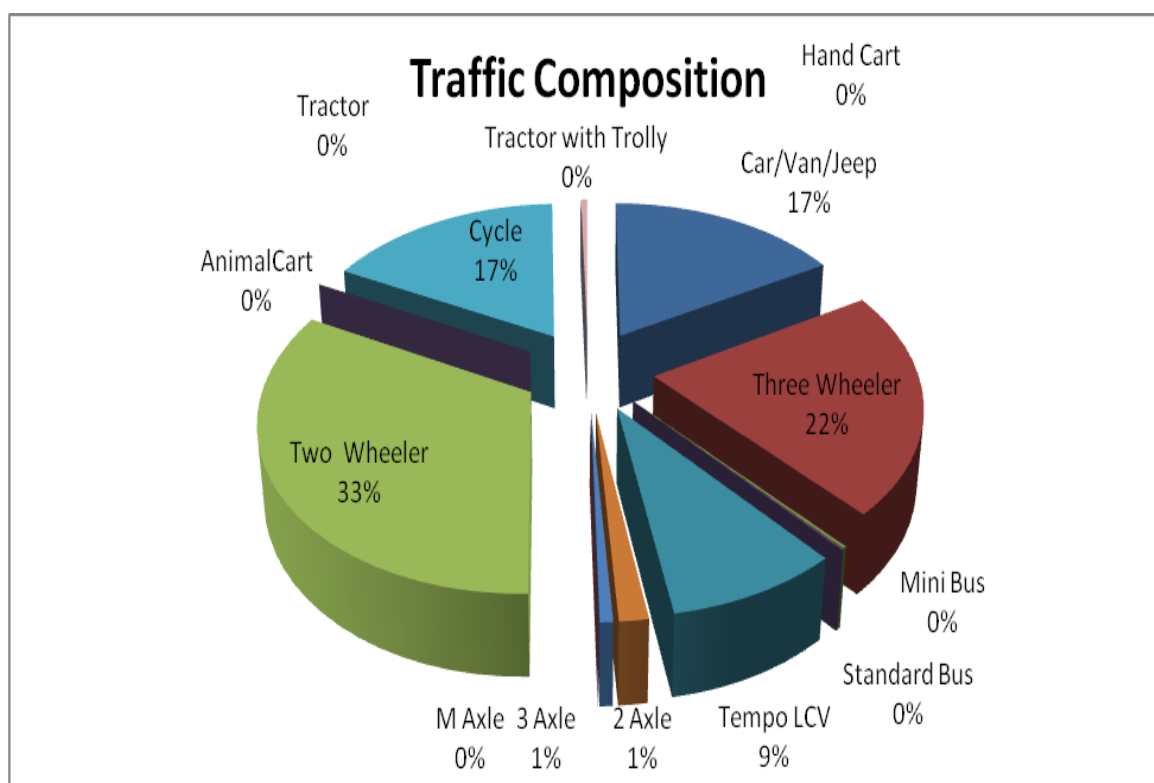


Figure 4.3: Composition of Traffic (By Volume) at Manu Town at Km 0+200

Table 4.6: AVERAGE DAILY TRAFFIC SURVEY OF MANU – CHAILENGTA - LALCHERRA ROAD

(Date:24.07.2016 to 30.07.2016)

Section : Manu – Chailengta - Lalcherra

Direction Bothways

Location: KM-
0+200

	Pessenger Vehicles				Commercial Vehicles				Slow Moving						Total
	Car/Van / Jeep	Three Wheeler	Mini Bus	Stand ard Bus	Tempo LCV	2 Axle	3 Axle	M Axle	Two Wheeler	Animal Cart	Cycle	Tractor with Trolly	Tractor	Hand Cart	
PCU Factor	1.0	1.0	1.5	3.0	1.5	3.0	3.0	4.5	0.5	6.0	0.5	4.5	1.5	3.0	
DAY 1	503	677	2	4	234	37	18	0	1068	0	520	0	0	15	3078
DAY 2	721	913	15	3	403	74	31	0	1359	0	738	0	0	22	4279
DAY 3	639	872	15	4	347	57	23	0	1302	0	652	0	0	15	3926
DAY 4	635	817	4	3	333	59	28	0	1229	0	616	0	0	20	3744
DAY 5	595	799	4	5	377	58	29	0	1308	0	733	0	0	20	3928
DAY 6	685	833	5	4	320	68	21	1	1211	0	599	0	0	15	3762
DAY 7	606	767	6	3	315	40	27	0	1183	0	598	0	0	10	3555
Total Weekly Traffic	4384	5678	51	26	2329	393	177	1	8660	0	4456	0	0	117	26272
ADT	626	811	7	4	333	56	25	0	1237	0	637	0	0	17	3753
PCU	626	811	11	12	500	168	75	0	619	0	319	0	0	51	3192

B. Km.87+080 after Kanchanpur Town

Survey was carried out at km - 87+080 after Kanchanpur Town.

ADT recorded at this station is 3030 nos./2370 PCU. Fast moving vehicles were recorded as 62.2% of the total traffic (in PCU). Peak hour traffic flow of 1684 nos. formed around 7.9% of the total traffic. Peak hour is identified during 18.00-19.00 hours.



Fig 4.4 Classified Volume Count at km - 87+080 after Kanchanpur Town

Table 4.7: AVERAGE DAILY TRAFFIC SURVEY OF Manu – CHAILENGTA - LALCHERRA ROAD

(Date:24.07.2016 to 30.07.2016)

Section : Manu – Chailengta - Lalcherra

Direction : Bothways

Location : KM-87+080 After Kanchanpur Town

	Passenger Vehicles				Commercial Vehicles				Slow Moving						Total
	Car/Van / Jeep	Three Wheeler	Mini Bus	Standard Bus	Tempo LCV	2 Axle	3 Axle	M Axle	Two Wheeler	Animal Cart	Cycle	Tractor with Trolley	Tractor	Hand Cart	
PCU Factor	1.0	1.0	1.5	3.0	1.5	3.0	3.0	4.5	0.5	6.0	0.5	4.5	1.5	3.0	
DAY 1	357	613	6	1	90	19	1	0	1071	0	414	0	0	7	2579
DAY 2	596	733	7	1	129	38	4	0	1525	0	540	0	0	8	3581
DAY 3	409	671	9	1	141	23	1	0	1159	0	500	0	0	9	2923
DAY 4	438	649	5	1	200	16	2	0	1159	0	514	0	0	8	2992
DAY 5	493	600	5	1	381	24	3	0	1167	0	556	0	0	9	3239
DAY 6	378	637	7	1	189	19	1	0	1099	0	483	0	0	9	2823
DAY 7	482	745	4	1	166	14	1	0	1135	0	523	0	0	5	3076
Total weekly traffic	3153	4648	43	7	1296	153	13	0	8315	0	3530	0	0	55	21213
Average Daily Traffic	450	664	6	1	185	22	2	0	1188	0	504	0	0	8	3030
PCU	450	664	9	3	278	66	6	0	594	0	252	0	0	48	2370

There will be variation of traffic for each day. The daily and hourly variation of traffic observed at km - 87+080 after Kanchanpur Town is presented graphically in Figure 4.5.

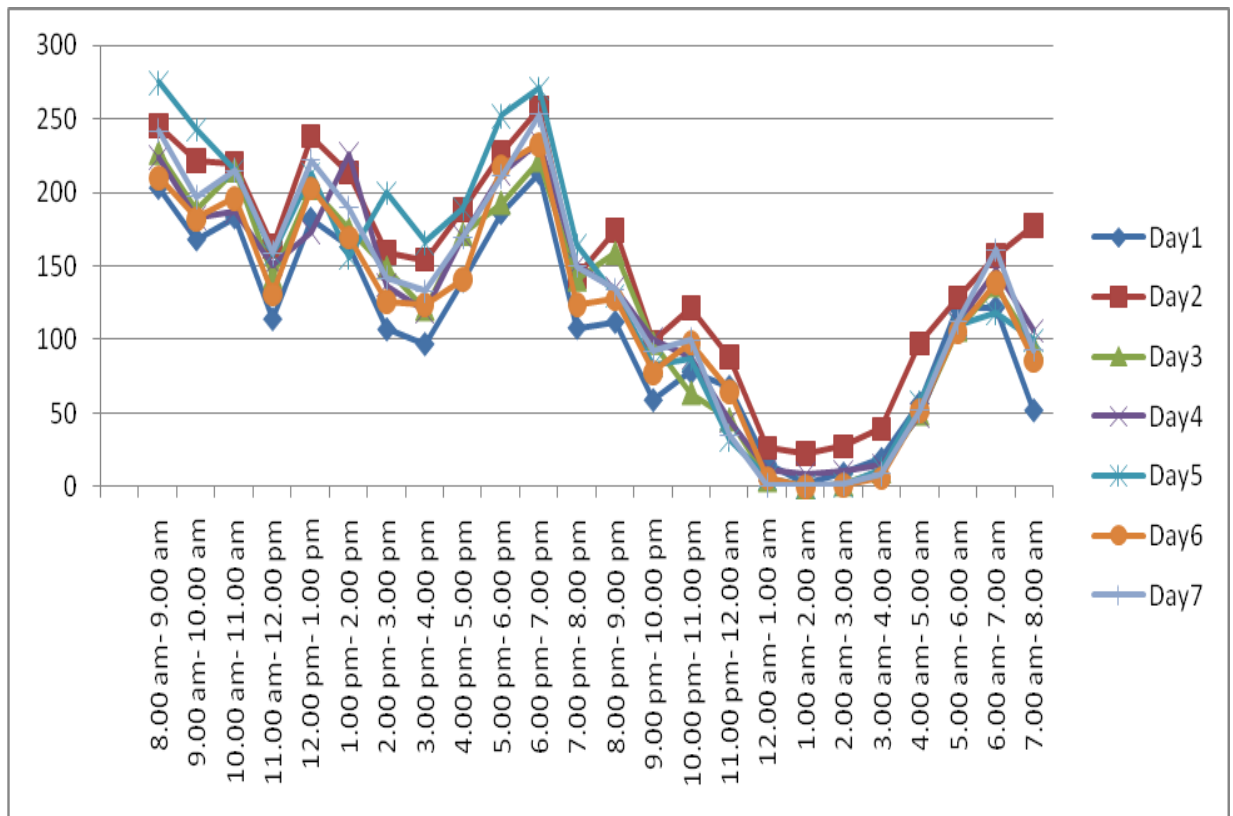


Figure 4.5: Daily and Hourly Variation at km - 87+080 after Kanchanpur Town

The traffic compositions observed at km - 87+080 after Kanchanpur town is presented graphically in Figure 4.6.

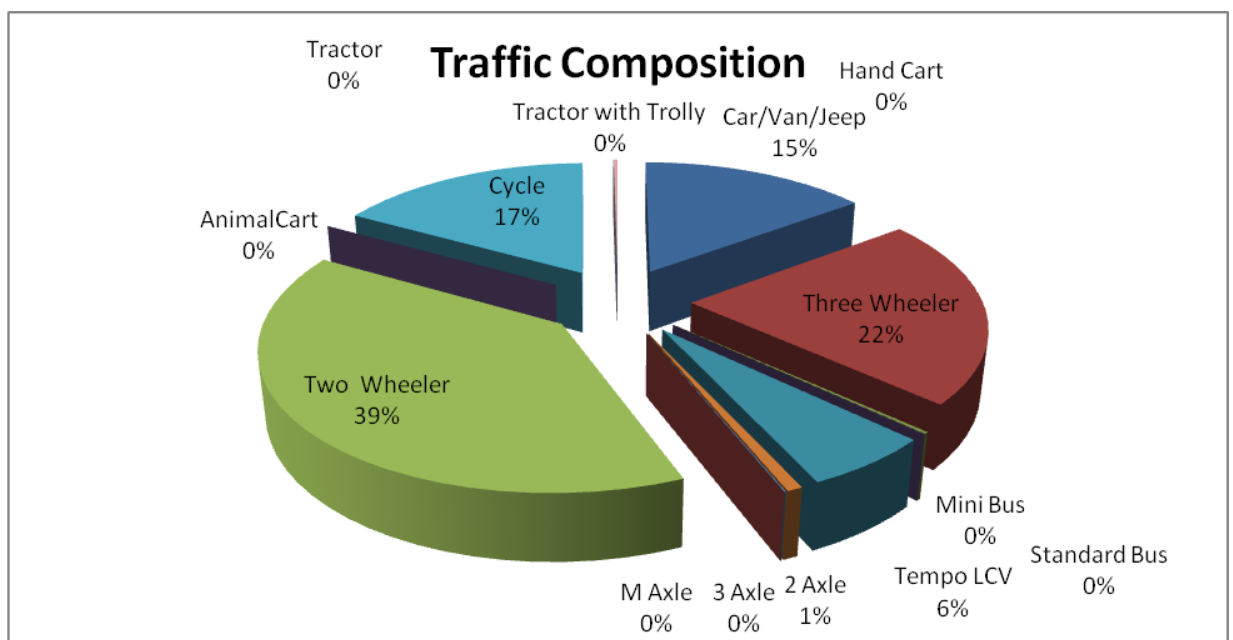


Figure 4.6: Composition of Traffic (By Volume) at km - 87+080 after Kanchanpur Town

Summary of ADT of all two Locations

Categories	PCU Factor	Km 0+200 at Manu Town Location-1		KM-87+080 After Kanchanpur Town		Average Daily	
		ADT		ADT		Traffic	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
Car/Jeep/Van	1.0	626	626	450	450	538	538
3 Wheeler	1.0	811	811	664	664	738	738
Mini Bus	1.5	7	11	6	9	7	11
Standard Bus	3.0	4	12	1	3	3	9
LCV / Tempo	1.5	333	500	185	278	259	389
2-Axle	3.0	56	168	22	66	39	117
3-Axle	3.0	25	75	2	6	14	42
MAV (4-6)	4.5	0	0	0	0	0	0
Two Wheeler	0.5	1237	619	1188	594	1213	607
Animal Cart	6.0	0	0	0	0	0	0
Cycle	0.5	637	319	504	252	517	286
Tractor with trolley	4.5	0	0	0	0	0	0
Tractor	1.5	0	0	0	0	0	0
Hand Cart	6.0	17	51	8	48	13	39
Total Traffic		3753	3192	3030	2370	3395	2776

4.7.2 Peak Hour Factor (PHF)

The hourly variation of traffic illustrates the distribution of traffic over the day with respect to the time, and the peak hour factor is the maximum percentage of the total traffic that uses the project highway in one single hour of the day. It is of significance as highway capacities and design calculations are based on PHF. The peak hour factor observed at the survey location is summarized as shown in Table 4.8.

Table 4.8: Observed Peak Hour Traffic Characteristics

SR. NO.	Survey Location	Peak Hour Volume (PCU)	ADT (PCU)	PHF (%)	Peak Hour
1	Km. 0+200 At Manu Town	2073	3753 (3192)	7.8%	18.00-19.00 hours.
2	Km.87+080 After Kanchanpur Town	1684	3030 (2370)	7.9%	18.00-19.00 hours.

4.7.3 Directional Distribution of Traffic

The directional distribution analysis, as reported in Table 4.9: below, indicates directional distribution at all three survey locations, there is an almost equal distribution in both directions of travel.

Table 4.9: Directional distribution (in PCU) at Survey Location (%)

Survey Location	Direction	Distribution of Total Vehicle
Km. 0+200 At Manu Town	Manu to Kanchanpura	52.96%
	Kanchanpura to Manu	47.03%
Km. 87+080 After Kanchanpura Town	Kanchanpura to Manu	52.15%
	Manu to Kanchanpura	47.84%

4.8 Seasonal Variation of Traffic Volume

Seasonal variation trends were observed based on sale of automobile fuel i.e. MS (Petrol) and HSD (Diesel), and average seasonal factors are worked out to arrive at Annual Average Daily Traffic (AADT). The monthly petrol and diesel sale data was collected from a fuel stations project road and its connecting National Highway (NH-113) for the period 2013 to 2014 (1 year). The data on monthly fuel consumption at both the fuel stations are presented in Table 4.9.

4.9 Average Annual Daily Traffic (AADT)

To derive the AADT from the ADT observed in March to account for seasonality in traffic a seasonal correction factor is used. As regular classified traffic count data is not available to assess seasonal variation in traffic on the Project road. The fuel sales data from the different fuel stations located along the project roadside are collected and used to calculate the seasonal correction factor.

For the present Study, Fuel sales data on the project road was collected and it was considered for analyzing SCF.

The value of SCF considered is 1.2. The annual average daily traffic (AADT) observed by normalizing the average daily traffic (ADT) at the survey location given in Table 4.10.

Table 4.10: Annual Average Daily Traffic (AADT)

Categories	PCU Factor	Km. 0+200 at Manu town Location-1		Km. 87+080 after Kanchanpur town Location-2		Average of all locations	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
Car/Jeep/Van	1.0	751	751	540	540	646	646
3 Wheeler	1.0	973	973	797	797	885	885
Mini Bus	1.5	8	12	7	11	8	12
Standard Bus	3.0	5	15	1	3	3	9
LCV / Tempo	1.5	400	600	22	333	311	467

2-Axle	3.0	67	201	26	78	47	141
3-Axle	3.0	30	90	2	6	16	48
MAV (4-6)	4.5	0	0	0	0	0	0
Two Wheeler	0.5	1484	742	1426	713	1455	728
Animal Cart	6.0	0	0	0	0	0	0
Cycle	0.5	764	382	605	303	685	343
Tractor with trolly	4.5	0	0	0	0	0	0
Tractor	1.5	0	0	0	0	0	0
Hand Cart	6.0	20	60	10	30	15	45
Total Traffic		4502	3826	3636	2814	4071	3324

4.10 Travel Pattern (Origin Destination Survey)

In order to understand the travel demand pattern in the region, origin & destination (O-D) Surveys were carried out at proposed survey locations i.e., at km 0+200 at manu town and km.87+080 after Kanchanpur Town. The Survey were typically started in the morning & continued as per schedule. The O-D Survey elicited characteristics like origin, Destination, Frequency, Purpose & Commodity etc. both for Passenger & Goods Vehicles. The information collected during road side interviews was analyzed to obtain the trip distribution based on a zoning system suitably designed in the study.



4.10.1 Sample Size & Expansion factors

The Vehicles during the O-D surveys were interviewed on a random sample basis. Based on the sample size of different categories of vehicle interviewed during the O-D Survey expansion factors were calculated for generating the expanded form of O-D Matrix. The Following Table 4.11 Shows the Survey Location wise AADT, Sample Size & Expansion Factors for the different homogeneous section Adopted.

Table 4.11 Sample Size Collected in origin Destination Survey

MODE	Car	Mini Bus	Bus	LCV	2 axle	3 axle	MAV	Total
Km- 0+200 (At Manu Town)								
OD Samples	151	2	1	80	14	6	4	258
AADT	751	8	5	400	67	30	19	1280
% age	20	20	20	20	20	20	20	20
Km- 87+080 (After Kanchanpur Town)								
OD Samples	108	2	1	45	6	1	0	163
AADT	540	7	1	222	26	2	0	798
% age	20	20	20	20	20	20	20	20

Based on the sample size of different categories of vehicles interviewed during the O-D Survey, direction wise expansion factors were calculated for the expansion of O-D matrix

generated from the sample data to assess the travel pattern of the vehicle plying on the project road.

4.10.2 Zoning System

To understand the spatial dimensions of the trip characteristics of the vehicles interviewed during the OD survey, a detailed zoning system was developed giving due consideration to the following factors:

- The road network catering to the traffic on the project road and its generating points
- Important towns, village, factories, and industrial centers around the project road.
- Administrative boundaries of districts and states.

Configuration of the project road in the regional road network with respect to other road.

Two major type of area (IIA): Immediate Influence area includes the cities/towns/villages and districts along the project road. In this study is consists of manu, Chailengta and kanchanpur, Vagmun Intermediate areas also include major districts contributing traffic share on the project road like Dhalai and North Tripura.

Board Influence Area (BIA): Board Influence Area included the states of Assam, Manipur, Mizoram, Nagaland, Arunachal Pradesh, Sikkim, Meghalaya and the influence of rest of India is also taken into account.

The zoning system adopted for data collection was based on 13 traffic analysis zones (TAZ).

4.10.3 Regional Distribution

Based on the zoning system devised for this study, the sample data has been expanded using factors based on the total AADT.

The traffic on stretch is analyzed keeping in view the movement of traffic in surrounding road network mainly focusing the traffic generating points like Agartala, Teriyamura, Ambasa, manu and considering various factor such as distance, toll location, terrain etc. So, based on the devised OD matrices, the regional distribution of the toll able vehicles have been worked out of the proposed toll plaza location in Table 4.12, which indicates the traffic generated from the different traffic zones.

Table 4.12: Regional Distribution of traffic (in %) at km 0+200 at Manu Town (O-D)

Region/Modes	Cars	LCV/ Tempo	2- Axle	3- Axle	Bus
Project Road (Manu, Mainama, Chailengta, Ialcherra, Kanchanpur, Manpui, Talakshi, Vagmun, Simlung Village)	29.8	42.9	18.2	12.5	50.0
Agartala	14.0	4.1	9.1	50.0	50.0
Masli	0.0	24.5	0.0	0.0	0.0
Chamanu	14.0	14.3	18.2	0.0	0.0

Kumarghat	24.6	2.0	18.2	0.0	0.0
Udaipur	0.0	0.0	9.1	0.0	0.0
Pechartaal, Panisagar, Dharmanagar,kadamtala	15.8	8.2	27.3	0.0	0.0
Border Areas	0.0	4.1	0.0	12.5	0.0
Ambasa	1.8	0.0	0.0	0.0	0.0
Assam	0.0	0.0	0.0	0.0	0.0
Mizoram	0.0	0.0	0.0	0.0	0.0
Nagaland	0.0	0.0	0.0	0.0	0.0
West bengal	0.0	0.0	0.0	12.5	0.0
Guwahati	0.0	0.0	0.0	12.5	0.0
Total	100.0	100.0	100.0	100.0	100.0

Table 4.13: Regional Distribution of traffic (in %) Km.87+080 after Kanchanpur Town (O-D)

Region/Modes	Cars	LCV/ Tempo	2- Axle	3- Axle	Bus
Project Road (Manu, Mainama, Chalengta, lalcherra, Kanchanpur, Manpui, Talakshi, Vaghmun, Simlung Village)	23.1	43.9	17.6	22.2	25.0
Agartala	19.2	7.0	23.5	44.4	50.0
Jampoi	6.4	21.1	0.0	0.0	0.0
Anand Bazar	10.3	12.3	11.8	0.0	0.0
Kumarghat	17.9	1.8	11.8	0.0	0.0
Udaipur	0.0	0.0	5.9	0.0	0.0
Pechartaal, Panisagar, Dharmanagar,kadamtala	15.4	7.0	17.6	22.2	25.0
Border Areas	0.0	3.5	0.0	11.1	0.0
Ambasa	1.3	0.0	0.0	0.0	0.0
Assam	3.8	3.5	5.9	0.0	0.0
Mizoram	2.6	0.0	0.0	0.0	0.0
Nagaland	0.0	0.0	5.9	0.0	0.0
West bengal	0.0	0.0	0.0	0.0	0.0
Guwahati	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0

4.11 Axle Load Survey

Axle Load Survey was carried out along with O-D Survey at on the Survey Stations, near the 7-day traffic Volume count survey location. The Survey was conducted to assess the cumulative No. equivalent standard axles based on the survey of goods vehicles follows and axle weight distribution and calculate the vehicle damage factor which causes damage to the pavement.



4.11.1 Vehicle damage Factor

The Axle Load Surveys Were conducted at all Prioritized locations, the spectrum of axle loads and the no. of equivalent 8.16T standard axles for the different categories of commercial vehicles have been determined on the basis of the axle load survey .

The equation for computing equivalency factor for single, tandem & tridem axles given below is used as directed in the IRC-37:2012 for converting different axle load repetitions into equivalent standard axle load repetitions.

- Single axle with single wheel on either side $= \{ \text{axle load in KN} / 65 \}^4$
- Single axle with dual wheel on either side $= \{ \text{axle load in KN} / 80 \}^4$
- Tandem axle with single wheel on either side $= \{ \text{axle load in KN} / 148 \}^4$
- Tridem axle with dual wheel on either side $= \{ \text{axle load in KN} / 224 \}^4$

The VDF of the different types of vehicles weighed at the above two locations.

As per IRC: 37-2012 clause 4.4.6 stated" where the sufficient information on axle loads is not available the default values of vehicles of vehicle damage factor as given in table 4.2 may be used".

As per table 4.2 for CVPD more than 1500 adopted VDF should be 2.5 for Hilly terrain.

Hence, The Adopted VDF is 1.5.

4.12 Traffic Demand Assessment

The traffic assessment of the project road is incomplete without assessment of the generated traffic on the corridor. And for a Toll road project it is very important to ascertain all the factors that will contribute to the traffic on the project road after improvement.

- . Diverted Traffic
- . Induced Traffic

Generally the project road will play the vital role in international trading in future. But as on today a very less or negligible traffic move to Mizoram from Manu or Agartala, as the existing road is in poor condition & maximum stretches is Earthen Road.

So, induced traffic can be assumed after construction of road. Further, India is also planning for the Kolkata to Agartala road route via Bangladesh. By this route west Bengal will be connected directly with Tripura. Hence, it will be a large scale Increase in traffic after finalization of this project.

4.13 TRAFFIC ESTIMATION AND FORECAST

4.13.1 General

As the project road is executed on a EPC basis, an estimation of the traffic expected to use the tolled highway and its future growth are important elements assess the project's economics as they are generally the main /sole source of revenue for the project. This chapter details various aspects of the project road traffics and its growth potential.

4.13.2 Project Road Traffic

The traffic that is likely to use the project road was estimated on the basis of the traffic and travel characteristics data gathered through primary as well as secondary surveys. The traffic on the project road would normally consist of the following components

- Normal Traffic
- Diverted Traffic
- Induced/New Generated Traffic

4.13.2.1 Normal Traffic

Normal traffic is the traffic which is playing on the project road, which has been assessed on the Basis on the traffic surveys carried out and described in previous section, and its project growth.

4.13.2.2 Diverted Traffic

Diverted traffic is generally dictated by the presence of the alternative route at a cheaper generalized coast.

4.13.2.3 Induced Traffic

Induced/new generated traffic is the one which would be generated, over and above normal growth, because of lowering of transport costs or new developments in the immediate influence area of the project road.

4.13.3 Traffic Projections

4.13.3.1 Projections of Traffic Normal Traffic @5% growth rate

The traffic projected on normal traffic census is done for the period up to year 2043 based upon 5% growth rates. The total projected traffic at each survey location is shown in Table-4.14 for projections for traffic on project road.

4.13.3.2 Projection of including diverted and induced traffic

The traffic projected on normal traffic census is done for the period up to year 2043 based upon suitable growth rates as considered for normal traffic projections. The total projected traffic at each survey location is shown in Table-4.15 for projections for traffic including diverted traffic on project road.

Table 4.14: Projection of AADT @growth rate 5%

		Growth Rate	Passenger Vehicles				Commercial Vehicles				Slow Moving Vehicles						AADT	PCU
			Car/Van/Jeep	Three Wheeler	Mini Bus	Standard Bus	Tempo LCV	2 Axle	3 Axle	M Axle	Two Wheeler	Animal Cart	Cycle	Tractor with Trolley	Tractor	Hand Cart		
Year			1.0	1.0	1.5	3.0	1.5	3.0	3.0	4.5	0.5	6.0	0.5	4.5	1.5	3.0		
Construction Period	2016		646	885	8	3	311	47	16	0	1455	0	685	0	0	15	4071	3323
	2017	5%	678	929	8	3	327	49	17	0	1528	0	719	0	0	16	4274	3488
	2018	5%	712	975	8	3	343	51	18	0	1604	0	755	0	0	17	4486	3660
	2019	5%	748	1024	8	3	360	54	19	0	1684	0	793	0	0	18	4711	3845
	2020	5%	785	1075	8	3	378	57	20	0	1768	0	833	0	0	19	4946	4037
1	2021	5%	824	1129	8	3	397	60	21	0	1856	0	875	0	0	20	5193	4238
2	2022	5%	865	1185	8	3	417	63	22	0	1949	0	919	0	0	21	5452	4449
3	2023	5%	908	1244	8	3	438	66	23	0	2046	0	965	0	0	22	5723	4669
4	2024	5%	953	1306	8	3	460	69	24	0	2148	0	1013	0	0	23	6007	4899
5	2025	5%	1001	1371	8	3	483	72	25	0	2255	0	1064	0	0	24	6306	5140
6	2026	5%	1051	1440	8	3	507	76	26	0	2368	0	1117	0	0	25	6621	5396
7	2027	5%	1104	1512	8	3	532	80	27	0	2486	0	1173	0	0	26	6951	5664
8	2028	5%	1159	1588	8	3	559	84	28	0	2610	0	1232	0	0	27	7298	5945
9	2029	5%	1217	1667	8	3	587	88	29	0	2741	0	1294	0	0	28	7662	6238

10	2030	5%	1278	1750	8	3	616	92	30	0	2878	0	1359	0	0	29	8043	6545
11	2031	5%	1342	1838	8	3	647	97	32	0	3022	0	1427	0	0	30	8446	6873
12	2032	5%	1409	1930	8	3	679	102	34	0	3173	0	1498	0	0	32	8868	7218
13	2033	5%	1479	2027	8	3	713	107	36	0	3332	0	1573	0	0	34	9312	7580
14	2034	5%	1553	2128	8	3	749	112	38	0	3499	0	1652	0	0	36	9778	7959
15	2035	5%	1631	2234	8	3	786	118	40	0	3674	0	1735	0	0	38	10267	8358
16	2036	5%	1713	2346	8	3	825	124	42	0	3858	0	1822	0	0	40	10781	8776
17	2037	5%	1799	2463	8	3	866	130	44	0	4051	0	1913	0	0	42	11319	9212
18	2038	5%	1889	2586	8	3	909	137	46	0	4254	0	2009	0	0	44	11885	9672
19	2039	5%	1983	2715	8	3	954	144	48	0	4467	0	2109	0	0	46	12477	10152
20	2040	5%	2082	2851	8	3	1002	151	50	0	4690	0	2214	0	0	48	13099	10656
21	2041	5%	2186	2994	8	3	1052	159	53	0	4925	0	2325	0	0	50	13755	11190
22	2042	5%	2295	3144	8	3	1105	167	56	0	5171	0	2441	0	0	53	14443	11752
23	2043	5%	2410	3301	8	3	1160	175	59	0	5430	0	2563	0	0	56	15165	12339
24	2044	5%	2531	3466	8	3	1218	184	62	0	5702	0	2691	0	0	59	15924	12957
25	2045	5%	2658	3639	8	3	1279	193	65	0	5987	0	2826	0	0	62	16720	13603

Table 4.15: Projection of AADT including diverted and induced traffic

Year		Growth Rate	Pessenger Vehicles				Commercial Vehicles				Slow Moving Vehicles						ADT	PCU
			Car/Van/Jeep	Three Wheeler	Mini Bus	Stand ar d Bus	Temp o LCV	2 Axle	3 Axle	M Axle	Two Wheeler	Anim al Cart	Cycle	Tract or with Trolly	Trac tor	Ha nd Car t		
			1.0	1.0	1.5	3.0	1.5	3.0	3.0	4.5	0.5	6.0	0.5	4.5	1.5	3.0		
Construction Period	2016	5%	646	885	8	3	311	47	16	0	1455	0	685	0	0	15	4071	3323
	2017	5%	678	929	8	3	327	49	17	0	1528	0	719	0	0	16	4274	3488
	2018	5%	712	975	8	3	343	51	18	0	1604	0	755	0	0	17	4486	3660
	2019	5%	748	1024	8	3	360	54	19	0	1684	0	793	0	0	18	4711	3845
	2020	5%	785	1075	8	3	378	57	20	0	1768	0	833	0	0	19	4946	4037
1	2021	Assumed by including generated & diverted traffic	1500	1200	25	50	700	500	300	50	3500	0	1100	0	0	30	8955	8953
2	2022	5%	1575	1260	26	53	735	525	315	53	3675	0	1155	0	0	32	9404	9405
3	2023	5%	1654	1323	27	56	772	551	331	56	3859	0	1213	0	0	34	9876	9880
4	2024	5%	1737	1389	28	59	811	579	348	59	4052	0	1274	0	0	36	10372	10379
5	2025	5%	1824	1458	29	62	852	608	365	62	4255	0	1338	0	0	38	10891	10898
6	2026	5%	1915	1531	30	65	895	638	383	65	4468	0	1405	0	0	40	11435	11441

7	2027	5%	2011	1608	32	68	940	670	402	68	4691	0	1475	0	0	42	12007	12012
8	2028	5%	2112	1688	34	71	987	704	422	71	4926	0	1549	0	0	44	12608	12612
9	2029	5%	2218	1772	36	75	1036	739	443	75	5172	0	1626	0	0	46	13238	13244
10	2030	5%	2329	1861	38	79	1088	776	465	79	5431	0	1707	0	0	48	13901	13908
11	2031	5%	2445	1954	40	83	1142	815	488	83	5703	0	1792	0	0	50	14595	14601
12	2032	5%	2567	2052	42	87	1199	856	512	87	5988	0	1882	0	0	53	15325	15331
13	2033	5%	2695	2155	44	91	1259	899	538	91	6287	0	1976	0	0	56	16091	16098
14	2034	5%	2830	2263	46	96	1322	944	565	96	6601	0	2075	0	0	59	16897	16907
15	2035	5%	2972	2376	48	101	1388	991	593	101	6931	0	2179	0	0	62	17742	17753
16	2036	5%	3121	2495	50	106	1457	1041	623	106	7278	0	2288	0	0	65	18630	18642
17	2037	5%	3277	2620	53	111	1530	1093	654	111	7642	0	2402	0	0	68	19561	19571
18	2038	5%	3441	2751	56	117	1607	1148	687	117	8024	0	2522	0	0	71	20541	20555
19	2039	5%	3613	2889	59	123	1687	1205	721	123	8425	0	2648	0	0	75	21568	21583
20	2040	5%	3794	3033	62	129	1771	1265	757	129	8846	0	2780	0	0	79	22645	22660
21	2041	5%	3984	3185	65	135	1860	1328	795	135	9288	0	2919	0	0	83	23777	23791
22	2042	5%	4183	3344	68	142	1953	1394	835	142	9752	0	3065	0	0	87	24965	24980
23	2043	5%	4392	3511	71	149	2051	1464	877	149	10240	0	3218	0	0	91	26213	26229
24	2044	5%	4612	3687	75	156	2154	1537	921	156	10752	0	3379	0	0	96	27525	27540

Chapter-5: Engineering Survey & Investigation

5.1 ROAD INVENTORY AND ROAD CONDITION:

An inventory of the project road has been carried out by visual observations supplemented with sample measurements using tape etc. Kilometer wise features like terrain, land-use, surfacing type and width, shoulder, sub grade, local soil type, curve details, intersectional details, retaining structures details, location of water bodies, height of embankment or depth of cut, ROW, CD structures, road side arboriculture, existing utility services, general drainage conditions etc., were recorded. The road inventory has been referenced to the existing km posts established along the roadside.

The project road starts from Km. 87.000 of NH-44A in Kanchanpur Village, Tripura and The Project road terminates on Km. 110.119 near talakshi village. The length of the homogenous section is 23.119 Km. (as per topographic Survey) & 20.249 (Design Length).

5.2 TERRAIN :

The terrain along the road is majorly hilly with some plain & rolling stretches.

Ex Ch From (Km)	Ex Ch To (Km)	Length(km)	Type (P / R / H)
87.000	88.450	1.45	Plain/Rolling
88.450	110.119	21.30	Hilly
Total		23.119	

5.3 LAND USE:

The land use along the project road is predominantly agricultural & residential. In Some length Forest land is observed by revenue Plans.

Chainage		Land Use	Remark
From (Km)	To (Km)		
87.000	88.000	Built-Up	Kanchanpur
88.000	106.600	Forest	
106.600	106.800	Built-Up	Manpui Village
106.800	107.000	Forest	Manpui Village
107.000	110.119	Forest	

5.4 CARRIAGEWAY WIDTH:

The project road is mainly single lane and Shoulder of about 1.0 m to 1.5m with a total road section is observed. At major junctions for channelization of traffic. Table 5.1 shows width of formation and carriageway.

Table: 5.1 Carriageway width

Start Ch.	End Ch.	Length (in km)	Type	Width (in M)
87.000	87.400	0.400	BT	6.50
87.400	94.000	4.600	BT	7.00
94.000	94.800	0.800	BT	7.50
94.800	95.600	0.800	BT	7.00
95.600	96.000	0.400	BT	7.50
96.000	109.400	11.400	BT	3.75
109.400	110.119	0.350	BT	3.00
Total		23.119 km		

5.5 SURFACING TYPE:

During reconnaissance survey visual condition of the project road reveals that project road is in fair condition for about 53.23% & 46.77% needs improvements (Poor Condition), especially for the reaches traversing through urban areas.

5.6 SHOULDER:

Apparently, the average shoulder of the road is 1.0 m to 1.5 m and the shoulder drop is noticed on the project corridor.

5.7 EMBANKMENT HEIGHT:

The average embankment of the road is 1.0 m to 20.0 m and the shoulder drop is not noticed on the project corridor. However, higher embankment exists at approaches to the bridges and at hilly portion. The condition of the embankment is fair.

5.8 VILLAGES AND TOWNS:

The villages and towns through which the project road passes are listed in Table 5.2.

Table 5.2 List of Villages along to project road

Sr. No.	Village/Town	Village Chainage (in Km.)	
		From	To
1	Kanchanpur Village	87+000	87+800
2	Manpui Village	106+600	106+800

5.9 ROAD JUNCTIONS:

There is no Major Junction but 11 Minor Junctions on the project road. List of all Junctions & Intersection area as follows: -

Table 5.3A: Major Junctions

Sr. No.	Existing Chainage	Category of Road	Type of junction	Remarks
Nil				

Table 5.3B: Minor Junctions

Sr. No.	Existing Chainage	Type of Junction	Remark
1	87+075	T-Type	Uricherra Village
2	87+370	T-Type	School
3	87+425	T-Type	Village Road
4	87+505	T-Type	Village Road
5	88+075	Y-Type	Asst. Director of ARDD office
6	88+235	T-Type	Village Road
7	88+995	T-Type	Village Road
8	104+835	T-Type	Depta Cherra
9	106+400	Y-Type	Sukna Cherra
10	109+650	Y-Type	Tjakshi Village

5.10 TOPOGRAPHIC SURVEYS:

GPS survey is being carried out and GPS control points are established along the alignment, In addition, auto leveling carried out between SOI GTS BMs and GPS control beacons.

The topographic survey includes:

- GPS control points at 5 km intervals which will be auto-leveled from Survey of India (SOI) GTS BM's to GPS control point BM's using auto levels (in accordance with IRC SP19)
- Additional intermittent benchmarks established on permanent structures like Culverts, Km stones, or on permanent structures enroute, etc.
- A total station traverse is being carried out with stations between 250m apart. Field checks will be carried out for mutual bearing, mutual distance and heights.
- The detailed survey is being carried out using a total station instrument with a strip width of 30 m, widened at horizontal curves and ROB locations. All topographical features will be picked up during the survey. Points will be picked up 50 m apart and cross sections taken at same intervals. Where existing roads / railways cross the alignment the surveys will be extended to 100 m either side of the alignment proposed. Culvert location will be surveyed as part of the detailed survey.
- Hard copies of the survey will be made and will be used by senior surveyor and the survey teams to verify the accuracy in the field of the detailed survey.
- The survey will be received in digital format in XYZ format compatible with Mx software together with hard copies.

5.11 CONDITION SURVEY:

Detailed field studies carried out to collect pavement/shoulder/drainage conditions are briefly discussed hereunder and the findings are presented in Annexure.

5.12 PAVEMENT CONDITION SURVEYS:

The survey on general pavement condition was primarily a visual exercise undertaken by means of slow drive-over survey, and supplemented with measurements wherever necessary. Visual assessment was carried out from a vehicle, with speed not exceeding 15 km/hr and stopping at various locations at suitable intervals at 200m and wherever necessary, depending on variations in pavement conditions. At the points of stoppage, simple measurements using measuring tape and straight edge were carried out to quantify pavement deficiency on a representative basis. Aspects of pavement conditions assessed include surface defects, rut depth, cracking, potholes, patched areas, shoulder condition etc. An overall assessment of performance serviceability of the road was also done to qualitatively rate the existing pavement and shoulder condition.

The pavement condition was recorded under the following sub-heads:

- Shoulder-
- Composition / Condition / material Loss
- Riding Quality (Good / Fair / Poor / Very Poor)
- Pavement Condition (surface distress type & extent)
- Cracking (%)
- Raveling (%)
- Potholes (%)
- Patching (%)
- Rut depth (mm)
- Edge break (m)
- Pavement edge Drop (mm)
- Embankment Condition (Good / Fair / Poor)
- Road Side Drain (Non Existing / Partially Functional / Functional)
- Drainage condition

For determining the pavement condition for each km. of road, the yardstick as given in Table 5.4 has been used to designate the pavement condition.

Table 5.4: Yardstick of Pavement Condition

Sl. No.	Condition	Pot holes (%)	Cracking (%)	Patching (%)	Raveling (%)
1	Fair	>5 ≤10	> 10 ≤ 20	> 0.5 ≤ 2.0	> 2.0 ≤ 5.0
2	Poor	>10	>20	>2	>5.0

5.13 SUMMARY OF CONDITION SURVEY RESULTS:

Based on the yardsticks, the overall condition of the pavement has been analysed and it varies between Very Poor to Fair.

Table 5.5 Surface Condition of the Carriageway

From (Km)	To (Km)	Length(km)	Type (BT/ CC/ WBM/ ER)	Width (m)	Condition
87.000	87.400	0.400	BT	6.50	Fair
87.400	94.000	6.600	BT	7.00	Fair
94.000	94.800	0.800	BT	7.50	Fair
94.800	95.600	0.800	BT	7.00	Fair
95.600	96.000	0.400	BT	7.50	Fair
96.000	100.400	4.400	BT	3.75	Fair
100.400	101.000	0.600	BT	3.70	Poor
101.000	102.000	1.000	BT	3.75	Fair
102.000	105.000	3.000	BT	3.75	Poor
105.000	109.400	4.400	BT	3.75	Fair
109.400	110.119	0.719	BT	3.00	Fair

Condition	Length(km)	% of total length
Fair	19.599	84.48%
Poor	3.600	15.52%
Very Poor	0.000	0.00%
Total	23.119 km	100%

5.14 SHOULDER CONDITION:

The project road has 3.75 m Carriageway with 1.0 –1.5m earthen shoulder throughout the project section, which is in poor conditions except at isolated stretches in village portions. Apparently, the average embankment of the road is 1.0 m to 2.0 m and the shoulder drop is not noticed on the project corridor.

5.15 DRAINAGE CONDITION:

The general condition of the roadside drains is not satisfactory. Sufficient camber is not provided to drain off the water from carriageway surface. There are numerous number of CD structures across the project alignment. The existing road has no proper provision of longitudinal drains on both sides. Pucca drains were observed at one location within manu village Kuchha drains (earthen) were not observed in cut sections of hill side. The general condition of the Pucca drains is poor.

5.16 TRIAL PITS:

The investigations were carried out along the existing road using two types of trial pits made as under:

- Large Test Pit-1.0m x 1.0m

- At Large pit locations following tests were conducted:
- Pavement Composition
- Characterisation (grain size and Atterberg limits)
- Laboratory moisture-density characteristics
- Laboratory CBR (un-soaked and 4-day soak compacted at three energy levels) and swell.

5.17 EXISTING PAVEMENT CRUST COMPOSITION

Test pits of approx. 1.5 m x 1.5 m size staggered on both sides of the pavement were excavated initially up to sub grade top at every 1.0 km along the project road. The pits were excavated on shoulders extending about 250mm into the pavement for the following observations:

Type of the pavement layers was visually observed and thickness of each layer was measured on all the three exposed face of the pavement layers to determine average value and recorded. The details of the same are in tabular form. Approx. 40 kg of disturbed soil sample was collected from each test pit for testing index properties of the soil and soaked CBR on re-moulded sample in the laboratory. The crust composition of the existing pavement is summarized as below in Table 5.6.

Table 5.6 Summary of the Existing Pavement Crust Composition

Thickness of Surface Course (mm)	Base Course Thickness (mm)	Sub Base Course Thickness (mm)	Total Thickness (mm)
40-60	100-140 (Brick Soling)	-	200-250

5.18 Sub grade Soil Investigations

Investigations of existing sub grade soil were carried out to assess the adequacy of the existing pavement layers apropos to present sub grade strength so that the strengthening and reconstruction requirement can be established for the design traffic loadings. Objectives of investigations also included evaluation of the characteristics of existing sub grade soil by means of laboratory tests.

The requirements of TOR were met through the following steps:

- The characteristics of the existing soil, two samples from every five km of the Project road or closer where change in soil type is encountered;
- The determination of sub grade CBR (soaked) every three km of the Project road or closer where change in soil type is encountered;
- Benkelman Beam Deflection measurements on the Project road – one set of ten readings in 250m for every three km of the Project road;
- Analysis of field and laboratory test results;
- Providing specific recommendation for existing Pavement; and
- Evaluation of problematic sub soil, if any.

5.18.1 Sub grade Characteristics and Strength

Test pits of size about 1.0 m x 1.0 m were excavated manually at pavement shoulder interface, extending through the pavement layers down to the sub grade level. Sub grade soil sample (about 40 kg) was taken from each pit and sealed properly for detailed laboratory test.

Following test were carried out on the sub grade soil sample in the laboratory.

- | | |
|----------------------------|-----------------------------------|
| • Atterberg's limits | As per IS: 2720, Part- V - 1985 |
| • Grain size analysis | As per IS: 2720, Part- IV- 1985 |
| • MDD (heavy compaction) | As per IS: 2720, Part- VIII- 1983 |
| • Optimum Moisture Content | As per IS: 2720, Part- VIII- 1983 |
| • CBR (4 days soaked) | As per IS: 2720, Part- XVI- 1987 |

5.18.2 Laboratory Test on Subgrade Samples

As Per test results the average CBR is <11. So, the value of adopted CBR is 10%.

5.19 Hydrological and Hydraulic Investigations

Hydrological Data

The hydraulic condition of each structure was assessed thoroughly by visual observations and details are collected from the local offices of PWD, Tripura and BRO department, wherever available to collect the available hydrological data.

For the existing major and minor bridges the Topographic maps obtained from Survey of India has been utilized for the Hydrological Calculations.

Topographic maps, obtained from Survey of India, on 1:50,000 scales, have been utilized for the hydrological study in the corridor, accordingly for entire project Corridor, are prepared and attached as Annexure 5.5 "Abstract of Hydraulic Calculations".

5.18.1 Hydrological Design Methodology

For the calculation of discharge of the stream by the Area-Velocity method, topographical survey including leveling surveys have been carried out across and along the water courses to determine the cross-section and the slope. A number of cross-sections have been taken at regular intervals on both upstream and downstream side of the structure, including one at the proposed location of the structure in accordance with IRC specifications.

The following assumptions have been made during peak discharge calculation:

For locations where water spreads over the banks, the cross-sections were extended up to the HFL, in order to calculate the effective cross-section of flow.

The longitudinal section to determine the bed slope have been taken at an approximate regular interval of 100 m following the channel course extending on both the upstream and the downstream sides of the structure. Caution is taken by following the curved flow line for longitudinal gradient, rather than a straight line.

5.18.1.1 Assessment of Peak Discharge

The peak discharge and the HFL have been calculated by the following methods.

Dickens Method to find discharge from catchment, and Area velocity methods at the bridge site, the upstream and the downstream sections.

Dickens Method

Dickens's Formula is proposed as Empirical formulae in entire road stretch, which is as below.

$$Q = CM (0.75)$$

Where,

Q = the peak run-off in cu.m/sec.

M Is the catchment area in sq.km and

C = 11-14, where the annual rainfall is 60-120 cm;

14-19, in Madhya Pradesh; and

32, in Western Ghats.

Area – Velocity Method (Manning's Formula)

$$Q = A \times V$$

$$= A \times [(1/n) \times (R)^{2/3} \times (S)^{1/2}]$$

Where, Q = the discharge in cumecs ;
A = Area of the cross section in sq. m.;
V = Velocity in m/sec;
R = Hydraulic mean depth in m. = A / P;
P = Wetted perimeter of the stream in m.;
S = Bed slope of the stream; and
n = Rugosity Co-efficient.

The Design Discharge has been taken as the maximum of peak discharges at different cross sections.

5.18.1.2 Hydraulic Analysis for Design HFL

In hydraulic analysis, the Design HFL has been calculated corresponding to the Design Discharge by Manning's Equation at the bridge site, as described above.

5.18.1.3 Afflux Calculation

When the waterway area of the opening of a bridge is less than the unobstructed natural waterway area of the stream, i.e. when bridge contracts the stream, afflux occurs. The afflux will be calculated using Molesworth's formula as given below: -

$$h = \left(\frac{V^2}{17.88} + 0.01524 \right) \{ (A/a)^2 - 1 \}$$

Where, h = Afflux in meters;
V = Average velocity of water in the river prior to construction in m/sec;
A = Unobstructed sectional area of the river at proposed site in sq m; and
a = Constricted area of the river at the bridge in sq m.

5.18.1.4 Scour Depth Calculation

To provide an adequate margin of safety for design of foundation, a further increase by 30% has been made over the design discharge as per IRC: 78-2000, thus obtaining the final design discharge for the design of foundation.

By IRC: 5-1998 / IRC: 78-2000

As per IRC: 5-1998 or IRC: 78-2000, the mean depth of scour below the highest flood level, Dsm, will be given by the following equation:

$$Dsm = 1.34 \times (Db^2 / Ksf)^{1/3}$$

Where, Db = the discharge in cumecs per meter width and Ksf = Silt Factor.

The value of 'Db' shall be the total design discharge divided by the effective linear waterway between abutments.

For most of the bridges, the silt factor, Ksf, has been calculated as per guidelines given in IRC-78: 2000 (Clause 703.2) otherwise it has been assumed as 1.5 due to absence of soil distribution curve.

5.18.1.5 Maximum Depth of Scour for Design of Foundation

The maximum depth of scour below the Highest Flood Level (HFL) for the design of piers (dsmp) and abutments (dsma), having individual foundations without any floor protection are as follows:

In the vicinity of pier: $dsmp = 2 \times Dsm$
In the vicinity of abutment: $dsma = 1.27 \times Dsm$

For the design of floor protection works for rafts or open foundations, the following values of maximum scour depth may be adopted:

In a straight reach: $1.27 \times Dsm$
In a bend: $1.50 \times Dsm$

For the RCC Box type structures proper scour protection is given in the form of floor apron and flexible apron both on the up-stream and downstream sides. No scour will be allowed to occur in the RCC Box type structures.

5.18.1.6 Additional Balancing Culvert on Main Carriage Way

Additional balancing culvert on Main Carriage Way has been provided if it is required for planning of adequate drainage system. Also additional culvert of 1.2m diameter HP (NP-4) for field channel (farm) shall be provided at bypasses to allow the water to pass from one side to other side, if the lands on both side of the road belong to the same owner.

5.18.2 Recommendations / Findings

5.18.2.1 Bridge locations

The detailed hydrological & hydraulic calculations of bridges have been presented in Annexure. The Results has been presented in Table below.

Sl. No.	Desing Chanage(Km)	Existing Chainage (Km)	Type of structures (RCC Box, Pipe, Slab Box, Masonry Arch)	Span Arrangement (No. X Length) (m)	Proposal		
					Recommendation	Type	Span
NIL							

Chapter-06:

Design Standards

6.1 Summary

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

Table 6.1: Draft Design Standards

Sr. No.	Element	Terrain			
		Rural (Non Urban)		Urban Area	Hilly
1	Width of Carriageway (m)	Intermediate Lane : 5.5 2-Lane : 7.0	2-Lane : 7 2-Lane+ Paved Shoulder : 10	2-Lane : 7 2-Lane+ Paved Shoulder : 10	
2	Shoulders (Earthen)	2-Lane : 2.50		2-Lane : Valley Side 1.0	
		2-Lane+Paved Shoulders : 12.0		2-Lane+ Paved Shoulders : Valley Side 1.0	
3	Formation Width (m)	Intermediate Lane : 10.0 2-Lane : 14.0	2-Lane+Paved Shoulder : 13.0 (inclusive 2X1.5m of Drain/Foot path)	Intermediate Lane : 10 2-Lane+ Paved Shoulders : 11	
4	Camber/ Cross Fall	Bituminous : 2.5% Concrete Pavement : 2.5% Earthen Shoulder : 3.5% (min)	Bituminous : 2.5% Concrete Pavement : 2.5%	Bituminous : 2.5% Concrete Pavement : 2.5% Earthen : 3.5% Shoulder : Min	
5	Design Speed (km/h)	<u>Plain Rolling</u> Ruling : 100 Mm: 80	Ruling : 60 Minimum : 40	Ruling : 60 Minimum : 40	

6.2 Geometric Design

6.2.1 General

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

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

6.2.2 Design Speed

The project road passes through plain, rolling and hilly terrain. For geometric design of the highway, design speed is used as an index which links road function, traffic flow and terrain. An appropriate design speed should correspond to general topography and adjacent land use. The speed selected for design should also cater to travel needs and behaviour of the road users. Rural highways, except expressways, are normally designed for speed of 80 km/hr, however depending on terrain and whether the design is for new alignment or reconstruction of an existing facility, the design speed is determined to the site requirement.

The ruling design speed corresponding to the type of terrain as per IRC:SP 37-2012, are as follows:

Table 6.2: Design Speed Standards

Terrain	IRC SP:37:2012
Plain/Rolling	80-100
Mountainous	40-60

Assuming a diverse mix of traffic on the project roads, a ruling design speed of 80-100 km/h for plain, rolling terrain and 40-60 km/h for hilly terrain is proposed to be adopted. Use of speed regulatory sign is proposed at locations such as hairpin bends, urban areas and other sharp curves where design speed cannot be maintained.

6.2.3 Levels of Service (LOS)

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

Table 6.3: Standards for Level of Service

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

Considering the importance of the highway Level of Service (LOS) 'B' is proposed.

6.2.4 Cross Sectional Elements

6.2.4.1 Roadway Width for Multilane Highways

Adequate roadway width will be provided for the requisite number of traffic lanes besides the shoulders and a central median dividing the traffic flow directions. As specified in the IRC 37-2012, in general, for multilane highways, the shoulder width should be 2.5 m and lane width 3.5 m per lane. Based on a comparative review of international standards and safety, the values proposed to be adopted for the roadway elements by the Consultants for the project highway are as follows:

Table 6.4: Road Cross Section

Item	Two-Lane with Earthen Shoulder	Two-Lane with Paved Shoulder	
		Plain/Rolling Terrain	Hilly Terrain
Carriageways	2 X 3.5 m	2 X 3.5 m	2 X 3.5 m
Paved shoulder	N.A.	2 X 1.5m	2 X 1.5
Unpaved shoulder	2 X 2.5 m	2 X 2	1x 1.0m
Plain/ rolling terrain			
Hilly terrain :			
Hill Side	2 X 1.0 m		
Valley Side	2 X 2.0 m		
Total Formation width	12 m	14m	
Plain/rolling terrain	10 m		11m
Hilly terrain			
Total Formation width in Urban Area(inclusive Foot path/Drain)	13 m (Inclusive of 2X1.5m of Footpath/Drain)	14m	11m

As the proposed road is a national highway, total carriageway width of 7.0 m i.e. two lane with 1.5m Paved shoulders & 2.0m earthen shoulders has been proposed with the formation width of 14m in plain/rolling terrain and 7.0m carriageway with 1.5m paved shoulder and 1.0m valley side earthen shoulder has been proposed with the formation width of 11m in hilly terrain.

6.2.4.2 Lane Width

Lane width has a significant influence on the safety and comfort of the road. The capacity of a roadway is markedly affected by the lane width. In general, safety increases with wider lanes up to a width of about 3.5 m. **The lane width as per IRC:SP 37-2012 is 3.5 m.**

6.2.4.3 Shoulders

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

IRC:SP 37-2012 recommends a paved outer shoulder of 1.5 m together with an earthen shoulder of 2.0 m for multilane highways. For mountainous terrain, the recommended earthen shoulder width is 1.0 m valley side.

6.2.4.4 Pavement Camber (Cross-fall)

IRC:SP 37-2012 recommends the following camber for various surface types:

Table 6.5: Provision for Cross-fall

Surface type	Camber
High Type Bituminous Surfacing	1.7% - 2.0 %
Thin Bituminous Surfacing	2.0 % - 2.5 %
Water Bound Macadam, Gravel	2.5 % - 3.0 %
Earth	3.0 % - 4.0 %

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

6.2.4.5 Embankment Slopes

The side slope shall not be steeper than 2H:1V unless soil is retained by suitable soil retaining by structure.

6.2.5 Typical Cross-sections

The proposed cross-section in rural sections consists of two lane with paved shoulder configuration during the service life of the project. Concentric widening is proposed to minimize land acquisition issues and to ensure maximum utilisation of existing carriageway.

6.2.6 Horizontal Alignment

6.2.6.1 General

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

6.2.6.2 Sight Distances

Sight distance is a direct function of the design speed. Safe stopping distances corresponding to various design speeds are given below:

Table 6.6: Sight Stopping Distance Criteria

Design Speed Km/h	IRC SP:73:2015
100	180
80	120
60	90
40	45

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

6.2.6.3 Horizontal Curve

The minimum horizontal curve radius is the limiting value of curvature for a given design speeds and is determined from the maximum rate of super elevation and the side friction factor. As per the IRC: 37 - 2012 the minimum ruling radii of Horizontal curve for National Highways corresponding to different terrain conditions are as follows:

Table 6.7: Horizontal Radii Criteria

Type of Terrain	Minimum Radii of Horizontal Curve	
	Two Lane	
	Ruling Minimum	Absolute Minimum
Plain	400	250
Rolling	400	250
Mountainous	150	75

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

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

Table 6.8: Adopted Horizontal Radii

S. No.	Start Ch	End Ch	Element	Side	Radius	Terrain
1	46597	46868	Straight			P/R
2	46868	46927	Arc	Right	1000	P/R
3	46927	47164	Straight			P/R
4	47164	47279	Arc	Right	200	P/R
5	47279	47281	Straight			P/R
6	47281	47417	Arc	Left	200	P/R
7	47417	47723	Straight			P/R
8	47723	47839	Arc	Left	90	P/R
9	47839	47858	Straight			P/R
10	47858	47925	Arc	Right	155	P/R
11	47925	48011	Straight			Hilly
12	48011	48074	Arc	Right	90	Hilly
13	48074	48150	Straight			Hilly
14	48150	48230	Arc	Right	45	Hilly
15	48230	48231	Straight			Hilly
16	48231	48302	Arc	Left	90	Hilly
17	48302	48303	Straight			Hilly
18	48303	48381	Arc	Right	90	Hilly
19	48381	48401	Straight			Hilly
20	48401	48505	Arc	Left	60	Hilly
21	48505	48641	Straight			Hilly
22	48641	48753	Arc	Right	90	Hilly
23	48753	48806	Straight			Hilly
24	48806	48922	Arc	Left	50	Hilly
25	48922	48951	Straight			Hilly
26	48951	49124	Arc	Right	50	Hilly
27	49124	49125	Straight			Hilly
28	49125	49193	Arc	Left	50	Hilly
29	49193	49224	Straight			Hilly
30	49224	49306	Arc	Left	800	Hilly
31	49306	49333	Straight			Hilly
32	49333	49524	Arc	Left	1000	Hilly
33	49524	49677	Straight			Hilly
34	49677	49845	Arc	Left	75	Hilly
35	49845	49904	Straight			Hilly
36	49904	49960	Arc	Left	600	Hilly
37	49960	49969	Straight			Hilly
38	49969	50005	Arc	Right	75	Hilly
39	50005	50009	Straight			Hilly
40	50009	50067	Arc	Left	75	Hilly

41	50067	50067	Straight			Hilly
42	50067	50164	Arc	Right	60	Hilly
43	50164	50203	Straight			Hilly
44	50203	50301	Arc	Left	90	Hilly
45	50301	50310	Straight			Hilly
46	50310	50393	Arc	Right	90	Hilly
47	50393	50429	Straight			Hilly
48	50429	50483	Arc	Left	75	Hilly
49	50483	50492	Straight			Hilly
50	50492	50537	Arc	Right	75	Hilly
51	50537	50550	Straight			Hilly
52	50550	50635	Arc	Left	75	Hilly
53	50635	50677	Straight			Hilly
54	50677	50767	Arc	Right	155	Hilly
55	50767	50802	Straight			Hilly
56	50802	50993	Arc	Right	60	Hilly
57	50993	51033	Straight			Hilly
58	51033	51117	Arc	Left	45	Hilly
59	51117	51216	Straight			Hilly
60	51216	51312	Arc	Right	90	Hilly
61	51312	51348	Straight			Hilly
62	51348	51452	Arc	Right	250	Hilly
63	51452	51497	Straight			Hilly
64	51497	51643	Arc	Left	45	Hilly
65	51643	51794	Straight			Hilly
66	51794	51900	Arc	Left	155	Hilly
67	51900	51905	Straight			Hilly
68	51905	52043	Arc	Right	90	Hilly
69	52043	52140	Straight			Hilly
70	52140	52234	Arc	Left	60	Hilly
71	52234	52277	Straight			Hilly
72	52277	52471	Arc	Right	60	Hilly
73	52471	52543	Straight			Hilly
74	52543	52698	Arc	Right	1500	Hilly
75	52698	53069	Straight			Hilly
76	53069	53230	Arc	Left	45	Hilly
77	53230	53372	Straight			Hilly
78	53372	53411	Arc	Left	90	Hilly
79	53411	53413	Straight			Hilly
80	53413	53519	Arc	Right	75	Hilly
81	53519	53548	Straight			Hilly
82	53548	53603	Arc	Left	75	Hilly

83	53603	53637	Straight			Hilly
84	53637	53677	Arc	Right	150	Hilly
85	53677	53707	Straight			Hilly
86	53707	53757	Arc	Right	75	Hilly
87	53757	53757	Straight			Hilly
88	53757	53812	Arc	Left	75	Hilly
89	53812	53866	Straight			Hilly
90	53866	54040	Arc	Right	60	Hilly
91	54040	54253	Straight			Hilly
92	54253	54336	Arc	Left	300	Hilly
93	54336	54489	Straight			Hilly
94	54489	54642	Arc	Left	250	Hilly
95	54642	54703	Straight			Hilly
96	54703	54897	Arc	Left	75	Hilly
97	54897	54954	Straight			Hilly
98	54954	55130	Arc	Right	75	Hilly
99	55130	55145	Straight			Hilly
100	55145	55219	Arc	Left	60	Hilly
101	55219	55219	Straight			Hilly
102	55219	55352	Arc	Right	60	Hilly
103	55352	55358	Straight			Hilly
104	55358	55496	Arc	Left	50	Hilly
105	55496	55522	Straight			Hilly
106	55522	55632	Arc	Right	75	Hilly
107	55632	55801	Straight			Hilly
108	55801	55932	Arc	Left	75	Hilly
109	55932	55939	Straight			Hilly
110	55939	56052	Arc	Left	250	Hilly
111	56052	56053	Straight			Hilly
112	56053	56146	Arc	Right	300	Hilly
113	56146	56291	Straight			Hilly
114	56291	56367	Arc	Right	75	Hilly
115	56367	56398	Straight			Hilly
116	56398	56567	Arc	Left	60	Hilly
117	56567	56583	Straight			Hilly
118	56583	56667	Arc	Right	60	Hilly
119	56667	56698	Straight			Hilly
120	56698	56761	Arc	Right	60	Hilly
121	56761	56774	Straight			Hilly
122	56774	56825	Arc	Left	60	Hilly
123	56825	56877	Straight			Hilly
124	56877	56980	Arc	Right	30	Hilly

125	56980	57000	Straight			Hilly
126	57000	57051	Arc	Left	90	Hilly
127	57051	57100	Straight			Hilly
128	57100	57187	Arc	Right	75	Hilly
129	57187	57259	Straight			Hilly
130	57259	57379	Arc	Left	45	Hilly
131	57379	57533	Straight			Hilly
132	57533	57637	Arc	Right	60	Hilly
133	57637	57645	Straight			Hilly
134	57645	57747	Arc	Left	60	Hilly
135	57747	57921	Straight			Hilly
136	57921	58023	Arc	Left	45	Hilly
137	58023	58044	Straight			Hilly
138	58044	58140	Arc	Right	30	Hilly
139	58140	58330	Straight			Hilly
140	58330	58549	Arc	Left	75	Hilly
141	58549	58595	Straight			Hilly
142	58595	58705	Arc	Left	250	Hilly
143	58705	58743	Straight			Hilly
144	58743	58913	Arc	Right	75	Hilly
145	58913	59078	Straight			Hilly
146	59078	59180	Arc	Left	600	Hilly
147	59180	59231	Straight			Hilly
148	59231	59436	Arc	Left	75	Hilly
149	59436	59500	Straight			Hilly
150	59500	59665	Arc	Right	90	Hilly
151	59665	59713	Straight			Hilly
152	59713	59832	Arc	Left	60	Hilly
153	59832	59930	Straight			Hilly
154	59930	60098	Arc	Right	50	Hilly
155	60098	60353	Straight			Hilly
156	60353	60444	Arc	Left	150	Hilly
157	60444	60456	Straight			Hilly
158	60456	60578	Arc	Right	75	Hilly
159	60578	60591	Straight			Hilly
160	60591	60654	Arc	Left	60	Hilly
161	60654	60777	Straight			Hilly
162	60777	60874	Arc	Left	75	Hilly
163	60874	60973	Straight			Hilly
164	60973	60809	Arc	Left	60	Hilly
165	60809	61108	Straight			Hilly
166	61108	61193	Arc	Right	90	Hilly

167	61193	61266	Straight			Hilly
168	61266	61328	Arc	Left	60	Hilly
169	61328	61330	Straight			Hilly
170	61330	61433	Arc	Right	45	Hilly
171	61433	61463	Straight			Hilly
172	61463	61549	Arc	Left	60	Hilly
173	61549	61592	Straight			Hilly
174	61592	61724	Arc	Right	40	Hilly
175	61724	61781	Straight			Hilly
176	61781	61849	Arc	Left	60	Hilly
177	61849	61881	Straight			Hilly
178	61881	61965	Arc	Left	75	Hilly
179	61965	62008	Straight			Hilly
180	62008	62098	Arc	Left	75	Hilly
181	62098	62229	Straight			Hilly
182	62229	62337	Arc	Right	75	Hilly
183	62337	62398	Straight			Hilly
184	62398	62457	Arc	Left	75	Hilly
185	62457	32490	Straight			Hilly
186	32490	62584	Arc	Right	75	Hilly
187	62584	62659	Straight			Hilly
188	62659	62831	Arc	Right	75	Hilly
189	62831	62868	Straight			Hilly
190	62868	63058	Arc	Left	155	Hilly
191	63058	63189	Straight			Hilly
192	63189	63311	Arc	Right	60	Hilly
193	63311	63318	Straight			Hilly
194	63318	63430	Arc	Left	60	Hilly
195	63430	63454	Straight			Hilly
196	63454	63539	Arc	Right	60	Hilly
197	63539	63544	Straight			Hilly
198	63544	63600	Arc	Left	60	Hilly
199	63600	63713	Straight			Hilly
200	63713	63813	Arc	Left	60	Hilly
201	63813	63814	Straight			Hilly
202	63814	63958	Arc	Left	90	Hilly
203	63958	64014	Straight			Hilly
204	64014	64178	Arc	Left	360	Hilly
205	64178	64336	Straight			Hilly
206	64336	64531	Arc	Left	180	Hilly
207	64531	64613	Straight			Hilly
208	64613	64908	Arc	Right	300	Hilly

209	64908	65098	Straight			Hilly
210	65098	65488	Arc	Left	360	Hilly
211	65488	65563	Straight			Hilly
212	65563	65703	Arc	Right	60	Hilly
213	65703	65710	Straight			Hilly
214	65710	65924	Arc	Left	125	Hilly
215	65924	65992	Straight			Hilly
216	65992	66142	Arc	Right	75	Hilly
217	66142	66276	Straight			Hilly
218	66276	66426	Arc	Left	120	Hilly
219	66426	66458	Straight			Hilly
220	66458	66515	Arc	Left	45	Hilly
221	66515	66523	Straight			Hilly
222	66523	66593	Arc	Right	45	Hilly
223	66593	66597	Straight			Hilly
224	66597	66670	Arc	Left	45	Hilly
225	66670	66678	Straight			Hilly
226	66678	66722	Arc	Right	110	Hilly
227	66722	66722	Straight			Hilly
228	66722	66767	Arc	Left	90	Hilly
229	66767	66845	Straight			Hilly

6.2.6.4 Transition (Spiral) Curves

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

It is proposed to adopt transition curve lengths provided above for minimum recommended moves.

6.2.6.5 Super-elevation

The IRC: SP 37-2012 design standards propose a maximum super-elevation rate of 7 % for plain and rolling terrains, and 10% for the mountainous terrain.

The limiting value of the super-elevation on the project road in both plain/rolling and hilly terrain is proposed to be 7%.

6.2.7 Vertical Alignment

6.2.7.1 General

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

6.2.7.2 Gradients

The IRC: SP 37-2012 geometric design standards propose ruling vertical grades of 3.3% to 5.0% for plain and rolling terrains; and 5.0% to 6.0% for hilly terrain.

Table 6.9 : Vertical Gradient

Terrain	Ruling (%)	Limiting (%)
Plain/Rolling	2.5%	3.3%
Hilly	5.0%	6.0%
Steep	6.0%	7.0%

To ensure adequate drainage, roadways typically have a minimum longitudinal grade of 0.5% to 0.6%, depending on the terrain. The minimum longitudinal grades as per IRC: SP 37-2012 design standards are 0.5% for lined side ditches, and 1.0% for unlined side ditches.

6.2.7.3 Vertical Curves

As per IRC: SP 37-2012 design standards, the minimum lengths of vertical curves are 60 m and 50 m for design speeds of 100 km/h and 80 km/h respectively. The length of a vertical curve is calculated using the following equation:

$$L = K \times A,$$

Where

L = Length of vertical curve in metres;

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

A = Algebraic difference of grade lines (%)

Summit or Crest Curves

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

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

As per IRC-SP-23-1993 design Guidelines the Consultant propose minimum summit curve K values of 75, 45, and 25 for design speeds of 100 km/hr, 80 km/hr, 65 km/hr respectively.

Valley or Sag Curves

The minimum K values for valley or sag curves, in accordance with AASHTO (2001) design guidelines are 45, 30 and 13 for design speeds of 100 km/hr, 80 km/hr and 50 km/hr respectively. The minimum K values for valley or sag curves, in accordance with TAC (1999) design guidelines are 37 to 50, 25 to 32 and 7 to 16 for design speeds of 100 km/hr, 80 km/hr, 50 km/hr and 40 km/hr respectively.

As per IRC-SP-23-1993 design Guidelines the Consultant propose minimum valley curve K values of 42, 26 and 15 for design speeds of 100 km/hr, 80 km/hr, 65 km/hr respectively.

6.3 Bridges and Cross Drainage Structures

6.3.1 General

The bridge having total length more than 60 m is termed as major bridge and bridge length between 6 m to 60 m as minor bridge. The culvert is the structure having length less than 6 m between inner faces of dirt wall or extreme vent way boundaries measured at right angles thereto.

6.3.2 Design Standards

6.3.2.1 Bridges and Culvert

For major and minor bridges the minimum overall width between the outermost faces of the bridge shall be equal to 12m comprising of 10.9m carriageway and 0.45m RCC barrier on each side. Width of culverts shall be equal to 12m.

6.3.2.2 Pipe Culvert

The existing pipe culverts that are hydraulically adequate and functional will be widened to full formation width. Pipe culverts having less than 0.90 m dia pipe will be replaced. Based on proposed finish levels if pipe culverts do not have adequate cushion, they shall be encased all round in M15 grade cement concrete with 200 mm thick slab and in M20 grade cement concrete over top of the pipe.

6.3.2.3 Various Codes and Publication to be adopted

The bridges shall be designed as per various IRC codes and special publications wherever required. For conditional cases, if IRC code does not specify anything then relevant BIS code will be followed. The following IRC codes shall be adopted for bridge design.

IRC: 5-1998	General features of design
IRC: 6-2014	Loads and Stresses
IRC: 18-2000	Design criteria for PSC Road Bridges
IRC: 21-2000	Cement concrete plain and reinforced
IRC: 22-2008	Composite Construction
IRC: 40-2002	Brick, stone and block masonry
IRC: 45-2015	Design of well foundation of bridges
IRC: 54-2000	Lateral and Vertical clearances at underpasses
IRC: 78-2000	Foundation and substructure
IRC: 83-1999	(Part I) Metallic Bearings
IRC: 83-1987	(Part II) Elastomeric Bearings
IRC: 83-2002	(Part III) POT PTFE Bearings
IRC: 89-1997	Guidelines for river training and control works
IRC: SP: 13:2004	Guidelines for the design of small bridges and culverts
IS 2911-2010	code of practice for design and construction of pile foundations

6.3.2.4 Design Live Load

The two-lane with paved shoulder carriageway shall be designed with loading combination of Class A, Class 2A, Class 3A and 70R two-lane load or IRC 70 R single lane whichever produces severe effects.

6.3.2.5 Vertical Load

The various components of bridge will be designed for self weight of structure as well as live load with buoyancy effect through pore pressure as well as uplift at base of foundation with appropriate factors depending upon the founding strata.

6.3.2.6 Longitudinal Forces

The bridge will be designed for longitudinal forces on account of tractive and braking action, wind force, seismic force as well as forces due to longitudinal movement of superstructure generated due to creep, shrinkage or temperature. All longitudinal forces will be considered as stipulated in various IRC codes.

6.3.2.7 Seismic Zone

The project road is located in a seismic zone V. It is proposed to design the bridges for seismic forces as mentioned in modified clause 222 of IRC: 6-2000.

6.3.2.8 Condition of Exposure

Since the project road is away from marine environment, a moderate condition of exposure will be adopted.

6.3.2.9 Grade of Concrete

The following minimum grade of concrete will be adopted for major and minor bridges as well as ROB, Flyover and Underpass.

Sr. No.	Type of Concreting	Major Bridge/	Minor Bridge and Culverts
1	Plain Cement Concrete (PCC)	M-20	M-20
2	Reinforced Cement Concrete (RCC)	M-30	M-30

6.4 Miscellaneous

6.4.1 Road Signs

Road signs are proposed to be placed according to IRC: 67:2012. The signs are to be placed on embankment such that extreme edge of sign would be 2.0m away from the edge of the carriageway. The location of each sign is to be decided in accordance with the guidelines therein.

The sheeting shall be provided of Super High Intensity Micro Prismatic sheets Type IX as per ASTM D 4956 for all types of road sign boards as well as Over Head Signs.

6.4.2 Road Markings

Road markings will be made for centre and edge lines using reflective thermoplastic paints. Appropriate road markings will also be provided at junctions and crossings.

6.4.3 Traffic Barriers

Traffic barriers are protective devices that are placed between traffic and a potential hazard off the roadway, with the intention of reducing the severity of a collision when an errant vehicle leaves the travelled portion of the roadway. Barriers are to be provided at high embankments, sharp curves and bridge approaches. The barrier is to be located in unpaved shoulders.

6.4.4 River Training work

River training works will be provided in accordance with IRC 89-1997 and designed as per forces and loads stipulated for respective components as per the site specific requirements.

Chapter-7: SUMMARY OF IMPROVEMENT PROPOSALS

7.1 Introduction

As evident from the above, the first step towards formulating Improvements Options is to collect information on the project road primarily from engineering surveys and secondarily from various agencies concerned. Towards this end detailed information on the past and present traffic, availability of land, condition of CD structures, potential sources of construction material, environmentally sensitive areas and social hot spots has been collected. Also collected is information pertaining to existing settlements.

7.2 Improvement Proposals

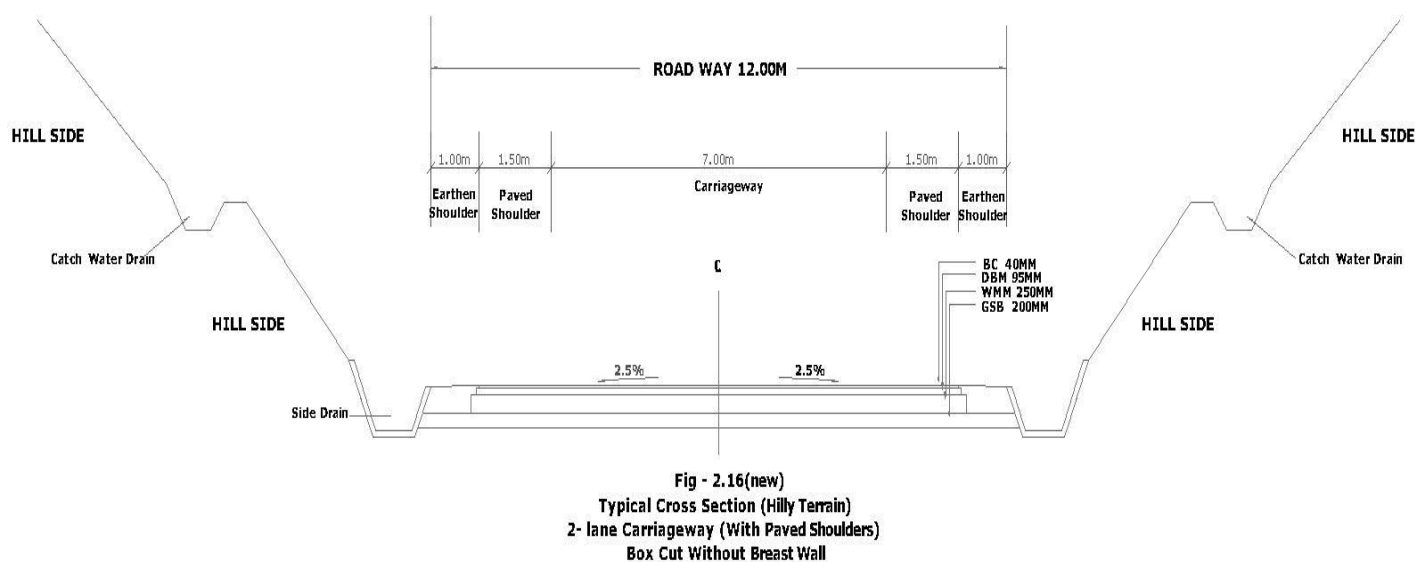
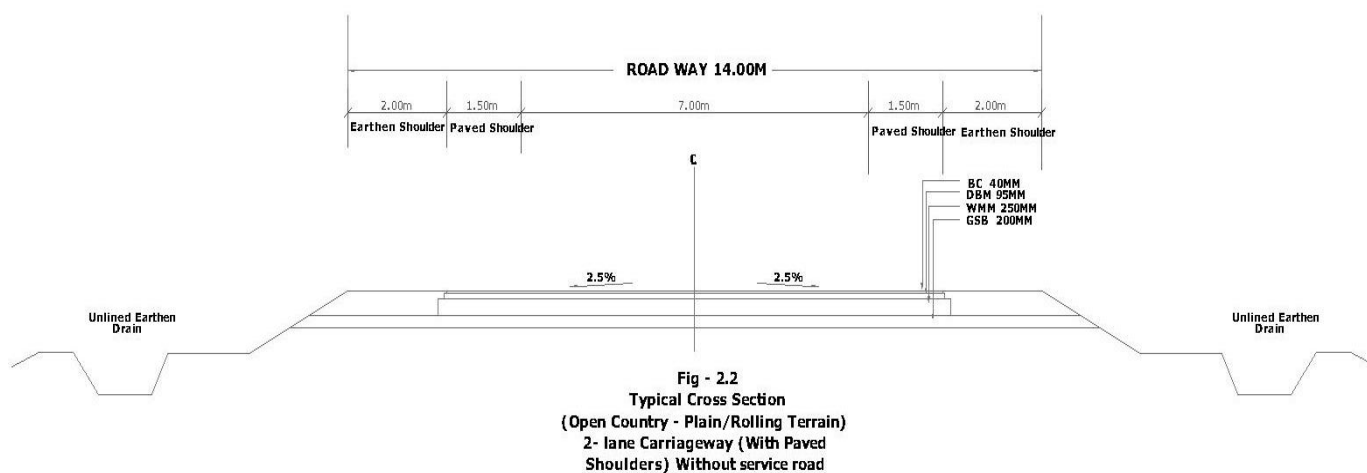
Improvement proposals apropos functional components manifested in appropriate horizontal and vertical alignments, sight distance availability, lateral and vertical, clearances, intersection treatment etc. Aim at improved design speed, road safety and also cover facilities such as proper intersection treatments, bus shelters etc. Improvement proposals apropos structural components on the other hand calls for detailed evaluation of widening options, concentric or eccentric widening of the existing road as dictated by the sight situations like available ROW, existing utilities, terrain, etc., and also existing structural conditions, both for pavement and CD structures.

As evident from the above, the first step towards formulating Improvements Options is to collect information on the project road primarily from engineering surveys and secondarily from various agencies concerned. Towards this end detailed information on the past and present traffic, availability of land, condition of CD structures, potential sources of construction material, environmentally sensitive areas and social hot spots has been collected. Also collected are information pertaining to existing settlements, present configuration of intersections, importance of discrete cross roads, utility lines, locations of bus stops, truck parking etc.

Subsequent to a close observation of all these parameters, frequent site-visits have been undertaken to formulate improvement options that suit requirements of the project.

Development to 2 Lane with Paved shoulder option is planned for the development of project road.

Typical Cross Sections



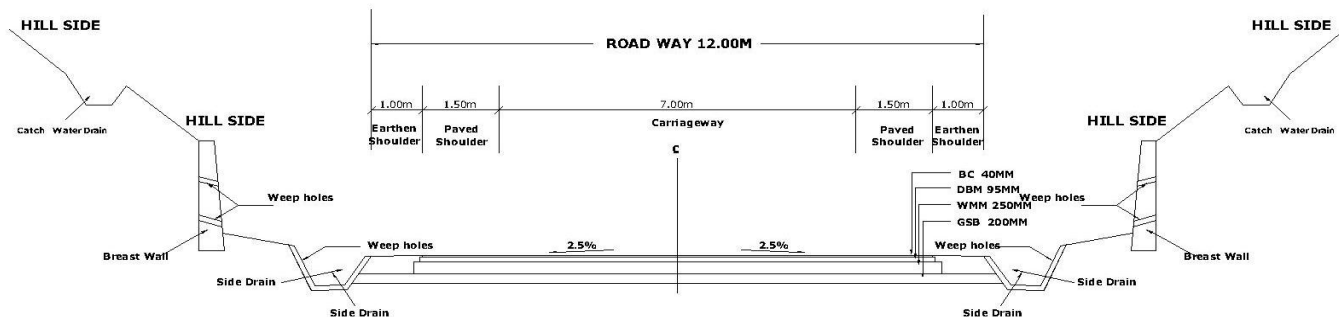


Fig - 2.15(new)
Typical Cross Section (Hilly Terrain)
2- lane Carriageway (With Paved Shoulders) Box Cut
With both side Breast Wall

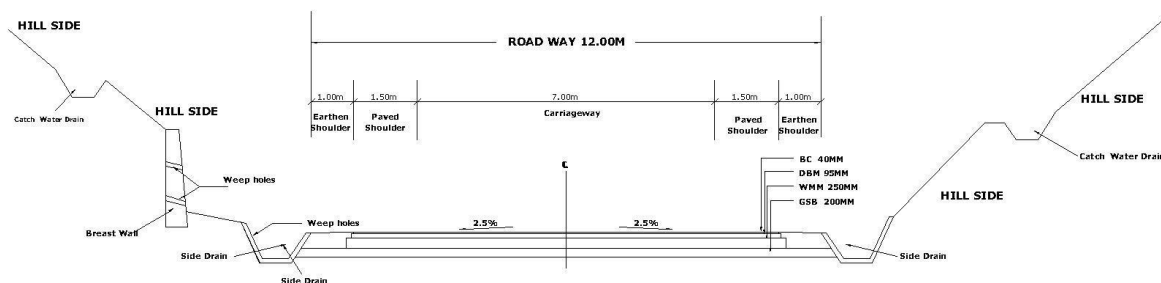
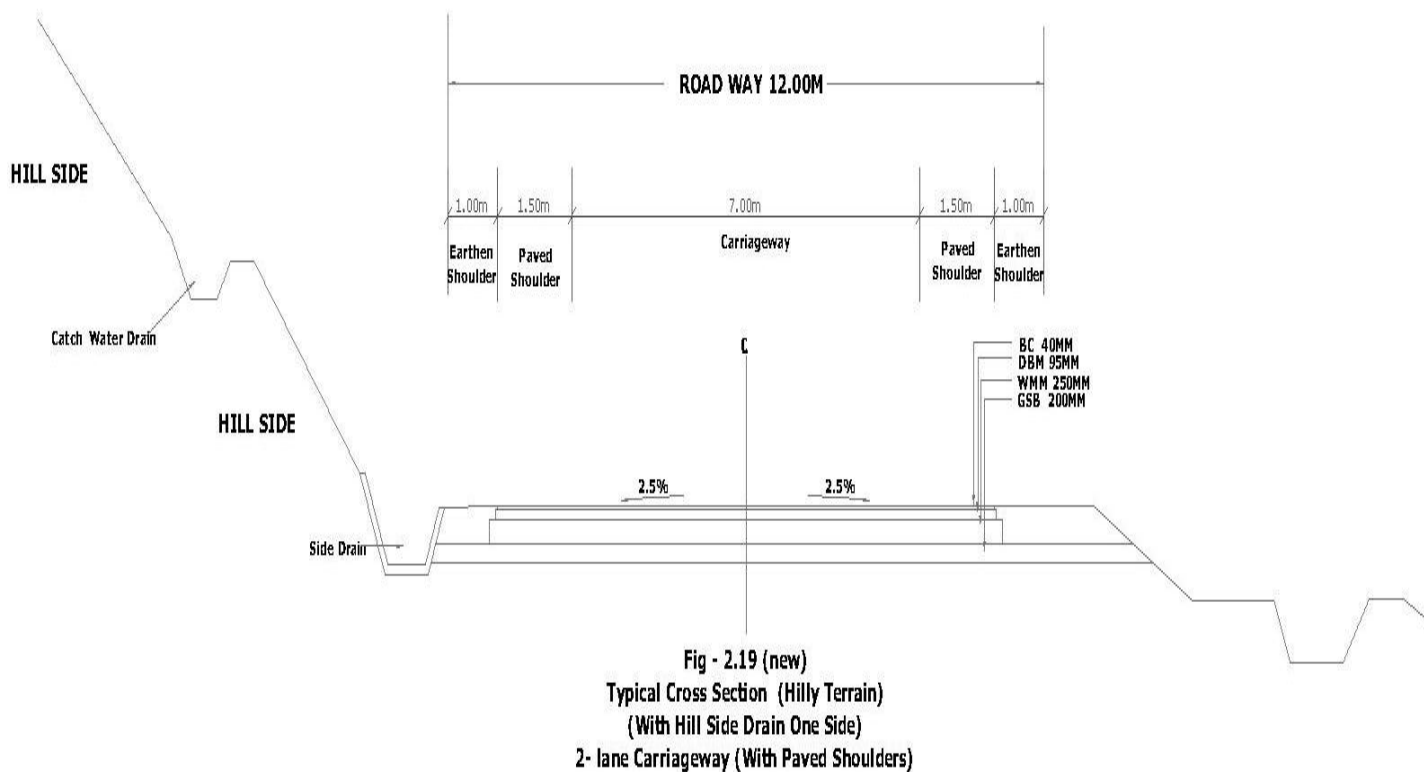
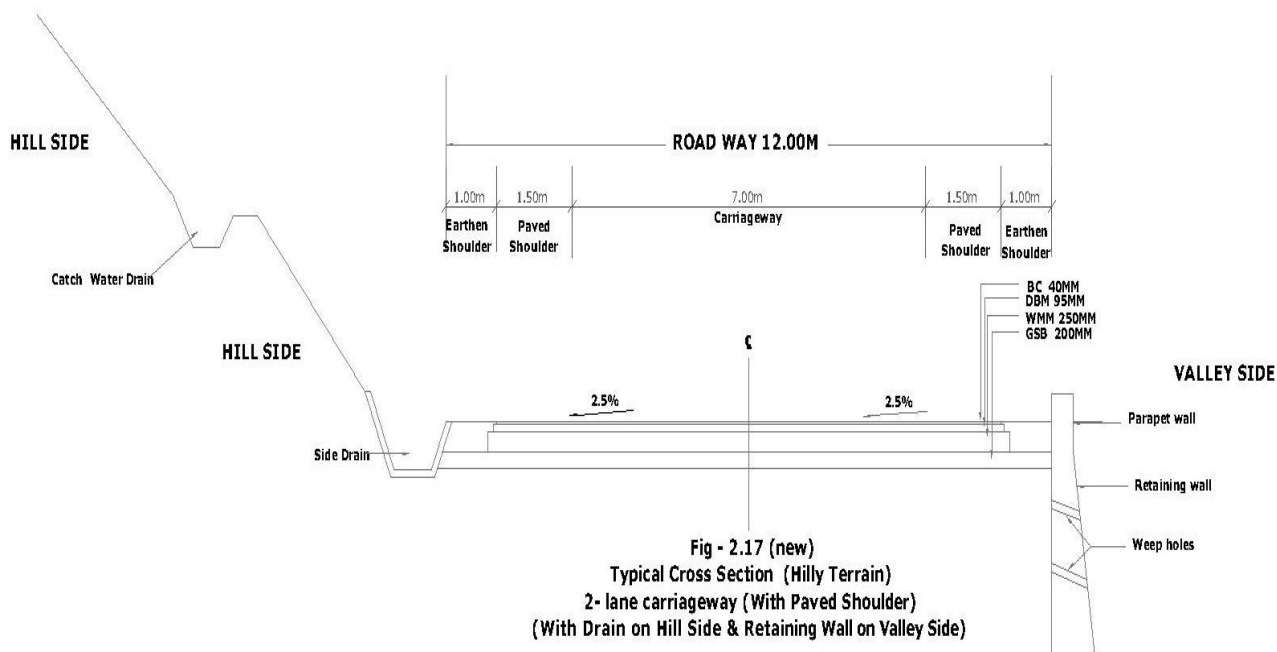


Fig - 2.14(new)
(Hilly Terrain) Typical Cross Section
2- lane Carriageway (With Paved Shoulders) Box Cut
With one side Breast Wall



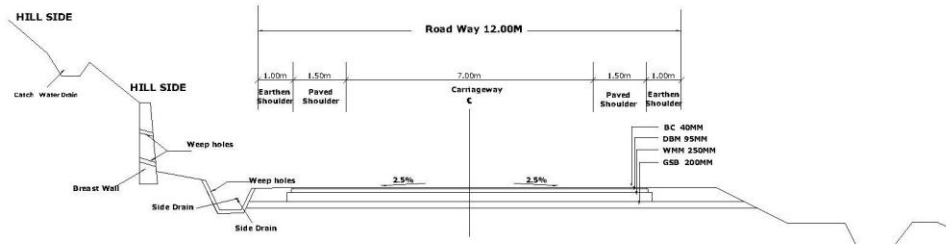


Fig - 2.20 (new)
Typical Cross Section
(With Hill side drain & Breast Wall)
2- lane Carriageway (With Paved Shoulders)

7.3 Details of Retaining wall

Sl. No.	Type of TCS	Location stretch		Length (m) for both side	Total Length (m)
		From (km)	To (km)		
1	TCS 2.17 (New)	48.120	49.220	1 x 1100	1100
2	TCS 2.17 (New)	52.320	52.420	1 x 100	100
Total Length					= 1.200 (km)

7.4 Hill Side Drain

Sr. No.	Type of TCS	Chainage		Length (m) for both	Total Length (m)
		From km	To km		
1.	2.19(New)	47.520	48.120	1x600	600
2.	2.17(New)	48.120	49.220	1x 1100	1100
3.	2.19(New)	49.220	50.320	1x 1100	1100
4.	2.16(New)	50.320	50.420	2x100	200
5.	2.19(New)	50.420	52.320	1x 1900	1900
6.	2.17(New)	52.320	52.420	1x 100	100
7.	2.19(New)	52.420	54.300	1x 1880	1880
8.	2.14(New)	54.300	54.720	2x420	840
9.	2.20(New)	54.720	55.020	1x 300	300
10.	2.14(New)	55.020	55.120	2x100	200
11.	2.20(New)	55.120	55.220	1x 100	100
12.	2.15(New)	55.220	55.320	2x100	200

13.	2.20(New)	55.320	55.520	1x 200	200
14.	2.14(New)	55.520	55.670	2x150	300
15.	2.20(New)	55.670	55.920	1x 250	250
16.	2.14(New)	55.920	57.020	2x1100	2200
17.	2.20(New)	57.020	57.320	1x 300	300
18.	2.14(New)	57.320	57.620	2x300	600
19.	2.20(New)	57.620	57.720	1x 100	100
20.	2.14(New)	57.720	57.970	2x 250	500
21.	2.20(New)	57.970	58.070	1x 100	100
22.	2.14(New)	58.070	58.120	2x 50	100
23.	2.20(New)	58.120	58.220	1x 100	100
24.	2.14(New)	58.220	58.420	2x 200	400
25.	2.20(New)	58.420	58.720	1x 300	300
26.	2.14(New)	58.720	59.270	2x 550	1100
27.	2.20(New)	59.270	59.820	1x 550	550
28.	2.14(New)	59.820	60.270	2x 450	900
29.	2.20(New)	60.270	60.470	1x 200	200
30.	2.14(New)	60.470	60.720	2x 250	500
31.	2.20(New)	60.720	60.870	1x 150	150
32.	2.14(New)	60.870	61.020	2x 150	300
33.	2.20(New)	61.020	61.320	1x 300	300
34.	2.14(New)	61.320	61.420	2x 100	200
35.	2.20(New)	61.420	62.070	1x 650	650
36.	2.14(New)	62.070	62.970	2x 900	1800
37.	2.20(New)	62.970	63.070	1x 100	100
38.	2.14(New)	63.070	63.270	2x200	400
39.	2.19(New)	63.270	63.470	1x 200	200
40.	2.14(New)	63.470	63.570	2x100	200
41.	2.19(New)	63.570	63.670	1x 100	100
42.	2.14(New)	63.670	64.070	2x400	800
43.	2.19(New)	64.070	64.470	1x 400	400
44.	2.14(New)	64.470	64.820	2x350	700
45.	2.19(New)	64.820	65.220	1x 400	400
46.	2.14(New)	65.220	65.420	2x200	400
47.	2.19(New)	65.420	65.570	1x 150	150
48.	2.14(New)	65.570	65.720	2x150	300
49.	2.19(New)	65.720	66.020	1x 300	300
50.	2.14(New)	66.020	66.470	2x450	900

51.	2.19(New)	66.470	66.845	1x 374	375
Total Length					= 26345 m

7.5 Catch water Drain

Sr. No.	Type of TCS	Chainage		Length (m) for both	Total Length (m)
		From km	To km		
1.	2.19(New)	47.520	48.120	1x600	600
2.	2.17(New)	48.120	49.220	1x 1100	1100
3.	2.19(New)	49.220	50.320	1x 1100	1100
4.	2.16(New)	50.320	50.420	2x100	200
5.	2.19(New)	50.420	52.320	1x 1900	1900
6.	2.17(New)	52.320	52.420	1x 100	100
7.	2.19(New)	52.420	54.300	1x 1880	1880
8.	2.14(New)	54.300	54.720	2x420	840
9.	2.20(New)	54.720	55.020	1x 300	300
10.	2.14(New)	55.020	55.120	2x100	200
11.	2.20(New)	55.120	55.220	1x 100	100
12.	2.15(New)	55.220	55.320	2x100	200
13.	2.20(New)	55.320	55.520	1x 200	200
14.	2.14(New)	55.520	55.670	2x150	300
15.	2.20(New)	55.670	55.920	1x 250	250
16.	2.14(New)	55.920	57.020	2x1100	2200
17.	2.20(New)	57.020	57.320	1x 300	300
18.	2.14(New)	57.320	57.620	2x300	600
19.	2.20(New)	57.620	57.720	1x 100	100
20.	2.14(New)	57.720	57.970	2x 250	500
21.	2.20(New)	57.970	58.070	1x 100	100
22.	2.14(New)	58.070	58.120	2x 50	100
23.	2.20(New)	58.120	58.220	1x 100	100
24.	2.14(New)	58.220	58.420	2x 200	400
25.	2.20(New)	58.420	58.720	1x 300	300
26.	2.14(New)	58.720	59.270	2x 550	1100
27.	2.20(New)	59.270	59.820	1x 550	550
28.	2.14(New)	59.820	60.270	2x 450	900
29.	2.20(New)	60.270	60.470	1x 200	200
30.	2.14(New)	60.470	60.720	2x 250	500
31.	2.20(New)	60.720	60.870	1x 150	150
32.	2.14(New)	60.870	61.020	2x 150	300

33.	2.20(New)	61.020	61.320	1x 300	300
34.	2.14(New)	61.320	61.420	2x 100	200
35.	2.20(New)	61.420	62.070	1x 650	650
36.	2.14(New)	62.070	62.970	2x 900	1800
37.	2.20(New)	62.970	63.070	1x 100	100
38.	2.14(New)	63.070	63.270	2x200	400
39.	2.19(New)	63.270	63.470	1x 200	200
40.	2.14(New)	63.470	63.570	2x100	200
41.	2.19(New)	63.570	63.670	1x 100	100
42.	2.14(New)	63.670	64.070	2x400	800
43.	2.19(New)	64.070	64.470	1x 400	400
44.	2.14(New)	64.470	64.820	2x350	700
45.	2.19(New)	64.820	65.220	1x 400	400
46.	2.14(New)	65.220	65.420	2x200	400
47.	2.19(New)	65.420	65.570	1x 150	150
48.	2.14(New)	65.570	65.720	2x150	300
49.	2.19(New)	65.720	66.020	1x 300	300
50.	2.14(New)	66.020	66.470	2x450	900
51.	2.19(New)	66.470	66.845	1x 374	374
Total Length					= 26345 m

7.6 Crash Barrier

Sl. No.	Location stretch from (km) to (km)		Length
1.	47.520	48.120	0.600
2.	48.120	49.220	1.100
3.	49.220	50.320	1.100
4.	50.420	52.320	1.900
5.	52.320	52.420	0.100
6.	52.420	54.300	1.880
7.	54.720	55.020	0.300
8.	55.120	55.220	0.100
9.	55.320	55.520	0.200
10.	55.670	55.920	0.250
11.	57.020	57.320	0.300
12.	57.620	57.720	0.100
13.	57.970	58.070	0.100
14.	58.120	58.220	0.100
15.	58.420	58.720	0.300
16.	59.270	59.820	0.550
17.	60.270	60.470	0.200
18.	60.720	60.870	0.150
19.	61.020	61.320	0.300
20.	61.420	62.070	0.650

21.	62.970	63.070	0.100
22.	63.270	63.470	0.200
23.	63.570	63.670	0.100
24.	64.070	64.470	0.400
25.	64.820	65.220	0.400
26.	65.420	65.570	0.150
27.	65.720	66.020	0.300
28.	66.470	66.845	0.375
Total			= 12.305 (km)

7.1 Breast wall

Sl. No.	Type of TCS	Location stretch		Length (m) for both side	Total Length (m)
		From (km)	To (km)		
1	TCS 2.14 (New)	54.300	54.720	1 x 420	420
2	TCS 2.20 (New)	54.720	55.020	1 x 300	300
3	TCS 2.14 (New)	55.020	55.120	1 x 100	100
4	TCS 2.20 (New)	55.120	55.220	1 x 100	100
5	TCS 2.15 (New)	55.220	55.320	2 x 100	200
6	TCS 2.20 (New)	55.320	55.520	1 x 200	200
7	TCS 2.14 (New)	55.520	55.670	1 x 150	150
8	TCS 2.20 (New)	55.670	55.920	1 x 250	250
9	TCS 2.14 (New)	55.920	57.020	1 x 1100	1100
10	TCS 2.20 (New)	57.020	57.320	1 x 300	300
11	TCS 2.14 (New)	57.320	57.620	1 x 300	300
12	TCS 2.20 (New)	57.620	57.720	1 x 100	100
13	TCS 2.20 (New)	57.720	57.970	1 x 250	250
14	TCS 2.20 (New)	57.970	58.070	1 x 100	100
15	TCS 2.20 (New)	58.070	58.120	1 x 50	50
16	TCS 2.20 (New)	58.120	58.220	1 x 100	100
17	TCS 2.20 (New)	58.220	58.420	1 x 200	200
18	TCS 2.20 (New)	58.420	58.720	1 x 300	300
19	TCS 2.20 (New)	58.720	59.270	1 x 550	550
20	TCS 2.20 (New)	59.270	59.820	1 x 550	550
21	TCS 2.20 (New)	59.820	60.270	1 x 450	450
22	TCS 2.20 (New)	60.270	60.470	1 x 200	200
23	TCS 2.20 (New)	60.470	60.720	1 x 250	250
24	TCS 2.20 (New)	60.720	60.870	1 x 150	150
25	TCS 2.20 (New)	60.870	61.020	1 x 150	150
26	TCS 2.20 (New)	61.020	61.320	1 x 300	300
27	TCS 2.20 (New)	61.320	61.420	1 x 100	100
28	TCS 2.20 (New)	61.420	62.070	1 x 650	650
29	TCS 2.20 (New)	62.070	62.970	1 x 900	900
30	TCS 2.20 (New)	62.970	63.070	1 x 100	100
31	TCS 2.14 (New)	63.070	63.270	1 x 200	200
32	TCS 2.14 (New)	63.470	63.570	1 x 100	100
33	TCS 2.14 (New)	63.670	64.070	1 x 400	400
34	TCS 2.14 (New)	64.470	64.820	1 x 350	350
35	TCS 2.14 (New)	65.220	65.420	1 x 200	200
36	TCS 2.14 (New)	65.570	65.720	1 x 150	150

37	TCS 2.14 (New)	66.020	66.470	1 x 450	450
Total Length					= 10.720 (km)

7.2 Widening Scheme as per Standard:

Table 7.1

Two lane undivided carriageway in plain/rolling area with paved shoulders (Open Area)

Carriageway	=	3.50 m	Either side
Paved Shoulder	=	1.50 m	Either side
Earthen Shoulder	=	2.00 m	Either side
Total Roadway	=	14.00 m	-
Proposed ROW	=	45.00 m	-

Table 7.3

Two lane undivided carriageway in Hilly Terrain with paved shoulders

Carriageway	=	3.50 m	Either side
Paved Shoulder	=	1.50 m	Either side
Earthen Shoulder	=	1.0 m	Either side
Total Roadway	=	12.00 m	-
Proposed ROW	=	24 m-45m	-

7.3 Horizontal Alignment Design

Design of the horizontal alignment has been carried out using highway design software as per widening scheme finalized. Extensive field checks to verify the feasibility of the proposed alignment have been carried out and suitable modifications to the alignment have been done wherever considered essential to safeguard sensitive elements.

7.4 Homogeneous Section

Based on TOR and existing road condition observed at site, the project road has been classified in 1 homogeneous section as shown below:

7.5 Cross Section Details

The overall Cross section details for the project is as given below in table.

Sr. No.	Design Ch.	Design Ch.	Length (km)
	From	To	
1	46.597	66.844	20.247
	Total		20.248 km

Table 7.4 TCS Summary

S.no	Ex. Ch.		Design Ch.		Design Length (km)	TCS as per IRC SP :73-2015
	From	To	From	To		
1	87.000	87.930	46.597	47.520	0.923	2.2
2	87.930	88.620	47.520	48.120	0.600	2.19(New)
3	88.620	89.760	48.120	49.220	1.100	2.17(New)
4	89.760	90.870	49.220	50.320	1.100	2.19(New)

5	90.870	91.000	50.320	50.420	0.100	2.16(New)
6	91.000	92.920	50.420	52.320	1.900	2.19(New)
7	92.920	93.020	52.320	52.420	0.100	2.17(New)
8	93.020	94.890	52.420	54.300	1.880	2.19(New)
9	94.890	95.420	54.300	54.720	0.420	2.14(New)
10	95.420	95.720	54.720	55.020	0.300	2.20(New)
11	95.720	95.920	55.020	55.120	0.100	2.14(New)
12	95.920	96.010	55.120	55.220	0.100	2.20(New)
13	96.010	96.200	55.220	55.320	0.100	2.15(New)
14	96.200	96.380	55.320	55.520	0.200	2.20(New)
15	96.380	96.660	55.520	55.670	0.150	2.14(New)
16	96.660	96.900	55.670	55.920	0.250	2.20(New)
17	96.900	98.550	55.920	57.020	1.100	2.14(New)
18	98.550	98.850	57.020	57.320	0.300	2.20(New)
19	98.850	99.220	57.320	57.620	0.300	2.14(New)
20	99.220	99.300	57.620	57.720	0.100	2.20(New)
21	99.220	99.550	57.720	57.970	0.250	2.14(New)
22	99.300	99.650	57.970	58.070	0.100	2.20(New)
23	99.550	99.770	58.070	58.120	0.050	2.14(New)
24	99.650	99.870	58.120	58.220	0.100	2.20(New)
25	99.770	100.050	58.220	58.420	0.200	2.14(New)
26	99.870	100.370	58.420	58.720	0.300	2.20(New)
27	100.050	101.100	58.720	59.270	0.550	2.14(New)
28	100.370	101.650	59.270	59.820	0.550	2.20(New)
29	101.100	102.220	59.820	60.270	0.450	2.14(New)
30	102.220	102.420	60.270	60.470	0.200	2.20(New)
31	102.420	102.720	60.470	60.720	0.250	2.14(New)
32	102.720	102.880	60.720	60.870	0.150	2.20(New)
33	102.880	103.010	60.870	61.020	0.150	2.14(New)
34	103.010	103.350	61.020	61.320	0.300	2.20(New)
35	103.350	103.520	61.320	61.420	0.100	2.14(New)
36	103.520	104.200	61.420	62.070	0.650	2.20(New)
37	104.200	105.510	62.070	62.970	0.900	2.14(New)
38	105.510	105.600	62.970	63.070	0.100	2.20(New)
39	105.600	105.900	63.070	63.270	0.200	2.14(New)
40	105.900	106.090	63.270	63.470	0.200	2.19(New)
41	106.090	106.250	63.470	63.570	0.100	2.14(New)
42	106.250	106.380	63.570	63.670	0.100	2.19(New)
43	106.380	106.900	63.670	64.070	0.400	2.14(New)
44	106.900	107.300	64.070	64.470	0.400	2.19(New)
45	107.300	107.700	64.470	64.820	0.350	2.14(New)
46	107.700	108.100	64.820	65.220	0.400	2.19(New)
47	108.100	108.300	65.220	65.420	0.200	2.14(New)
48	108.300	108.480	65.420	65.570	0.150	2.19(New)

49	108.480	108.730	65.570	65.720	0.150	2.14(New)
50	108.730	109.020	65.720	66.020	0.300	2.19(New)
51	109.020	109.750	66.020	66.470	0.450	2.14(New)
52	109.750	110.119	66.470	66.845	0.375	2.19(New)
Total Design Length					20.248	

1. Bypass

No Bypasses is proposed.

7.12 Proposed Horizontal Alignment:

The Project road section is an existing bitumen road and has a well-defined formation. The improvements include flattening the sharp horizontal curves conforming to the minimum design of 80 kmph for plain/rolling terrain and 40 to 60 kmph for hilly terrain.

The improvement proposal of the project road has been designed in such a manner so as to utilize the existing road and cross drainage structures to its maximum and have minimum acquisition of structures & land to avoid resettlement impacts and shifting of utilities.

7.13 GPS, TBM & Traverse details:

The fixing of GPS, TBM & Traversing detailing on the Project Road is under process. We will furnish the detail information in later stage.

7.14 Junction Design

At-grade intersections, unless properly designed, can be accident-prone and can reduce the overall capacity of the road. The basic requirements for the design of intersections are not only to cater to safe movements for drivers, but also to provide them complete traffic-related information by way of signs, pavement markings and traffic signals. Simplicity and uniformity should be the guiding principles for intersection design. Based upon these principles the at-grade intersections have been categorized as:

- 1) Minor;
- 2) Channelized with or without acceleration and deceleration lanes;
- 3) Staggered;
- 4) Signalized intersections; and

There are a number of intersections along the project corridor with various categories of roads.

7.15 Major Junctions:

List of Major Junctions along the project corridor is presented in the table below:

Table 7.9: List of Major Junctions

S.no	Existing Chainage	Design Chainage	Category of Road	Type of Junction	Remarks
NIL					

7.16 Minor Junctions:

There are a number of intersections along the project corridor with various categories of roads. There is approx. 8 Nos. of minor junction in our project road. Details are given below.

Table 7.10: List of Minor Junctions

S.No.	Existing Chainage	Design Chainage	Type of Junction	Remark
1	87+075	42.371	T-Type	Uricherra Village
2	87+370	42.666	T-Type	School
3	87+425	42.721	T-Type	Village Road
4	87+505	42.801	T-Type	Village Road
5	88+075	-	Y-Type	Asst. Director of ARDD office
6	88+235	43.441	T-Type	Village Road
7	88+995	44.176	T-Type	Village Road
8	104+835	-	T-Type	Depta Cherra
9	106+400	57.666	Y-Type	Sukna Cherra
10	109+650	60.146	Y-Type	Tlakshi Village

7.17 Bus Shelter:

As per authority 3 bus Shelters in each Habitation will be provided. Hence total Nos. 03 bus shelter provided along the Project Corridor.

7.19 Improvement proposal for Bridges

Existing bridges to be re-constructed

- The existing bridges at the following location shall be re-constructed as new Structures:-

(a) Major Bridges – NIL

S.No.	Existing	Design	Existing				Proposed		
	Chainage	Chainage	Structure	Structural/Hydraulic	Span	Width of	Span	Structure Type	Width of Bridge (m)
			Type	Condition	(m)	bridge (m)			
NIL									

(b) Minor Bridges – 00

S. No.	Desing Chanage(Km)	Existing Chainage (Km)	Type of structures (RCC Box, Pipe, Slab Box, Masonry Arch)	Span Arrangement (No. X Length) (m)	Width of Culvert (m)	Proposal		
					Total (m)	Recommendation	Type	Span
NIL								

7.20 Improvement Proposal of Culverts

General Condition of Culverts

As per the observations made at site for the project stretch, there are two types of culverts found. (i) Slab Culverts (RCC slabs and Stone slabs), (ii) Pipe Culverts. The structural condition of most of the RCC slab culverts, Pipe culverts is generally poor such as in spalled concrete, damaged / missing parapet wall, exposed reinforcement in slab, debris, & vegetation in waterway etc. A summary of all the types of culverts found at site.

Improvement Proposal of Culverts

Reconstruction of existing culverts:

The existing culverts at the following locations shall be re-constructed as new culverts:

(A) Hume Pipe Culverts – 0 nos.

S.No	Existing Chainage	Design Chainage	Existing		Proposed	
			Existing Span Arrangement (m)	Structure Type	Structure	Span/Dia. Of Pipe (m)
NIL						

(B) Slab Culverts – 0 Nos

S.No.	Existing Chainage	Design Chainage	Existing		Proposed	
			Existing Span Arrangement (m)	Structure Type	Structure	Span/Dia. Of Pipe (m)
NIL						

(c) Box Culverts – 30 nos.

Sl. No.	Design Chainage	Existing Chainage	Type of structure s (RCC Box, Pipe, Slab Box, Masonry Arch)	Proposal			
				Recommendation	Type	Span	Overall width of culverts
1	46+830	87+235	RCC SLAB	Reconstruction	BOX	1no. 5x5	14.00
2	46+975	87+380	RCC SLAB	Reconstruction	BOX	1no. 2x3	14.00
3	51+560	92+180	RCC SLAB	Reconstruction	BOX	1no. 2X2	12.00
4	52+370	92+980	RCC SLAB	Reconstruction	Box	1no. 2x2	12.00
5	53+150	93+735	RCC SLAB	Reconstruction	Box	1no. 2X3	12.00
6	55+310	96+195	HPC	Reconstruction	Box	1no. 2x2	12.00
7	55+990	97+000	HPC	Reconstruction	Box	1no. 3x3	12.00

8	56+170	97+110	HPC	Reconstruction	Box	1no. 2x2	12.00
9	56+190	97+330	HPC	Reconstruction	Box	1no. 2x2	12.00
10	56+290	97+485	HPC	Reconstruction	Box	1no. 2x2	12.00
11	56+440	97+705	RCC SLAB	Reconstruction	Box	1no. 3x3	12.00
12	57+310	98+840	HPC	Reconstruction	Box	1no. 2X2	12.00
13	57+960	99+550	HPC	Reconstruction	Box	1no. 2X2	12.00
14	58+420	100+060	HPC	Reconstruction	BOX	1no. 2x2	12.00
15	58+490	100+135	FCW	Reconstruction	BOX	2no. 3X3	12.00
16	59+290	101+090	HPC	Reconstruction	BOX	1no. 2X2	12.00
17	60+730	102+735	HPC	Reconstruction	BOX	1no. 2X2	12.00
18	60+890	102+870	RCC SLAB	Reconstruction	BOX	1no. 3X3	12.00
19	61+030	103+030	HPC	Reconstruction	BOX	1no. 2X2	12.00
20	62+090	104+240	HPC	Reconstruction	BOX	1no. 2X2	12.00
21	62+310	104+525	HPC	Reconstruction	BOX	1no. 2X2	12.00
22	62+490	104+890	HPC	Reconstruction	BOX	1no. 5X5	12.00
23	62+590	104+945	HPC	Reconstruction	BOX	1no. 2X2	12.00
24	63+090	105+620	HPC	Reconstruction	BOX	1no. 2X2	12.00
25	63+190	105+850	HPC	Reconstruction	BOX	1no. 2X2	12.00
26	63+390	106+000	HPC	Reconstruction	BOX	1no. 2X2	12.00
27	63+450	106+075	HPC	Reconstruction	BOX	1no. 2X2	12.00
28	65+770	108+800	HPC	Reconstruction	BOX	1no. 2X2	12.00
29	66+090	109+380	HPC	Reconstruction	BOX	1no. 2x2	12.00
30	66+270	109+535	HPC	Reconstruction	BOX	1no. 2x2	12.00

Widening of existing culverts:

The existing culverts at the following locations shall be widened:

(A) Hume Pipe Culverts – 0 nos.

S.No	Existing Chainage	Design Chainage	Existing		Structure Type	Proposed		
			Existing Span Arrangement	Width (m)		Structure	Width (m)	Span/Dia. Of Pipe (m)

			ent (m)					
NIL								

(B) Slab Culverts – 0 Nos

S.No.	Existing Chainage	Design Chainage	Existing			Proposed		
			Existing Span Arrangement (m)	Width (m)	Structure Type	Structure	Width (m)	Span/Dia. Of Pipe (m)
NIL								

Retain & Repair of existing culverts:

The existing culverts at the following locations shall be retained with minor repair:

(A) Hume Pipe Culverts – 0 nos.

S.No	Existing Chainage	Design Chainage	Existing	
			Existing Span Arrangement (m)	Width (m)
NIL				

(B) Slab Culverts – 0 Nos

S.No.	Existing Chainage	Design Chainage	Existing		
			Existing Span Arrangement (m)	Width (m)	Structure Type
NIL					

Additional new culverts:-

Additional new culverts shall be constructed as per particulars given in the table below:

(A) Hume Pipe Culvert – 0 Nos.

S.No.	Location (Design Chainage)	Dia. Of Pipe/Span Length (m)	Width of Culvert (m)
NIL			

(B) Box Culvert –41 Nos.

Sl. No.	Design Chainage	Proposal			
		Recommendation	Type	Span	Width of
1.	47+570	New Construction	Box	1no. 2x2	14
2.	48+000	New Construction	Box	1no. 2x2	12
3.	48+250	New Construction	Box	1no. 2x2	12
4.	48+400	New Construction	Box	1no. 2x2	12
5.	48+690	New Construction	Box	1no. 2x2	12
6.	49+700	New Construction	Box	1no. 2x2	12

7.	49+900	New Construction	Box	1no. 2x2	12
8.	50+200	New Construction	Box	1no. 2x2	12
9.	50+445	New Construction	Box	1no. 2x2	12
10.	50+700	New Construction	Box	1no. 2x2	12
11.	51+100	New Construction	Box	1no. 2x2	12
12.	51+400	New Construction	Box	1no. 2x2	12
13.	51+800	New Construction	Box	1no. 2x2	12
14.	52+100	New Construction	Box	1no. 2x2	12
15.	52+600	New Construction	Box	1no. 2x2	12
16.	52+860	New Construction	Box	1no. 2x2	12
17.	53+600	New Construction	Box	1no. 2x2	12
18.	53+800	New Construction	Box	1no. 2x2	12
19.	54+400	New Construction	Box	1no. 2x2	12
20.	54+540	New Construction	Box	1no. 2x2	12
21.	54+710	New Construction	Box	1no. 2x2	12
22.	54+840	New Construction	Box	1no. 2x2	12
23.	55+850	New Construction	Box	1no. 2x2	12
24.	56+800	New Construction	Box	1no. 2x2	12
25.	57+100	New Construction	Box	1no. 2x2	12
26.	57+500	New Construction	Box	1no. 2x2	12
27.	57+690	New Construction	Box	1no. 2x2	12
28.	58+750	New Construction	Box	1no. 2x2	12
29.	59+130	New Construction	Box	1no. 2x2	12
30.	59+770	New Construction	Box	1no. 2x2	12
31.	61+310	New Construction	Box	1no. 2x2	12
32.	61+910	New Construction	Box	1no. 2x2	12
33.	62+430	New Construction	Box	1no. 2x2	12
34.	62+570	New Construction	Box	1no. 2x2	12
35.	62+810	New Construction	Box	1no. 2x2	12
36.	63+170	New Construction	Box	1no. 2x2	12
37.	64+190	New Construction	Box	1no. 2x2	12
38.	64+650	New Construction	Box	1no. 2x2	12
39.	65+000	New Construction	Box	1no. 2x2	12

40.	65+450	New Construction	Box	1no. 2x2	12
41.	66+530	New Construction	Box	1no. 2x2	12

Table 7.12: Summary of Culvert Proposal

Reconstruction with Box	30
New construction Box Culverts	41

Chapter-8: SUMMARY OF EIA & SIA

8.1 INITIAL ENVIRONMENTAL EXAMINATION

8.1.1 GENERAL

The Initial Environmental Examination (IEE) is carried out to assess the potential environmental impacts likely to be triggered by the project road. The project road will be upgrading, without any land acquisition and displacement of people. The project road belongs to **Category B** projects as per ADB's Environmental Assessment Guidelines (2003) and requires an IEE to be carried out. IEE report will be prepared based on the IEE format of ADB with due consideration to environmental legislation e.g. Environment (Protection) Rules, 1986 of Government of India (GoI).

The project, up-gradation of Kanchanpur - Vagmun Section is located in North Tripura District of Tripura. Total design length of the project is 20.248 km.

The objective of IEE is as following:

- to provide information about the general environmental settings around the sub project area as baseline data;
- to provide information on potential impacts of the project and characteristic of impacts, magnitude, distribution, and their duration;
- to provide information on potential mitigation measures to minimize the impact;
- to provide information on Environmental Management Plan (EMP)
- The field visits were made to collect the requisite information from various government departments and from other secondary sources (including limited public consultation in the form of focused group discussions).

In the IEE, activities proposed to be undertaken as part of this project will be considered and the potential impacts will be analyzed.

8.1.2 DESCRIPTION OF THE PROJECT

The road generally traverses through hilly terrain except at some portion of the road passing through Plain/Rolling terrain. The Project Road starts from Kanchanpur town and terminated at Km. 110.119 near talakshi village.

The proposed project road at present has two/intermediate/single lane carriageway. The road will be widened for two lane with paved shoulder. It is planned to upgrade the

existing road with provisions for side drains, bridges, culverts, retaining walls etc. The project road will be implemented within the existing ROW (If possible).

The terrain is flat with very minor changes in elevation, and the landscape is open and forest cover as per REA Checklist below. The only noticeable changes from the flat terrain occur in the few places where the road briefly descends through ravines carved out by streams, and then climbs back to the level plain. Agriculture is the predominant land use and wheat crop is mainly cultivated on roadside. Settlements are sparse; the road runs largely through open fields. Numerous hand pumps are placed alongside the roadway for obtaining drinking.

8.1.3 ASIAN DEVELOPMENT BANK REQUIREMENTS

The ADB classifies projects such as SRED into one of three categories based on a screening of their expected environmental impacts:

- **Category A.** Category A projects are defined by the ADB as "Projects expected to have significant adverse environmental impacts. An environmental impact statement (EIA) (as defined by the ADB regulations) is required to address significant impacts."
- **Category B.** Category B projects are defined as "Projects judged to have some adverse environmental impacts, but of a lesser degree and/or significance than those for Category A projects. An initial environmental examination (IEE) is required to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report."
- **Category C.** Category C projects are defined as "Projects unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are still reviewed."

8.1.4 GOVERNMENT OF INDIA REQUIREMENTS

The following is provided for informational purposes. The IEE in hand has not been prepared to meet, and **does not purpose to meet**, GOI requirements that may ultimately be determined to be applicable to certain SRED activities. As of this writing, it is not anticipated that any GOI EIAs will be required. Careful planning of those activities that of necessity occur outside the existing ROW (for example: placement of labor camps, extraction of fill from borrow areas, placement of temporary approaches to river crossings during bridge replacement), combined with proper contracting and procurement measures, should keep all SRED activities below the threshold that would trigger the need for an EIA.

- **Central Government Requirements.**

- Primary responsibility for administration and implementation of the GOI policy with respect to conservation, ecologically sustainable development and pollution control rests with the Ministry of Environment and Forest (MOEF) and the regulations established pursuant to the National Conservation Strategy; National Forest Policy; the Policy for Abatement of Pollution (1992); and the Indian Environmental Protection Act 1986 (29 of 1986), revised in 1997.
- Guidance for the preparation of environmental impact assessments (EIAs) within this overall framework for environmental clearance of new development proposals is provided by the GOI's *Handbook of Environmental Procedures and Guidelines* (1994).
- Additional guidelines for road projects are provided by the Ministry of Road Transport and Highways (MORTH) in its publication entitled *Environmental Guidelines for Rail/Road and Highway Projects*. The Guidelines include the summary questionnaire to be submitted to MOEF for the preparation of EIAs for domestic road projects requiring an EIA as noted above.
- MOEF Circular No. 21012/26-99-1a-111 dated 15 October 1997 exempts linear projects with ROWs of less than 20 metres (including the existing ROW and land acquisition as may be required by the project) from most review processes. Projects entirely contained within the existing ROW are considered as maintenance, which is generally not subject to MOEF review.
- Thus, road projects limited to actions such as those proposed by SRED are generally exempted from GOI/EIA requirements. The Project will not include construction of any new high level bridges and thus will not require significant changes to the existing road alignment or grade level.

- **State Forest Department Requirements**

- Removal of trees along the ROW: Trees will have to be removed within the existing ROW in some places to allow for widening of the carriageway, construction of shoulders, or to meet current road safety standards. It should be noted that trees within the ROW are considered to be within the purview of the State Forest Department. Therefore, an application will be required pursuant to MOEF letter Ref no. 4-1/97-FC, dated 18 February 1998, which provides revised guidelines for applicability of the Forest Conservation Act (1980) to linear infrastructure projects such as rail and road projects. Clearance by the State Forest Department is assumed to have been granted unless there is an indication to the contrary within 30 days.

- Impacts to Reserved Forests: In the event of potential impacts to Reserved Forests, a Notice of Compliance (NOC) is required from the State Forest Department. In the event that a submission to MOEF is required, the NOC must be obtained prior to action by MOEF.

- **State level Environment Impact assessment Authority.**

- A State level Environment Impact assessment Authority hereinafter referred to as the SEIAA shall be constituted by the Central Government under sub-section (3) of section 3 of the Environment (Protection) Act, 1986 comprising of three members including a Chairman and a Member – Secretary to be nominated by the State Government or the Union territory administration concerned.

All projects and activities are broadly categorized in to two categories – Category A and Category B, based on the spatial extent of potential impacts and potential impacts on human health and man made resources:

- (i) All projects or activities included as Category 'A' in the Schedule, including expansion and modernization of existing projects or activities and change in product mix, shall require prior environmental clearance from the Central Government in the Ministry of Environment and Forests (MoEF) on the recommendations of an Expert Appraisal Committee (EAC to be constituted by the Central Government for the purposes of this notification.
- (ii) All projects or activities included as Category 'B' in the Schedule, including expansion and modernization of existing projects or activities as specified will require prior environmental clearance from the State/Union territory Environment Impact assessment Authority (SEIAA).

- **State Pollution Control Board Requirements (SPCB).**

- Certain actions to be included in SRED (e.g. the locations and operations of asphalt plants) will require submission of an application to the SPCB pursuant to the Water (Prevention and Control of Pollution) Act of 1974, Cess Act of 1977, and Air (Prevention and Control of Pollution) Act of 1981.
- The SPCB generally establishes a review panel and circulates the application for public review and comment in each affected district. At least one public hearing is held in each affected district following not less than 30 days notice in local and regional newspapers.
- A state-level hearing is also required, taking all comments received from the districts into account. Assuming acceptability, the SPCB issues a NOC.

- o The SPCB's NOC, as well as the Forest Department's NOC, is required before MOEF action on any required EIA can be considered complete.

8.1.5 DESCRIPTION OF THE ENVIRONMENT

Data and information required for preparation of the IEE report have been collected from various government departments, secondary sources and through actual field visits. Environmental conditions of the area are discussed below:

(i) Physical Resources

- **Climate**

The state has a tropical savanna climate, designated Aw under the Köppen climate classification. The undulating topography leads to local variations, particularly in the hill ranges. The four main seasons are winter, from December to February; pre-monsoon or summer, from March to April; monsoon, from May to September; and post-monsoon, from October to November. During the monsoon season, the south west monsoon brings heavy rains, which cause frequent floods. The average annual rainfall between 1995 and 2006 ranged from 1,979.6 to 2,745.9 mm (77.94 to 108.11 in). During winter, temperatures range from 13 to 27 °C (55 to 81 °F), while in the summer they fall between 24 and 36 °C (75 and 97 °F). According to a United Nations Development Programme.

- **Ambient Air Quality**

The air quality along the road is good as there is less flow of traffic. No major source of emission of exhaust gases exist along the road except some commercial and residential establishments, which burn wood as a fuel for commercial and domestic purposes.

As existing road is in narrow condition, dust due to wind blown and movement of vehicles on earthen shoulder portion is observed along the road. However, such dust particles are settled within short distances from the road.

- **Noise Levels**

In the area along the project road, noise levels are moderate as there is less traffic flow. Therefore, the contribution of traffic, in increase of ambient noise levels can be considered insignificant.

- **Topography and Soil**

The topography along the project road is generally hilly. Soil is usually yellow soil and black soil at some stretches.

- **Seismology**

As per seismic zonal map of India, the sub project area is located in seismic zone II. The bridges, culverts and other structures, therefore, need to be designed accordingly.

(ii) Ecological Resources

- **Terrestrial Ecology**

Impacts to flora will be minimal throughout most of the Project areas. Most of the length of the ROW lies in rural (primarily agricultural) areas where the floral habitat has been seriously disturbed and altered from its native state. Certain portion, however, passes through or near some of the forested areas and no threatened or endangered plant species are located within or adjacent to the affected ROWs, and no adverse impacts to special status species are likely to occur due to these activities. Virtually all rehabilitation activities will be confined to the existing ROWs, and both direct and indirect impacts to threatened or endangered plant species are unlikely.

Plant species present within the ROW are either introduced species or ubiquitous native species, which are highly tolerant of grazing, compaction, and other physical disturbances. Construction activities will have direct impact only in a narrow band of vegetation adjacent to the existing roadways. Potential impacts to flora, in both the forest and non-forest areas will be avoided by ensuring that roadside activities such as asphalt plants, construction camps and other ancillary features are properly sited.

ROW, both inside and outside of forested areas, is lined by mature trees overarching the roadways. In some portion trees will have to be cut to permit rehabilitation of the roads to current safety standards.

- **Wildlife**

No impact is anticipated in terms of the wildlife habitat alteration or its destruction. In short is no wildlife area within the project area along the road.

- **Fisheries**

No fishing activity is observed in the drains of subproject area.

- **Rare or Endangered Species**

No rare or endangered species is reported in the area.

(iii) Economic Development

- **Industries**

No major/minor industrial activity is observed along the project road.

- **Commercial Activities**

Commercial activities observed mostly near the inhabitation portion, along the project road. These commercial activities are in the form of shops.

- **Infrastructure Facilities**

Infrastructure facilities are adequate in the area along the project road.

- **Agricultural Development**

The climate of the area is more suitable for growing agricultural i.e. wheat, Potato as well as vegetables. There exist huge potential as far as the agriculture development is concerned. Soils are Medium to Deep Black with relatively high clay content. The principal crops are paddy, wheat, jute, sugar cane, potato, turmeric, coconut and oil seeds. Irrigation is common.

- **Tourism**

Within its small geographical area, Tripura offers plenty of attractions for the tourists in the form of magnificent palaces (Ujjayanta Palace and Kunjaban Palace at Agartala and Neermahal - Lake Palace at Melaghar), splendid rock-cut carvings and stone images (Unakoti near Kailashahar, Debtamura near Amarapur and Pilak in Belonia Sub-divisions), important temples of Hindus and Buddhists including the famous Mata Tripureswari temple (one of the 51 Pithasthans as per Hindu mythology) at Udaipur, vast natural as well as artificial lakes namely Dumboor lake in Gandacherra subdivision, Rudrasagar at Melaghar, Amarsagar, Jagannath Dighi, Kalyan Sagar, etc. at Udaipur, the beautiful hill station of Jampui hill bordering Mizoram, wild life sanctuaries at Sepahijala, Gumti, Rowa and Trishna, eco parks created by forest department at Manu, Baramura, Ambassa and rich cultural heritage of Tribals, Bengalis and Manipuri communities residing in the state. The main attractions in Agartala are Ujjayanta Palace, State Museum, Heritage Park, Tribal Museum, Sukanta Academy, M.B.B. College, Laxminarayan Temple, Uma Maheswar Temple, Jagannath Temple, Benuban Bihar, Gedu Mian Mosque, Malancha Niwas, Rabindra Kanan, Purbasha, Handicrafts Designing Centre, Fourteen Goddess Temple, Portuguese Church etc.

Rapid Environmental Assessment (REA) Checklist – Road NH – 44A

Road Section **Kanchanpur- Vagmun section, Distt. North Tripura in the State of Tripura – 20.248 km**

Screening questions	Yes	No	Remarks
A. Project siting Is the project area adjacent to or within any of the following environmentally sensitive areas?			The project road does not pass through any National park/wildlife century and forest area. The project is not closed to any cultural heritage site.
▪ <u>Cultural heritage site</u>		X	The project does not pass through any heritage cultural site.
▪ <u>Protected area</u>	X		The project does pass through any Protected area
▪ <u>Wetland</u>		X	
▪ <u>Mangrove</u>		X	
▪ <u>Estuarine</u>		X	
▪ <u>Buffer zone of protected area</u>		X	The project does not pass through any Protected area
▪ <u>Special area for protecting biodiversity</u>		X	
B. Potential environmental impacts Will the project cause...			
Encroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?		X	The topography of project road is mainly plain terrain with small section of hilly and rolling terrain. Minor impacts of landscape by road embankments, cuts and fills are anticipated. No encroachment of historical places. However, some temples exist along the project road which may get impacted. Proper management plan will be required during construction to sustain the quarries.
Encroachment on precious ecology (e.g. Sensitive or protected areas)?		X	

Screening questions	Yes	No	Remarks
Alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?		X	Project road crossed water streams. Controlled construction activities will ensure sediment discharge into streams to the extent.
Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?		X	Adequate sanitary facilities and drainage in the workers camps will help to avoid this possibility. As the construction activity in this project will not contain any harmful ingredients, no impact on surface water quality is anticipated.
Increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?	X		With appropriate mitigation measures and use of most modern environment friendly equipments/machineries air pollution shall be reduced to permissible levels
Noise and vibration due to blasting and other civil works?	X		Short term minor impact may occur during construction period, Suitable mitigation measures will be required to minimize the adverse effects
Dislocation or involuntary resettlement of people		X	No resettlement
Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?		X	Imposing of appropriate mitigation measures in contract agreement to keep the air pollution within permissible levels will keep a check on this problem.
Hazardous driving conditions where construction interferes with pre-existing roads?		X	To minimized the impact suitable traffic management plan will be required

Screening questions	Yes	No	Remarks
Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases from workers to local populations?	X		Proper provisions for sanitation, health care and solid waste disposal facilities will be available in the contract documents to avoid such possibility. Workers will be made aware about communicable diseases
Creation of temporary breeding habitats for mosquito vectors of disease?		X	
Dislocation and compulsory resettlement of people living in right-of-way?		X	No displacement
Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life?		X	Adoption of suitable traffic signage system at sensitive places will reduce such possibility.
Increased noise and air pollution resulting from traffic volume?	X		Due to improvement in Riding Quality & Comfort in driving due to unidirectional traffic such pollution will be reduced. Mitigation measures along with monitoring plan will be required
Increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?	X		Controlled construction activities and proper drainage system will reduce this possibility. Due to improvement in Riding Quality & Comfort in driving due to unidirectional traffic such pollution will be reduced.

After reviewing the answers above the Mission Leader and Environment Specialist agree that the project.

		should be categorized as an A project.
X		should be categorized as a B project.
		should be categorized as a B project in an environmentally sensitive area.
		should be categorized as a C project.
		should be categorized as an A/B project because (give reason).
		requires additional information for classification. Therefore,
o		an Environment Specialist should be involved in the PPTA Fact-finding Mission.
o		Mission Leader should gather additional information during the PPTA Fact-finding Mission.

On the basis of above finding, project road may be categorized as Project 'B'

8.2 INITIAL SOCIAL ASSESMENT

8.2.1 INTRODUCTION

An initial social assessment (ISA) is required for every development project in order to identify the people who may be beneficially or adversely affected by the project. It should access the stage of development of various subgroups and their needs, demands and absorptive capacity. It should also identify the institutions to be involved in the project and assess their capacities. The ISA should identify the key social dimensions aspects such as in voluntary resettlement, indigenous peoples, poverty reduction, and women in development. The ISA is generally taken as early as possible in the project cycle and preferably by the time of fact finding for a project preparation technical assistance.

As per the guidelines of ADB and Government of India policy the initial social and poverty analysis is being carried out. The social analysis study will among other things provide a socio economic profile of the project area. Particular attention is given to areas like indigenous people, communicable deceases like HIV AIDS, human trafficking, poverty alleviation, gender, local population, industry and agriculture. Aspects like health, education child labour land acquisition and resettlement need to be analyzed.

8.2.2 BACKGROUND

As part of the Project, to ascertain the Resettlement and Social Development Component of the Project, the scope of the present study as defined by the Terms of References (TORs) involved several elements as discussed below:

- (a) To examine and assess the overall social and poverty profile of the Project area on the basis of the primary and secondary data sources such as statistical handbooks, poverty data, land use patterns etc, field visits, key stakeholder interviews and preparation of a socio-economic profile of the state of Tripura and the project districts.
- (b) Preparation of social and poverty analysis, taking into account socio-economic and poverty status of the project area of influence, including the nature, extent and determinants of poverty in the project area including assessment of the risk of human trafficking and HIV/AIDS due to the project. In addition, estimation of the likely socioeconomic and poverty reduction impacts of the project also constituted an important aspect of the study.

- (c) Consultations with concerned officials in the Government and other relevant offices, this includes consultation with APs and affected communities to assess responses to the Project and ascertain the nature and scope of local participation in project planning and implementation.
- (d) To identify, analyze and, wherever appropriate, quantify the potential resettlement impacts of the proposed Project on the area population.
- (e) To suggest measures to enhance benefits and mitigate adverse impact.

The report is based on the findings of the socioeconomic surveys, field visits and small group meetings with the Project populations in the Project area.

8.2.3 METHODOLOGY

The study will be conducted with a participatory approach that aimed at putting the community at the center with a collective process of reflection, discussion and consultation with all major stakeholders in the Project. The primary stakeholders, such as farmers, shopkeepers, daily wage laborers, panchayat members, women, and other socio-economically deprived groups like Scheduled Caste (SC), scheduled tribes (ST), health workers, school teachers, and non-government organizations (NGOs) will be consulted individually, in homogenous sub-groups and mixed groups to understand the local needs thereby to assess the responses to the proposed subprojects and also ascertain the impact of the proposed project on the communities area and the overall region.

The team will make Field Visits to the respective projects and also interact with the villages (to be affected by the proposed project intervention) in order to ascertain the socio-economic profile of the area,

PRA techniques like social mapping, resource mapping, transect walk, mobility maps etc. will be used during the course of the field investigation.

Community meetings shall be initiated to obtain the views, responses & possible solutions from the local people.

Focus group discussions (FGD's) will be organized at the village level with different potential affected groups of people, more importantly, women, indigenous and other socio-economically deprived people to ascertain the impact of the project on them.

Meetings with village panchayats, non-government organizations, health workers, and school teachers will also be held during the course of field visits with special emphasis on project impact, poverty, road safety and related issues.

A Census Survey covering all affected structures along the alignments of each of the subprojects shall be conducted by means of a detailed questionnaire.

A detailed analysis of secondary data sources shall be carried out to understand the social, economic & demographic situation in the project area & will be submitted along with Detailed Project Report.

8.2.4 INVOLUNTARY SETTLEMENT ISSUES

The road area is not free of encroachments and illegal settlements within ROW. There shall not be any need for involuntary resettlement of people

8.2.3 INDEGENIOUS PEOPLE'S DEVELOPMENT

The study findings reveal that there would no significant impact on the indigenous people due to road widening and development. During the discussions held with the ST communities in the Project locations, the group expressed that the improved road network will augment access to services and economic opportunities not just for them but also for all segments of the state population. They did not envisage any negative impacts of the proposed project. However, a checklist has been prepared for Initial Screening for Project with Impact on Indigenous Peoples.

8.2.6 INITIAL POVERTY AND SOCIAL ASSESSMENT

On the basis of socio-economic data collected from the District Handbooks and other departmental publications and brochures relevant to the Project roads, as stated earlier, a Project Road Influence Area Profile (PRIA) has been prepared. The profile consists of demographic features, land utilization, occupation structure, agriculture production, acreage intensity, irrigation facilities, and concentration of infrastructure facilities, such as, availability of banks, hospital beds, primary schools, electrified villages, drinking water facilities, status of accessibility (paved/unpaved road), number of hat/bazaar, primary health centers, government public distribution shops, post offices and family planning center. The compiled data have been used in the present project for several analyses during the study. A summary with salient features is presented **below**.

Geography:

Located in the North-eastern part of Tripura, the District covers an area of about 2426 km. It is mainly located between two hills namely 'Atharamura range' and 'Sakhan Range'. More than 70% area is hilly and forest covered. The terrain is mostly undulating and hilly with small water streams (chharas), rivers and fertile valleys intervening. Major rivers originating from Dhalai are Dhalai, Khowai,

Gomati & Manu. Major hills are Atharamura, Longtharai, Kalajhari & part of Sakhan. The District headquarter at Ambassa is located at a distance of about 85 km from the State capital Agartala. The District is bordered by Bangladesh on the Northern & Southern sides. Oil and Natural Gas Corporation (ONGC) is currently exploring for natural gas reserves in the district in Salema block. The district falls in Seismic Zone 5 of India and is prone to landslides, thunderstorms and lightning strikes in summer and rainy seasons.

Economy:

In 2006 the Ministry of Panchayati Raj named Dhalai one of the country's 250 most backward districts (out of a total of 640). It is the only district in Tripura currently receiving funds from the Backward Regions Grant Fund Programme (BRGF).[12] The district has predominantly agrarian economy with several Micro and Small scale industrial units.

Demographics:

According to the 2011 census Dhalai district has a population of 377,988, roughly equal to the nation of Maldives. This gives it a ranking of 564th in India (out of a total of 640). The district has a population density of 157 inhabitants per square kilometre (410/sq mi). Its population growth rate over the decade 2001-2011 was 22.78%. Dhalai has a sex ratio of 945 females for every 1000 males, and a literacy rate of 86.82%.

Since the time series data are not available for the above socio-economic parameters, it is difficult to establish any trend. However the data available reveal the salient features of the Project Road Influence Area as well as the concentration of different activities in the Project area. The status of a PRIA, thus identified, in a specific activity would be useful to appreciate the relative importance of that particular Project road. The information collected and compiled for all the Project roads has been utilized for establishing the relative potential for future development and growth and in turn, an increase in traffic.

8.2.7 INITIAL SOCIAL IMPACTS AS A RESULT OF ROAD DEVELOPMENT

As per local inquiry and analysis of data collected, general picture suggests that the impact of road development project on social scenario of area shall be fairly positive. Since there are no critical issues which could adversely affect local people in terms of employment, culture, livelihood, health education etc. the project seems to create a positive impact on people in the project road influence area.

8.2.8 IMPACT ON POVERTY

The project road shall develop the transportation infrastructure in the adjoining area which in turn, will create avenues for development in employment, commerce, tourism, agriculture, health and education. All these aspects shall enhance social development of the area which shall ultimately result in reduction of poverty level.

8.2.9 IMPACT ON INDIGENEOUS PEOPLE

The indigenous people who are presently confined to local area only shall after development of road and thus transportation infrastructure will get more exposure to education, health, markets etc. The area is not vulnerable to migration settlements from external people. Since the major occupation of people in local area is agricultural based and there are no proper warehousing facilities for storage of agricultural product in the area the indigenous people will be benefited by road development project.

Initial Screening Checklist for Project with Impact on Indigenous Peoples

Sub Project:

Improvement/up-gradation of Kanchanpur - Vagmun Section to two lane with paved shoulder

Screening question	Not known	Yes	No	Any other comments
Aside from the mainstream population, are there population groups who have been living in the project location before modern states or territories were created and before modern borders were defined?			✓	The Initial Social assessment of project study area identifies no ST household in the project area will be affected.
Are there population groups who maintain culture and social identities separate from mainstream or dominant societies and cultures?			✓	
Are there populations of tribal groups or culture minorities who have migrated into the project areas to which they are not indigenous, but have established a presence and separate social cultural identity?			✓	

Are there population groups that self- identifies themselves, or are identified by other and the mainstream population or by the Law, as being part of a distinct indigenous cultural group of ethnic minority?			✓	
Are there populations groups with a linguistic identify different from that of the mainstream society?			✓	
Are there population groups with social, culture, economic and political traditions and institutions distinct from the mainstream culture?			✓	
Are there population groups with economic systems oriented more toward traditional systems of production than the mainstream systems?			✓	
Are there population groups who maintain attachments to traditional habitats and ancestral territories and the natural resources in these habitats and territories?			✓	

Chapter-09: COST ESTIMATE

9.1 General

This chapter provides a cost estimate for **Kanchanpur - Vagmun Section** in the state of **Tripura**. The cost estimate is prepared based on the detailed assessment of project road section.

9.2 Methodology

The rates for the items of work have been assessed from SOR, PWD-NH tripura -2017 and escalation of 5% per year is adopted.

9.3 Construction Quantities

The quantities of earthwork and pavement for road and bridge have been worked out manually.

The details of quantities work out for road work on the basis of following proposed typical cross sections:

Proposed typical cross section for project highway is given in table 9.1 & table 9.2 below:

Table No. 9.2 Type of Typical Cross Section

Sr. No.	Description	Design Length (Km.)	Proposed TCS Type
		HS-I (Km)	
1	Reconstruction in Two-Lane Carriageway with Paved Shoulder in Open Country (Plain/Rolling Terrain)	0.923	TCS-2.2
2	Two-Lane with with paved shoulder in Hilly Terrain with Hill side Drain on Both sides and breast wall on one side in open Country area (Box cut)	6.820	TCS-2.14(New)
3	Two-Lane with with paved shoulder in Hilly Terrain with Hill side Drain and breast wall on both sides in open Country area (Box cut)	0.100	TCS-2.15(New)
4	Two-Lane with with paved shoulder in Hilly Terrain with Hill side Drain on Both sides in open Country area (Box cut)	0.100	TCS-2.16(New)
5	Two Lane Road with Paved shoulders in Hilly Terrain with Trapezoidal drain on hill side and retaining wall on valley side	1.200	TCS-2.17(New)
6	Two Lane Road with Paved shoulders in Hilly Terrain with Hill side drain	7.405	TCS-2.19(New)
7	Two Lane Road with Paved shoulders in Hilly Terrain with Hill side drain and breast wall	3.700	TCS-2.20(New)
	Total	20.248 km	

9.4 Pavement Design Options

The Project Road Section majorly Passes through hilly terrain, so as per IRC SP:73-2015, fig-2.2, 2.14, 2.15, 2.16, 2.17, 2.19 and 2.20 will be the adopted cross section including paved shoulder.

Flexible pavement

Fig-2.2- Two lane with Paved Shoulder (10.0m) carriageway with 2.0m earthen shoulder in Plain/ Rolling terrain is adopted for the project road. Total formation width will be 14.0m excluding drain.

Fig-2.14- Two lane with Paved Shoulder (10.0m) carriageway with 1.0m earthen shoulder both in Hilly terrain is adopted for the project road. Total formation width will be 12.0m excluding drain.

Fig-2.15- Two lane with Paved Shoulder (10.0m) carriageway with 1.0m earthen shoulder both in Hilly terrain is adopted for the project road. Total formation width will be 12.0m excluding drain.

Fig-2.16- Two lane with Paved Shoulder (10.0m) carriageway with 1.0m earthen shoulder both side in Hilly terrain is adopted for the project road. Total formation width will be 12.0m excluding drain.

Fig-2.17- Two lane with Paved Shoulder (10.0m) carriageway with 1.0m earthen shoulder both side in Hilly terrain is adopted for the project road. Total formation width will be 12.0m excluding drain.

Fig-2.19- Two lane with Paved Shoulder (10.0m) carriageway with 1.0m earthen shoulder both side in hilly terrain is adopted for the project road. Total formation width will be 12.0m excluding drain.

Fig-2.20- Two lane with Paved Shoulder (10.0m) carriageway with 1.0m earthen shoulder both side in hilly terrain is adopted for the project road. Total formation width will be 12.0m excluding drain.

Rigid pavement

No Rigid pavement is proposed.

9.5 Project Cost

The summary of cost estimate is presented as below:

General Abstract of Cost

Total Length 20.248 Kms

c	Item	Total (Rs.)	Total in Crores
A	CIVIL WORK FOR RECONSTRUCTION OF PROJECT ROAD		
1	SITE CLEARANCE	2,978,322	0.30
2	EARTHWORK	372,900,697	37.29
3	GRANULAR SUB-BASE, BASE-COURSE	1,279,376,340	127.94
4	BITUMINOUS COURSES	432,464,592	43.25
	SUB TOTAL (A)	2087719952	208.77
B	CROSS DRAINAGE STRUCTURES		
5	RECONSTRUCTION OF Culverts	290,906,580	29.09
	SUB TOTAL OF CROSS DRAINAGE STRUCTURES (B)	290906580	29.09
C	OTHER ITEMS		
6	TRAFFIC SIGNS MARKING AND ROAD APPURTENANCES	50,122,571	5.01
7	Slope protection	3,908,960	0.39
8	Catch Water Drains	34,224,328	3.42
9	Hill Side Dains	48,400,442	4.84
10	Breast wall & Retaining Wall	499,444,838	49.94
	SUB TOTAL OF OTHER ITEMS (C)	636,101,139	63.61
D	Total (D= A+B+C)	3,014,727,671	301.47
E	Add Contingency Charges @ 2.8 % on F (G)	84,412,375	8.44
F	Total Civil Cost (F= D+E)	3,099,140,046	309.91
	Cost Per Km	153,059,070	15.31
G	Add 3% Supervision Charges on F (G)	92,974,201	9.30
H	Add 3% Agency Charges on F (H)	92,974,201	9.30
I	Add 0.25% QC Charges on F (I)	7,747,850	0.77
J	Add 0.25% Road Safety Cell Audit Charges (J)	7,747,850	0.77
K	Add Price Escalation @ 5% per annum for 2.5 years Construction Period i.e total 12.5% on F	387,392,506	38.74
L	Add Post Construction Maintainence During DLP Payable @ 5% for 4 Years to EPC Contrator on F	154,957,002	15.50
M	Grand Total (M= F+G+H+I+J+K+L)	3,842,933,657	384.29
	Total Project Cost	3,842,933,657	384.29
	Cost per Km.	189,793,247	18.98

CHAPTER – 10 CONCLUSION & RECOMMENDATION

10.1 General

National Highways and Infrastructure Development Corporation Limited, has decided to take up up-gradation & rehabilitation of Manu - Simlung Road (NH-44A) in the Tripura where the intensity of traffic has increased and there is requirement of augmentation of capacity for safe and efficient movement of traffic.

Given the needs of the project to adequately address the concerns of the local population, the project has been conceived with suitable improvements.

10.2 Audit of Proposed Design

The Audit Team reviewed the proposed design from a road safety perspective and recommended in the following provisions.

Table 10.1: Road Safety Audit Report

Contents	Items	Provisions
Aspects to be checked	Safety and operational implications of proposed alignment and junction strategy with particular references to expected road users and vehicle types likely to use the road.	In general main carriageway has been designed for minimum design speed of 80 kmph in plain terrain for providing reasonable speed to heavy commercial vehicle. Turning radius at junctions and sharp curves will be improved to facilitate high-speed turns. All major junctions will have acceleration and deceleration lanes.
	Width options considered for various sections.	Two lane + Paved Shoulder
	Safety implications of the scheme beyond its physical limits; i.e. how the scheme fits into its environs and road hierarchy	Initial environment impact assessment has been carried out and report shall be prepared and submitted separately.
General	Departures from standards	Project road is designed at minimum speed of 65 kmph.
	Cross-sectional variation	Except in built-up, at no place cross section is expected to be varied from standard formation width defined.
	Drainage	Adequate provisions in terms of unlined drain on both side of main carriageway in plain / rolling terrain, open lined drain with kerbs in Hilly section and

Contents	Items	Provisions
		covered lined drain in built-up areas under separator are proposed. Besides above, drain network connectivity is also considered by keeping the provision of pipe culverts on cross roads merging/diverging from the project road.
	Climatic conditions	Hot in Summer and Cold in Winter
	Pedestrian Crossings	Provision for at grade crossing is made at locations based on pedestrian crossing survey.
	Landscaping	Vegetation/ Agriculture/ Forest
	Public Transport	State government (Tripura) and private operators regularly ply buses. Besides for local transport, people travel by privately run buses/jeeps.
	Visibility	All horizontal and vertical curves have been designed for appropriate stopping sight distance.
	Staging of contracts	The entire length of the project road is proposed to be develop in four packages. This Report deals with Package-1.
Local Alignment	New / Existing road interface	Concentric widening is followed to restrict land acquisition issues to bare minimum. As far as possible, existing geometry has been followed in urban area. Aspects of ease in construction and traffic movement during the construction phase have been considered while preparing the widening scheme. Realignment is proposed in some areas to maintain the design speed.
	Safety Aids on steep slopes	In high embankment section, metal beam crash barrier provision has been made. Vertical grades have been kept within 3.33% to 6% depending up on terrain.
Junctions	Minimize potential conflicts	As cross traffic movement on most of the junctions are found to be varying from low to high, there

Contents	Items	Provisions
		is need to minimize conflict points. Conflict points will be addressed by providing adequate wearing lengths.
	Layout	As far as possible, Y-junction will be eliminated and layout will be so designed so as to have minimum acquisition of land.
	Visibility	All junctions will be designed to have adequate least stopping sight distance.
Signs and Lighting	Signs / Markings	Standard road signage having retro-reflective sheeting of Super High Intensity grade type IX and pavement marking of highest grade have been considered for the project road. Road studs and Arrow Sign Boards are considered at Junction and curve portions.
Construction and Operation	Build ability	All aspects of available latest construction technology have been considered while proposing the highway and bridge design.
	Operational	Pavement design has been proposed in such a manner as would require minimum maintenance.
	Network management	New junctions have been introduced where the road is proposed to be re-alignment is proposed.

10.3 Recommendations

The following general recommendations are made:

- Based on the lane capacity analysis, the consultant suggests going for two lane with Paved shoulder for the project Road section.
- The scheme of construction / improvement proposals for Project Road, cross drainage structures and other facilities discussed in various chapters will be adopted for development of highway project.
- Highway expansions can be developed without causing significant adverse environmental impacts to the natural, social, economic or cultural environments

of the study area, assuming the mitigation measures identified in this report are incorporated into detailed design.

- The project road has been designed for 100 km/h to 80 km/h speed in plain terrain & 40 km/h to 65 km/h speed in hilly terrain.
- The vertical profile of the project road has been designed as at-grade sections with gentle gradient to achieve cost savings and minimize construction of elevated structures.
- Flexible pavement is recommended for entire stretch.
- The project section can be constructed within 18 months period with strategic planning and through one construction package. The construction work may begin from July, 2017.
- The baseline data was collected as per guidelines for Environmental Impact Assessment of highway project and as per provision in EIA notification of 27th January 1994 and amended on 14th September 2006.
- **The estimated TPC is Rs. 384.29 Crores.**
- The Project is to be developed on EPC Mode. Schedules of Concession Agreement (EPC) are presented in Volume-III.