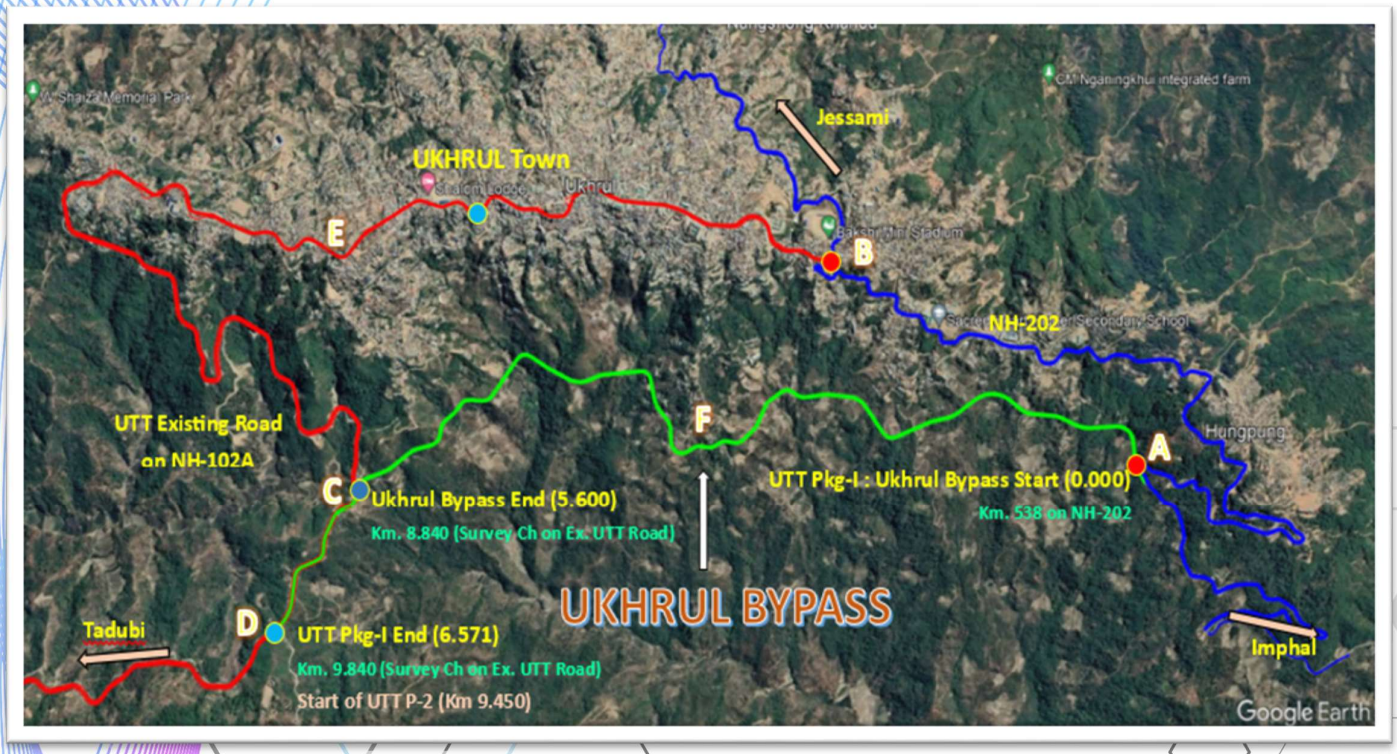
Consultancy Services for preparation of Feasibility Study and Detailed Project Report for Two laning with Hard shoulder of Ukhrul-Toloi-Tadubi section of NH-102A (115 km) in the State of Manipur on EPC mode : Package 1 (Ukhrul Bypass)

DPR : MAIN REPORT



National Highways & Infrastructure Development Corporation Ltd.

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National Highways & Infrastructure Development Corporation Ltd.

Ministry of Road Transport & Highways, Government of India

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Doc No: CET/3640/DPR **October: 2023**

EXECUTIVE SUMMARY

0.1 Project Background

National Highways & Infrastructure Development Corporation Limited (NHIDCL has decided to take up the development of Ukhrul-Toloi-Tadubi section of NH-102A into two lane with hard shoulder configuration in the State of Manipur on EPC Mode. NHIDCL accordingly procured the services of a Technical Consultants for carrying out suitable feasibility Study and DPR consultancy services for proper structuring and implementation of the project on EPC mode.

The company promotes, surveys, establishes, design, build, operate, maintain and upgrade National Highways and Strategic Roads including interconnecting roads in parts of the country which share international boundaries with neighboring countries. The regional connectivity so enhanced would promote cross border trade and commerce and help safeguard India's international borders. This would lead to the formation of a more integrated and economically consolidated South and South East Asia. In addition, there would be overall economic benefits for the local population and help integrate the peripheral areas with the mainstream in a more robust manner.

NHIDCL has appointed C.E. Testing Company Pvt. Ltd. (CETEST) as consultant to prepare the Detailed Project Report for the above road stretches vide Letter of Acceptance No. NHIDCL/DPR/Manipur/Ukhrul-Toloi/NH-102A dated 23.11.2015&NHIDCL HQ COS Letter No. NHIDCL/DPR/Ukhrul-Taloi-Tadubi Road /Manipur/3836 dated 13.09.2023.

Ukhrul-Toloi-Tadubi Road Package -1 will bypass the Ukhrul town on the existing road. Proposed Ukhrul-Toloi-Tadubi road Package-1 including Ukhrul Bypass will starts near Km 538 of NH-102A (about 6 Km before Ukhrul Town) & meets existing Ukhrul-Toloi-Tadubi Road at Ex chainage 8+840 (De. Ch. 5+600 Km) and then follow the existing road for about 1 Km & ends at De. Ch. 6+571 Km.

The project road i.e., Package 1 lies in Ukhrul Districts of Manipur State. Project stretch will shorten the travel length of about 9 Km and avoiding congestion of Ukhrul town.

The Start co-ordinate of the project is Latitude 2773296.943 N & Longitude 635691.017 E. The End co-ordinate is Latitude 2778417.579 N & Longitude 635099.531 E.

The project road lies in Ukhrul districts of Manipur State. The project road is located in mountainous Terrain. The entire road passes through major village / localities namely Hundung & Hunphun on NH-102A in the State of Manipur.

0.2 OBJECTIVES

The main objective of the Consultancy Service is to prepare the Detailed Project Report (DPR) for up gradation of existing road to two lane configurations of Ukhrul-Toloi-Tadubi Road section Pkg-1 of NH-102A in the State of Manipur ensuring –

- ✓ Minimum Land acquisition
- ✓ Enhanced road safety
- ✓ Minimum adverse impact on environment

0.3 Deficiencies and Issues for Existing Alignment

The following major deficiencies have been identified and addressed in terms of traffic operation, safety, road conditions and maintenance. A few other issues which contribute to operational deficiencies and safety concerns and which prevent the optimum utilization of the highway capacity to a desirable level of service, e.g. driving discipline and compliance, traffic surveillance, corridor security and management, level of regular road maintenance, maintenance and its road worthiness etc. are beyond the scope of this study.

a) Operation

- ✓ No access controls
- ✓ Fast Moving Vehicles conflicts with slow moving vehicles due to bad pavement condition
- ✓ Deficient road surface conditions (roughness)
- ✓ No proper Geometry of road alignment
- ✓ Uncontrolled roadside developments and encroaching the area under ROW
- ✓ Cross-drainage structure require to be improved through reconstruction

b) Safety

- ✓ Shoulder drop-off at places.
- ✓ Exposed roadside hazards, specially a protective part throughout the road stretch.
- ✓ Inadequate traffic signs.
- ✓ Blind Curve on the project road.

c) Road

- ✓ Poor pavement condition and structurally inadequate.
- ✓ Shoulder functionally and structurally inadequate.
- ✓ Cross drainage - poor condition and inadequate.
- ✓ Curve radii less than what is required for the ruling Design speed of 40 km / hr. in roads for mountainous terrain.
- ✓ Deficient curves and reverse curves in roads of plain terrain without transition length for safe reversal of elevation.

0.4 Salient Features

This relates to the most suitable alignment for 2-laning of road sections based on field data and detail study involving traffic, geo-technical, topographic, pavement and road condition and socio-economic aspects. Special attention has been given for augmentation of capacity for intended level of service in design period. A few appropriate design applications have been considered for operational efficiency and road safety.

Table 0.1: Salient Features of the ProposedRoad

Descriptions		Through Existing Alignment	Through Proposed Bypass
Start Point	:	The Project Road starts from Ukhrul (Junction with NH-202 (De. Ch. 0+000 Km)	The Project Road starts near Km 538 of NH-202 (De. Ch. 0+000 Km)
End Point	:	Ends at Chainage 9+840 Km on Existing Ukhrul-Toloi-Tadubi Road on NH-102A	Ends at Design Chainage 6+571 Km (Start point of Pkg-2)
Length	:	Existing Length = 9.840 Km	Proposed Length =6.571 Km
Terrain	:	Mountainous/Steep Terrain	Mountainous/Steep Terrain
Alignment	:	The horizontal alignment of the existing road has maximum stretches with sub-standard horizontal curves due to deficient geometrics where the vehicle achieves even lower speed which require geometric improvement	Proposed alignment has been designed based on the design speed adopted for mountainous terrain as per standard specified in IRC SP 73-2018 and IRC SP-48-1998-hill road manual
Design Speed	:	10-20 kmph in entire stretch.	Considering mountainous/Steep terrain in general design speed has been adopted as Design Speed: 40 - 60 kmph
Cross-Section	:	**Carriageway:**3.00 m – 4.00 m **Earthen Shoulder:**0.50 m – 1.0 m **Formation Width:** 3.5 m –7.50 m	(1) Rural Area a) Carriageway Width = 7.0 m b) Hard Shoulder Width = 2 x 1.5 m c)Earthen Shoulder Width on Valley side = 1.0 m d)Roadway Width= 11.0 m (2) Rural Area a) Carriageway Width = 7.0 m b) Hard Shoulder Width = 2 x 1.5 m c)Earthen Shoulder Width = 1 x 1.0 m c)Roadway Width= 12.0 m (2) Rural Area with Retaining Wall, Breast Wall & Gabion Wall a) Carriageway Width = 7.0 m b) Hard Shoulder Width = 2 x 1.5 m c)Roadway Width= 10.0 m
CBR Considered	:	-	10%
Traffic	:	Present Traffic (Yr. 2023) projected from base year traffic (Yr. 2020) including diverted Traffic from OD Survey	Projected traffic (Yr. 2045, Design life 20 years from project completion Yr. 2025) including diverted Traffic from OD Survey
		Total Vehicle in numbers = 2579 nos. Total Vehicles in PCU = 2535 PCU	Total Vehicle in numbers = 12660 nos. Total Vehicles in PCU = 12446 PCU
Traffic Growth Rate	:	-	7.50%
Pavement Design Life	:	-	Flexible Pavement - 20 Years
Design msa	:	-	**Calculated MSA = 10.74 msa** **Adopted MSA = 20 msa as per IRC: SP:73-2018 clause no. 5.4.1**

Descriptions		Through Existing Alignment	Through Proposed Bypass
Flexible Pavement Thickness	:	Bituminous Surface = 20 mm WMM = 75 mm GSB = 100 mm Total Pavement Thickness = 195 mm	**Conventional Method** BC = 40 mm DBM = 70 mm WMM = 250 mm GSB = 200 mm **Total = 560 mm**
			Non-Conventional Method with WMM and CT Sub-base BC = 30mm DBM = 50 mm WMM = 150 mm CT Sub-base = 200 mm **Total = 430 mm**
			Rigid Pavement Method PQC = 250 mm DLC = 150 mm GSB = 150 mm **Total = 550 mm**
			Non-Conventional Method has been Recommended due to Project Cost is less
Bridges	:	Nil	Proposed Bridge – 5 Nos. 1. Minor Bridge at De. Chainage km 2.379 PSC I Girder (1 x 30 m) 2. Minor Bridge at De. Chainage km 3.624 PSC I Girder (1 x 40 m) 3. Minor Bridge at De. Chainage km 4.109 PSC I Girder (1 x 30 m) 4. Minor Bridge at De. Chainage km 4.375 PSC I Girder (1 x 40 m) 5. Major Bridge at De. Chainage km 4.906 Steel Truss (1 x 90 m)
Culverts	:	**Total Culvert = 25 Nos.** Slab Culvert: 3 numbers, Pipe Culvert: 5 numbers.	**Total Culvert proposed = 20 Nos. (New Construction)** Type-1: 2 m x 2 m Box Culvert = 12 Nos. Type-2: 2 m x 3 m Box Culvert = 2 Nos. Type-3: 3 m x 4 m Box Culvert = 4 Nos. Type-4: 5 m x 4 m Box Culvert = 2 Nos.
Protection Work	:	Length of RR Masonry Retaining Wall = 128 m	Length of RR Masonry Retaining Wall = 662 m
		Length of Breast Wall = 210 m	Length of Breast Wall = 1300 m
			Length of Gabion Structure = 3787 m
Drains	:	Length of Masonry/CC (Pucca) Lined Drain = 1571 m	Length of Triangular 'V' Shaped Drain = 6371 m
		Length of Earthen (Kutcha) Unlined Drain = 4298 m	
Bus – Bay with Passenger Shelter	:	Nil	4 Numbers at 2 Locations
ROW	:	9 m-12 m	30 m to 55 m
Land Details	:	Available land 0.5593 Ha.	Land to be acquired 24.8183 Ha.

Descriptions		Through Existing Alignment			Through Proposed Bypass		
Muck Disposal Area		-			Muck Disposal area = 2.4093 Ha.		
Forest Stretch	:	Forest present along the total stretch.			Forest present along 6.571 km (100% of the total proposed road length) Total land required in unclassified forest area = 2.4093 Ha. Including Muck Disposal area.		
Major Intersection	:	2 Nos. Major Intersections			1 no. Major Intersections will be improved at grade		
		Sl. No.	**Chainage (Km)**	**Type of Junction**	**Sl. No.**	**Chainage (Km)**	**Type of Junction**
		1	0+000	3-legged	1	5+600	3-legged
		2	4+850	3-legged			
Minor Intersection	:	15 Nos.			11 Nos.		
Total Civil Cost (Rs.)	:	-			Conventional Method (Flexible Pavement): Rs. **110.39** Cr. (Rs. **16.80** Cr. / Km) Non-Conventional Method (WMM & CT Sub Base Pavement): Rs. 1**07.07** Cr. (Rs. **16.29** Cr. / Km) Rigid Pavement Rs. **111.41** Cr. (Rs. **16.95** Cr./ Km)		

0.4 Cost Estimates

Rate Analysis of each item of work has been carried out as per Manipur Schedule of Rates, 2022 for National Highways works published by Public Works Department, Govt. of Manipur. The standard Data Book for Analysis of Rates revised in 2019 by MoRTH has essentially been taken as the basis for the publication for this schedule. The rates for materials and labour have been collected from the market and the other sources and rationalized for the entire state. Leads for major construction materials, considered for the rate analysis, are given in Table 0.2 below:

Table 0.2: Leads for Various Materials

Sl. No.	Name of Material	Name of Source	Distance from Source to Start/ End Point of Project Road (Km)	Distance on Project Road (Km) (Half of Project Road)	Total Lead (Km)
1	Sand (Fine)	Local	15	3.4	18.4
2	Filling Material	On Site	-	-	-
3	Stone Metal	On Site	-	-	-
4	Stone Boulder	On Site	-	-	-
5	Stone Chips, Aggregate	On Site	-	-	-
6	Coarse Sand	Local	15	3.4	18.4
7	Cement	On Site	-	-	-
8	Steel	On Site	-	-	-
9	Bitumen	On Site	-	-	-
10	Bitumen Emulsion	On Site	-	-	-
11	Structural Steel	On Site	-	-	-
12	RCC Pipe	On Site	-	-	-

TABLE 0.3: Abstract of Cost Estimate

Ukhrul-Toloi-Tadubi Road (Pkg-I) 'Ukhrul Bypass' in the State of Manipur by NHIDCL on EPC Mode.

PACKAGE-I (0+000 KM TO 6+799 KM)

GENERAL ABSTRACT OF COST

Length of Road:							**6.571 Km**
DESCRIPTION OF WORKS		**Conventional Method (Flexible Pavement)**		**Non-Conventional Method (WMM and CT Sub Base Pavement)**		**Rigid Pavement**	
		TOTAL COST (IN CR.)	**COST PER KM. LENGTH (IN CR.)**	**TOTAL COST (IN CR.)**	**COST PER KM. LENGTH (IN CR.)**	**TOTAL COST (IN CR.)**	**COST PER KM. LENGTH (IN CR.)**
A.	**ROAD WORKS**						
1	Site Clearance and Dismantling	0.29	0.04	0.29	0.04	0.29	0.04
2	Earth work, Subgrade and Erosion control	32.85	5.00	32.81	4.99	32.53	4.95
3	Sub-Base & Base	6.61	1.01	4.88	0.74	1.22	0.19
4	Bituminous Courses	5.99	0.91	4.43	0.67	12.71	1.93
5	Junction Improvement (Major & Minor)	0.50	0.08	0.50	0.08	0.50	0.08
6	Traffic signs, Road marking & other road appurtenances	3.39	0.52	3.39	0.52	3.39	0.52
7	Bus bay & Passenger Shelter	0.26	0.04	0.26	0.04	0.26	0.04
8	**Drainage and Protective Works**						
a.	Longitudinal Drains (V Drain)	1.58	0.24	1.58	0.24	1.58	0.24
b.	Retaining wall (RR)	2.15	0.33	2.15	0.33	2.15	0.33
c.	Breast wall	4.47	0.68	4.47	0.68	4.47	0.68
b.	Gabion Structure	14.09	2.14	14.09	2.14	14.09	2.14
c.	Soil Stabilization with Coir Mat	0.98	0.15	0.98	0.15	0.98	0.15
d.	Soil Stabilization with Bamboo Plantation	1.52	0.23	1.52	0.23	1.52	0.23
B.	**BRIDGES & CULVERTS**						
9	Culverts	8.31	1.26	8.31	1.26	8.31	1.26
10	Minor Bridges	13.60	2.07	13.60	2.07	13.60	2.07
11	Major Bridges	13.80	2.10	13.80	2.10	13.80	2.10
C.	**COST OF CIVIL WORKS IN LAKHS(AS PER SOR 2022)**	**110.39**	**16.80**	**107.07**	**16.29**	**111.41**	**16.96**
	GST @ 18% of 'C'	19.87		19.27		20.05	
D.	**Construction cost + GST**	**130.27**	**19.82**	**126.34**	**19.23**	**131.47**	**20.01**
	Contingencies @ 1.0% On of 'C'	1.10		1.07		1.11	
	Agency Charges 3% on of 'C'	3.31		3.21		3.34	

GENERAL ABSTRACT OF COST

Length of Road:							**6.571 Km**
DESCRIPTION OF WORKS		**Conventional Method (Flexible Pavement)**		**Non-Conventional Method (WMM and CT Sub Base Pavement)**		**Rigid Pavement**	
		TOTAL COST (IN CR.)	**COST PER KM. LENGTH (IN CR.)**	**TOTAL COST (IN CR.)**	**COST PER KM. LENGTH (IN CR.)**	**TOTAL COST (IN CR.)**	**COST PER KM. LENGTH (IN CR.)**
	Supervision Charges 3% on of 'C'	3.31		3.21		3.34	
	Price Escalation@ 2.50% (for 24 months) on of 'C' for one year	5.52		5.35		5.57	
	Maintenance @ 2.5% on ''C'	2.76		2.68		2.79	
E.	**Total Provision for Contingencies and Centages**	**16.01**	**2.44**	**15.53**	**2.36**	**16.15**	**2.46**
(i)	LA and Standing Properties Cost	51.73		51.73		51.73	
(ii)	Forest, Environmental & Wildlife Clearance Budget	7.92		7.92		7.92	
(iii)	Electric Utility Shifting	0.07		0.07		0.07	
(iv)	PHED Utility Shifting	0.20		0.20		0.20	
F.	**Total Preconstruction Cost**	**59.92**	**9.12**	**59.92**	**9.12**	**59.92**	**9.12**
G.	**Total Project Cost**	**206.19**	**31.38**	**201.79**	**30.71**	**207.54**	**31.58**

- **Non-Conventional Method has been recommended due to Total Project Cost is Less other than Two Methods.**

CHAPTER – 1
INTRODUCTION

1.1 General

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

As a part of the above-mentioned endeavor, National Highways & Infrastructure Development Corporation Limited (NHIDCL) has been entrusted with the assignment of Consultancy Services for Carrying out Feasibility Study, Preparation of Detailed Project Report and providing pre-construction services in respect of 2 laning of Ukhrul-Toloi-Tadubi Road Pkg-1 (Ukhrul Bypass) on NH-102A on Engineering, Procurement and Construction mode in the state of Manipur.

National Highways & Infrastructure Development Corporation Ltd. is the employer and executing agency for the consultancy services and the standards of output required from the appointed consultants are of international level both in terms of quality and adherence to the agreed time schedule.

National Highways & Infrastructure Development Corporation Limited (NHIDCL), MoRT&H, New Delhi has appointed C.E. Testing Company Pvt. Ltd. (CETEST) as consultant to prepare the Detailed Project Report for the above road stretches vide Letter of Acceptance No. NHIDCL/DPR/Manipur/Ukhrul-Toloi/NH-102A dated 23.11.2015 & NHIDCL HQ COS Letter No. NHIDCL/DPR/Ukhrul-Toloi-Tadubi Road /Manipur/3836 dated 13.09.2023.

1.2 Project Background

State Profile

Manipur is one of the Border States in the northeastern part of the country having an international boundary of about 352 km long stretch of land with Myanmar in the southeast. It is bounded by Nagaland in the north, Assam in the west and Mizoram in the south. It has a total area of 22,327 sq. km. It lies between 23.8°N to 25.7°N latitude and 93.5°E to 94.8°E longitude.

Geographically, the state of Manipur could be divided into two regions, viz. the hill and the valley. The valley lies in the central part of the state and the hills surround the valley. The average elevation of the valley is about 790m above the sea level and that of the hills is between 1500m and 1800m. The hill region comprises of ten districts viz. Senapati, Kangpokpi, Tamenglong, Noney, Churachandpur, Pherzawl, Chandel, Tengnoupal, Ukhrul, Kamjong and the valley region consists of six districts, viz. Imphal East, Imphal West, Thoubal, Jiribam, Kakching and Bishnupur. The hill districts occupy about 90 percent (20,089 sq. km) of the total area of the state and the valley occupies only about tenth (2,238 sq. km) of the total area of the state.

Manipur in northeast India is a small beautiful state with Imphal as its capital. The name Manipur literally means "Land of Jewels" and the state has a rich culture which can be seen in martial arts, dance, theatre and sculpture. Renowned for its greenery and pleasant climate, Manipur has been a popular tourist destination.

Manipur has been at the crossroads of Asian economic and cultural exchange for more than 2,500 years. It has long connected the Indian subcontinent to Southeast Asia, enabling migration of people, cultures and religions. It has also witnessed many wars, including fighting during World War II.

Agriculture is the main mode of living of the people. People of Manipur are also engaged in handloom sector which is the largest cottage industry in Manipur.

The state is the birth place of the game Polo which was known as Sagol Kangjei or Pulu and is also famous for its Manipuri dance the Ras Lila created by Rajashree Bhagyachandra. Manipur also boosts of its rich culture and tradition. People of Manipur are very enthusiastic about their traditional art and dance forms. Ras Lila is the highest expression of artistic genius, devotion and excellence. Manipur is a land of festivities. Throughout the year different festivals are celebrated by the different tribes of the state. Followings are some facts & figures regarding the state:

Location	:	Approximately lies between 23.8° to 25.7° latitude, North of Equator and between the longitudinal lines 93.5°E to 94.8°E.
Area	:	22,327 Sq. km.
Capital	:	Imphal (790 m above sea level)
District	:	*Bishnupur, Churachandpur, Chandel, Imphal East, Senapati, Tamenglong, Thoubal, Ukhrul, Imphal West, Kangpokpi, Tengnoupal, Pherzawl, Noney, Kamjong, Jiribam and Kakching.*
Population	:	28,55,794 (According to 2011 census)
Density of Population	:	128 persons per sq.km.
Male	:	14,38,586
Female	:	14,17,208
Sex Ratio	:	985 (Female per 1000 Male)
Main languages	:	Meitei/Meeteilon (Manipuri), Tangkhul, Kabui Kuki, Hmar, Paite, Thadou, Bishnupriya Manipuri, English, Hindi and local dialects

Tribes	:	The Meitei constitute a majority of the state's population. According to 1891 census Meitei were recorded as a forest tribe. In 1901 Meitei were listed as main tribe of Manipur. They live primarily in the state's valley region. Besides the Meitei people, the Thadous have the second highest percentage of the population. The third is the Nagas who are further sub-divided into subtribes:Tangkhul,Maram, PoumaiNaga, Sumi,Angami, Ao, Chakhesang, Chang, Khiamniungan, Konyak, Liangmai,Lotha, Pochury, Rongmei, Zeme and Mao.		
Literacy	:	79.21% (According to 2011 census)		
Per capita income	:	Rs. 36,474/- (2012-2013)		
Climate	:	Rainfall 1467.5 mm average		
Temperature	:	15^0 C to 32^0 C in Summer &4^0 C to 28^0 C in Winter		
Surfaced Roads Length	:	National Highways - 968 km, out of which the length of NH under PWD, Manipur is 283 kms only. The remaining 685 km is under BRO. State Highways - 668 km		
Crops	:	There are forests of teak, pine, oak, uningthou, leihao, bamboo, and cane. Rubber, tea, coffee, and cardamom are grown in hill areas. Rice and cash crops make up the main vegetation cover in the valley.		
Fruits	:	Litchi, cashew nuts, walnuts, orange, lemon, pineapple, papaya, peach, pear, banana and plum.		
Vegetable	:	Cauliflower, Cabbage, Tomato, Pea etc.		
Major Minerals	:	Limestone, Asbestos, Copper, Lignite, Nickel, Chromites, Salts etc.		
Forests	:	17,086 sq. km (76.53% of total land area).		
Livestock & Poultry	:	Category	Year	Stock / Population
		1. Cattle	2012	263843 Nos.
		2. Buffalo	2012	66369 Nos.
		3. Mithun	2012	10131 Nos.
		4. Sheep	2012	11463 Nos.
		5. Goats	2012	65158 Nos.
		6. Horses	2012	1101 Nos.
		7. Pigs	2012	277215 Nos.
		8. Dogs	2012	161818 Nos.
		9. Rabbits	2012	2039 Nos.
		Poultry		

		1. Fowls	2012	1851109 Nos.
		2. Ducks	2012	551433 Nos.
		2. Others	2012	19778 Nos.
Industries	:	Handlooms, Handicrafts, Sericulture, Food Processing, Bamboo Processing, IT, Hydro Power and Tourism.		

Project Road

Ukhrul-Toloi-Tadubi Road Package-1 will bypass the Ukhrul town on the existing road. Proposed Ukhrul-Toloi-Tadubi road Package-1 including Ukhrul Bypass will starts near Km 538 of NH-102A (about 6 Km before Ukhrul Town) & meets existing Ukhrul-Toloi-Tadubi Road at Ex chainage 8+840 (De. Ch. 5+600 Km) and then follow the existing road for about 1 Km & ends at De. Ch. 6+571 Km. The entire corridor falls under Ukhrul district in the state of Manipur.

The stretch of NH-102A from km 0.00 to km 9.840 passes through Ukhrul town, which is a district headquarters having population of more than 2.37 lakh as per 2011 census. This section of NH-102A not only passes through heavily built-up area of Ukhrul town but also having poor/sub-standard geometry. So, the widening & improvement of this section will require acquisition of land and structures in heavily built-up urban/market area. Even if the existing NH in the town portion is improved, the issue of traffic congestion and safety issue will remain due to heavy built-up urban section/market area. Hence, in order to avoid acquisition of land and huge structures in heavily built-up town/market area as well as to avoid traffic congestion and safety point of view, construction of bypass to Ukhrul town is important. Moreover, NH-102A also acts as an alternative route to the capital city of Imphal with reduction in travel distance by 8.16 km.

Location Map of the project road stretch is enclosed in **Figure 1.1**

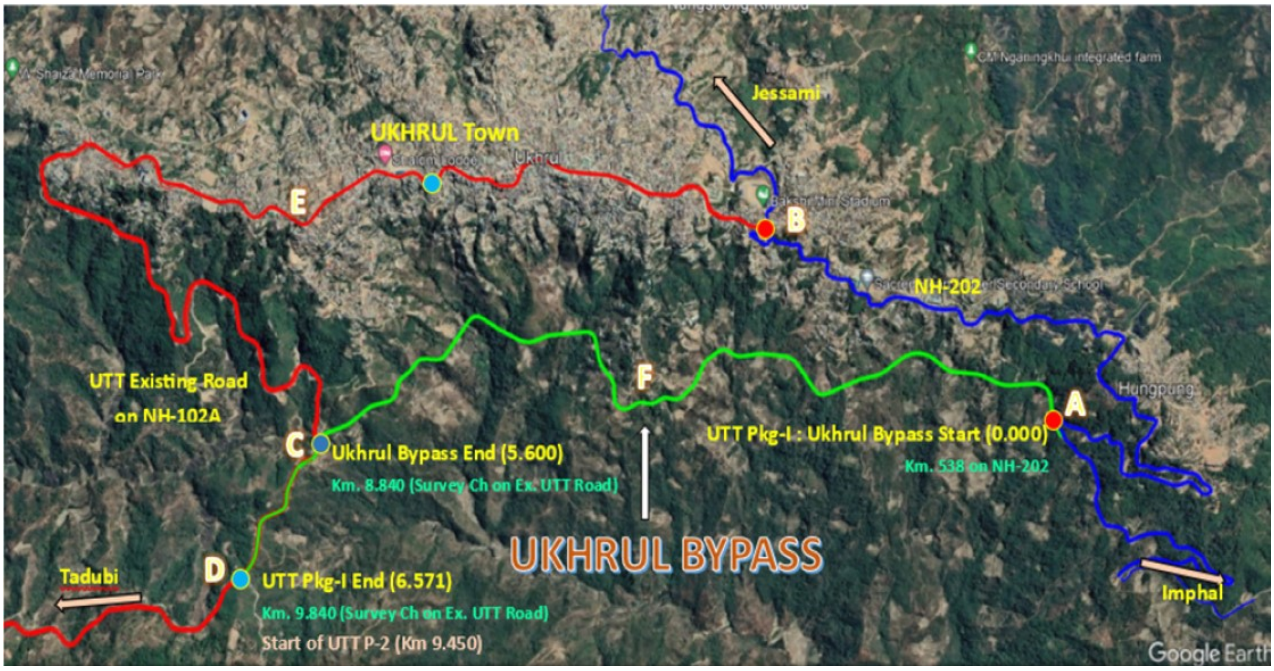


Figure 1.1: Location Map of Ukhrul-Toloi-Tadubi Road Pkg-1 (Ukhrul Bypass) on NH-102A

The Project Districts

The Package – I of project road stretch falls under Ukhrul district of Manipur.

Ukhrul District

Ukhrul is a district in Manipur, India. According to the 2011 Census, the district has a total population of 2.37 lacs with a sex ratio of 943 per one thousand males. The district has a population density of 40 inhabitants per square kilometer. The total literacy rate of the district is 81.4 per cent. The district has a total area of 4,544 sq. km.

The district is home to the Tangkhul Nagas, who are the dominant tribe in the region. Other tribes like Kuki are also included in very low numbers. Ukhrul is known for its scenic beauty and is often referred to as the "Land of Shirui Lily". The district is also home to the Shirui Lily National Park, which is home to the rare and beautiful Shirui Lily flower.

The Ukhrul District is located in the northern part of the state of Manipur. It is bounded on the east by international border with Myanmar; on the west by Kangpokpi District; on the north by the Kangpokpi District and on the south by the Kamjong District. The District is at an altitude varying from 1061 m to 1788 m above sea level. The hills run along the north south direction and gradually slope down towards south and meet the Imphal Valley.

1.3 Overview of NHIDCL Organization & Activities

National Highways and Infrastructure Development Corporation is a fully owned company of the Ministry of Road Transport & Highways, Government of India. The company promotes surveys, establishes, designs, builds, operates, maintains and upgrades National Highways and Strategic Roads including interconnecting roads in parts of the country which share international boundaries with neighboring countries. An approximate aggregate length of 10,000 kms has been identified to begin with for development through this company. The company envisages creating customized and specialized skills in terms of addressing issues like complexities of geographical terrains and addressing extensive coordination requirements with security agencies. The company would also endeavor to undertake infrastructure projects including but not restricted to urban infrastructure and urban or city transport and to act as an agency for development of all types of Infrastructure. The company envisages working towards cross sharing of technical know-how and enhancing opportunities for business development with other nations and their agencies including the multilateral organizations and institutions.
The company 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. These projects are being funded by ADB (Asian Development Bank).

Mission & Vision of NHIDCL

To be a professional company which works in most efficient and transparent manner and designs, develops & delivers infrastructure projects in a time bound basis for maximizing benefits to all stakeholders. To be an instrument for creation and management of infrastructure of the highest standard in the country with focus on the North East and Border areas and contribute significantly towards nation building.

1.4 Objectives of Consultancy Services

The main objective of the consultancy service is to establish the technical, economical, and financial viability of the project and prepare detailed project reports for rehabilitation and upgrading of the existing road to 2-lane configuration.

The viability of the project shall be established taking into account the requirements with regard to rehabilitation, upgrading and improvement based on highway design, pavement design, provision type of intersections, rehabilitation and widening of existing and/or construction of new bridges and structures, road safety features, quantities of various items of works and cost estimates and economic analysis.

The Detailed Project Report would inter-alia include detailed highway design, design of pavement, design of bridges and cross drainage structures and grade separated structures, quantities of various items, detailed working drawings, detailed cost estimates, economic and financial viability analyses, environmental and social feasibility, social and environmental action plans as appropriate and documents required for tendering the project on commercial basis for international / local competitive bidding.

Preparation of detailed project should incorporate aspects of value engineering, quality audit and safety audit requirement in design and implementation. Cost estimates along with Detailed Project Report should be given.

1.5 Scope of Consultancy Services

The broad area of scope of Consultancy services is given below:

- The widening/improvement work to 2 lane road shall be within the existing right of way avoiding land acquisition as far as possible with the provision of bypasses wherever required in urban areas. Proposal for land acquisition will be taken up as per revenue records for further processing of land acquisition document.
- Environmental Impact Assessment, Environmental Management Plan and Rehabilitation and Resettlement Studies shall be carried out as per the requirement and suggestion of NHIDCL.
- Preparation of the bid documents including required schedules preferably for EPC mode of documents. To assist the NHIDCL and its Financial Consultant and the Legal Adviser by furnishing clarifications as required for the financial appraisal and legal scrutiny of the Project Highway and Bid Documents.
- Review of all available reports and published information about the project road and the project influence area;
- Environmental and social impact assessment, including such as related to cultural properties, natural habitats, Involuntary resettlement etc.;
- Public consultation, including consultation with Communities located along the road, NGOs working in the area, other stake-holders and relevant Govt. departments at all the different stages of assignment (such as inception stage, feasibility stage, preliminary design stage and once final design are concretized).
- Detailed reconnaissance & reflection in the report;
- Identification of possible improvements in the existing alignment and bypassing congested locations with alternatives, evaluation of different alternatives comparison on techno-economic and other considerations and recommendations regarding most appropriate option;

- Traffic studies including traffic surveys, Axle load survey and demand forecasting for next thirty years;
- Inventory and condition surveys for road;
- Inventory and condition surveys for bridges, cross-drainage structures, other structures, river bank training/protection works and drainage provisions;
- Detailed topographic surveys using mobile/aerial LiDAR or equivalent technology;
- Pavement investigations;
- Sub-grade characteristics and strength; investigation of required sub-grade and sub-soil characteristics and strength for road and embankment design all sub soil investigation;
- Identification of sources of construction materials;
- Detailed design of road, its x-sections, horizontal and vertical alignment and design of embankment of height more than 6m and also in poor soil conditions and where density consideration require, even lesser height embankment. Detailed design of structures preparation of GAD and construction drawings and cross-drainage structures and underpasses etc.
- Identification of the type and the design of intersections;
- Design of complete drainage system and disposal point for storm water.
- Value analysis / value engineering and project costing;
- Economic and financial analyses;
- Contract packaging and implementation schedule;
- Strip plan indicating the scheme for carriageway widening, location of all existing utility services (both over and underground) and the scheme for their relocation, trees to be felled; reports documents and drawings arrangement of estimates for cutting of trees and shifting of utilities from the concerned department;
- To find out financial viability of project for implementation and suggest the preferred mode on which the project is to be taken up.
- Preparation of detailed project report, cost estimate, approved for construction drawings, rate analysis, detailed bill of quantities, bid documents for execution of civil works through budgeting resources;
- Indicating the proposal of project facilities in the plan drawing
- Tie-in of on-going/sanctioned works of MORT&H/NHAI/other agencies;

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

CHAPTER-2 PROJECT DESCRIPTION

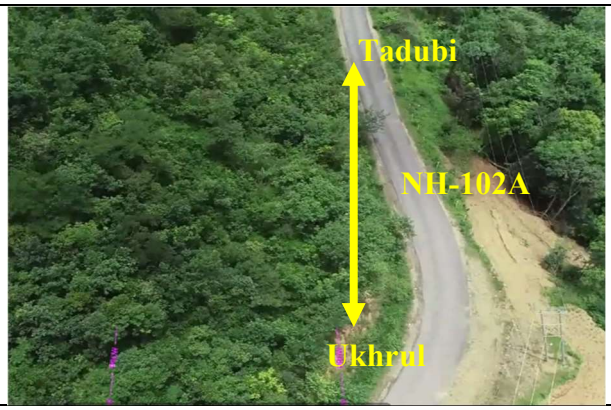
2.1 Existing Scenario

2.1.1 Start and End Point of The Project Road

The project Road i.e., Ukhrul-Toloi-Tadubi Road Pkg-1 (Ukhrul Bypass) lies in the State of Manipur. The Project Road starts near Km 538 of NH-102A (about 6 Km before Ukhrul Town) and the Project Road passes through major village/localities namely Hundung & Hunphun and meets existing Ukhrul-Toloi-Tadubi Road at Ex chainage 8+840 (De. Ch. 5+600 Km) and then follow the existing road for about 1 Km & ends at De. Ch. 6+571 Km. in the State of Manipur. The project road lies in Ukhrul district of Manipur.

The pictures at Start and End Point are as follows:

Start point of the project road near Km 538 of NH-202 (De. Ch: 0.000 km)



End point of the project road at Km. 9_840 of existing UTT Road (De. Ch: 198.827 km)

2.1.2 Settlement

During reconnaissance survey it has been observed that 2 nos. habitations along the project road. Detailed of the habitation are listed below in Table-2.1:

TABLE- 2.1: Details of Settlement/Habitational Area

Sl No	Design Chainage (km)	Name of the habitation	Side
1	0+000 to 4+122	Hundung	Both
2	4+122 to 6+571	Hunphun	Both

2.1.3 Land Use Pattern

Land used pattern of the road stretch is predominately passes through forest land with road side agriculture and habitation are observed at 2 villages namely Hundung & Hunphun (Ukhrul) in Ukhrul District in the state of Manipur.

Plate – 2.1: Photographs of forest land and habitation area

Agricultural Land

Habitation Area

2.1.4 Existing Right of Way (ROW)

The existing ROW width in open area of mountainous terrain is 9-12 m throughout the road except junction portion. Therefore, the existing ROW does not cater the codal provision of 24m-50m ROW required for hill road in rural areas and 20m ROW in built-up area. Thus, the additional land may have to be acquired to accommodate the proposed 2-lane lane with hard shoulder configuration.

2.1.5 Existing Pavement

The existing road is mostly Single lane carriageway. The existing carriageway is 3.75 m. Only the portion.

The existing pavement condition along the road is basically poor. Some portion of the stretch the existing pavement is partially damaged with raveling's, rutting edge breaking and potholes and some stretches have been observed that existing bituminous layer is fully damaged and exposed bituminous layer of pavement. Also, significant part of the stretches has been found where the existing pavement is gravel & earthen type.

Some photographs of existing pavement distress Plate – 2.2.

Plate – 2.2: Photographs of existing Pavement Distresses

Raveling

Potholes

The above distresses signify the existing pavement surface has undergone structural failure, moisture infiltration, sub grade settlement due to inadequate compaction and improper mix design of bituminous layers. Therefore, reconstruction from sub-grade will be ideal option for improvement/ up gradation of pavement surface.

Variation of Carriageway width is given below in **Table-2.2:**

TABLE 2.2: Variation of Existing Carriageway Width

Sr. No.	Exisitng Chainage (Km)			C/W
	From	To	Length	
1	0.000	4.100	4.100	7.00
2	4.100	4.900	0.800	5.50
3	4.900	9.840	4.940	4.20
Sub Total (Km)			9.840	

2.1.6 Existing Junction

There are 2 major intersections apart from several minor intersections observed along the project road length. Details of the Major Junction are given below in **Table-2.3.**

TABLE- 2.3: Details of Major Junction

Sl. No.	Chainage in Km.	Location	Type
1	0+000	Junction at Ukhrul	3-legged
2	4+850	Junction at Somsai	3-legged

Photograph of Major Intersections are presented in Fig – 2.3:

Fig – 2.3 Junction at Ex. Km 0+000 (Ukhrul)

2.1.7 Existing Bridges and Culverts

Bridges:

There is no existing bridge in this stretch.

Culverts:

There are 25 nos. existing culverts observed along the road stretch.

Sample photographs of Existing Culverts are presented in Fig – 2.4:

Existing Culvert

Details are given below in **Table-2.4**.

TABLE- 2.4: Details of Existing Culverts

Sl. No.	Existing Chainage (km)	Type of Culvert	Span/Dia(m)	Width(m)
1	0+613	Pipe culvert	1x0.6	7.00
2	4+552	Slab Culvert	1x1.0	7.50
3	5+465	Pipe culvert	1x1.0	7.20
4	5+525	Pipe culvert	1x1.0	7.20
5	5+725	Pipe culvert	1x0.6	7.50
6	5+810	Pipe culvert	1x1.0	7.50
7	5+915	Pipe culvert	1x0.6	7.50
8	6+020	Pipe culvert	1x0.6	7.50
9	6+155	Pipe culvert	1x0.6	7.50
10	6+324	Pipe culvert	1x0.9	7.50
11	6+990	Pipe culvert	1x0.9	7.50
12	7+040	Pipe culvert	1x0.6	7.50
13	7+087	Slab Culvert	1x1.5	7.50
14	7+245	Pipe culvert	1x0.6	7.00
15	7+300	Slab Culvert	1x3.0	7.80
16	7+420	Pipe culvert	1x0.9	7.50
17	7+620	Pipe culvert	1x0.9	7.50

Sl. No.	Existing Chainage (km)	Type of Culvert	Span/Dia(m)	Width(m)
18	7+741	Pipe culvert	1x0.9	7.50
19	7+840	Pipe culvert	1x0.6	7.50
20	7+990	Pipe culvert	1x0.6	7.50
21	8+200	Pipe culvert	1x0.6	7.50
22	8+485	Pipe culvert	1x1.0	7.50
23	8+677	Pipe culvert	1x0.9	7.50
24	9+090	Pipe culvert	1x0.9	7.50
25	9+665	Pipe culvert	1x1.0	12.40

2.1.8 Forest Stretch

Entire stretch of the project road passing through forest area.

2.1.9 Land Slide Zone

No Land slide zone have been observed on the project road.

2.1.10 Sinking Zone

No Sinking zone have been observed on the project road.

2.1.11 Roadway Drainage

Side drains (Lined & Unlined) are present in the few stretches in the built-up area & unlined drain is also present in few stretches in the hill side. Thus, maximum portion of the project road stretch is affected by rain water and seepage water from hilly portion.

2.1.12 Photograph of Existing Road

Photograph of road corridor is presented below

Existing Road Photograph

 Start Point	 Bituminous Road

2.2 Development Proposal

2.2.1 Geometrics Design

Horizontal Alingment

Horizontal alignment of proposed 2 lane road has been designed as per the design speed mentioned in IRC: SP 73-2018 for mountainous terrain (i.e., Ruling = 60 Kmph & Limiting = 40 Kmph).

Details of Horizontal & Vertical Alignment Report indicating important features like curve radius, length, direction of curve, design speed, super elevation, extra widening etc. are presented below in **Table 2.5**.

HORIZONTAL ALIGNMENT REPORT

HIP/CURVE NO.	DEFLECTION ANGLE			ELEMENT	START			END			LENGTH (m)	CHORD LENGTH (m)	BEARING (dd mm ss)	RADIUS (m)	HAND OF ARC	SUPERELEVATION (%)	DESIGN SPEED	EXTRA WIDENING
	DEG	MIN	SEC		CHAINAGE (m)	EASTING	NORTHING	CHAINAGE (m)	EASTING	NORTHING								
				Start	0.000	635691.017	2773296.943	63.767	635753.824	2773307.967	63.767							
				Transition	63.767	635753.824	2773307.967	108.767	635797.342	2773319.019		45						0.9
1	79	48	24.95	Arc	108.767	635797.342	2773319.019	203.057	635855.901	2773388.458		94.289		100	Left	7.0	50	0.9
				Transition	203.057	635855.901	2773388.458	248.057	635859.450	2773433.217		45						0.9
				Straight	248.057	635859.450	2773433.217	352.710	635859.885	2773537.869	104.653		N 0^14'17.20" E					
				Transition	352.710	635859.885	2773537.869	392.710	635861.383	2773577.823		40						0.6
2	27	17	6.5	Arc	392.710	635861.383	2773577.823	447.953	635874.594	2773631.283		55.243		200	Right	7.0	60	0.6
				Transition	447.953	635874.594	2773631.283	487.953	635891.878	2773667.336		40						0.6
				Straight	487.953	635891.878	2773667.336	529.844	635911.237	2773704.486	41.891		N 27^31'23.70" E					
				Transition	529.844	635911.237	2773704.486	569.844	635928.521	2773740.539		40						0.6
3	18	29	30.34	Arc	569.844	635928.521	2773740.539	594.392	635936.215	2773763.834		24.548		200	Left	7.0	60	0.6
				Transition	594.392	635936.215	2773763.834	634.392	635943.803	2773803.090		40						0.6
				Straight	634.392	635943.803	2773803.090	716.902	635956.756	2773884.577	82.510		N 9^01'53.36" E					
				Transition	716.902	635956.756	2773884.577	761.902	635967.105	2773928.266		45						0.9
4	33	11	17.69	Arc	761.902	635967.105	2773928.266	774.826	635972.691	2773939.911		12.924		100	Right	7.0	50	0.9
				Transition	774.826	635972.691	2773939.911	819.826	636000.287	2773975.329		45						0.9
				Straight	819.826	636000.287	2773975.329	848.844	636019.786	2773996.819	29.018		N 42^13'11.04" E					
				Transition	848.844	636019.786	2773996.819	898.844	636051.500	2774035.412		50						0.6
5	73	11	3.95	Arc	898.844	636051.500	2774035.412	1065.987	636067.238	2774195.130		167.143		170	Left	7.0	60	0.6
				Transition	1065.987	636067.238	2774195.130	1115.987	636043.666	2774239.170		50						0.6
				Straight	1115.987	636043.666	2774239.170	1198.785	636001.066	2774310.168	82.797		N 30^57'52.90" W					
				Transition	1198.785	636001.066	2774310.168	1233.785	635984.249	2774340.839		35						0.6
6	23	43	44.67	Arc	1233.785	635984.249	2774340.839	1260.907	635975.386	2774366.433		27.123		150	Right	7.0	50	0.6
				Transition	1260.907	635975.386	2774366.433	1295.907	635969.635	2774400.936		35						0.6
				Straight	1295.907	635969.635	2774400.936	1331.349	635965.171	2774436.095	35.442		N 7^14'08.24" W					
				Transition	1331.349	635965.171	2774436.095	1361.349	635960.897	2774465.786		30						0.6

HORIZONTAL ALIGNMENT REPORT

HIP/CURVE NO.	DEFLECTION ANGLE			ELEMENT	START			END			LENGTH (m)	CHORD LENGTH (m)	BEARING (dd mm ss)	RADIUS (m)	HAND OF ARC	SUPERELEVATION (%)	DESIGN SPEED	EXTRA WIDENING
	DEG	MIN	SEC		CHAINAGE (m)	EASTING	NORTHING	CHAINAGE (m)	EASTING	NORTHING								
7	10	28	8.54	Arc	1361.349	635960.897	2774465.786	1386.164	635955.540	2774490.009		24.816		300	Left	5.3	60	0.6
				Transition	1386.164	635955.540	2774490.009	1416.164	635946.896	2774518.733		30						0.6
				Straight	1416.164	635946.896	2774518.733	1571.114	635899.774	2774666.344	154.950		N 17^42'16.78" W					
				Transition	1571.114	635899.774	2774666.344	1601.114	635892.587	2774695.415		30						0.9
8	75	58	30.89	Arc	1601.114	635892.587	2774695.415	1670.565	635915.811	2774758.258		69.451		75	Right	7.0	40	0.9
				Transition	1670.565	635915.811	2774758.258	1700.565	635940.177	2774775.668		30						0.9
				Straight	1700.565	635940.177	2774775.668	1830.769	636050.921	2774844.143	130.204		N 58^16'14.11" E					
				Transition	1830.769	636050.921	2774844.143	1865.769	636079.774	2774863.901		35						0.6
9	48	54	41.27	Arc	1865.769	636079.774	2774863.901	1937.477	636119.135	2774922.666		71.708		125	Left	7.0	50	0.6
				Transition	1937.477	636119.135	2774922.666	1972.477	636126.425	2774956.867		35						0.6
				Straight	1972.477	636126.425	2774956.867	2039.885	636137.387	2775023.377	67.407		N 9^21'32.84" E					
				Transition	2039.885	636137.387	2775023.377	2074.885	636142.270	2775058.027		35						0.6
10	10	33	43.76	Arc	2074.885	636142.270	2775058.027	2085.971	636143.059	2775069.084		11.086		250	Left	6.4	60	0.6
				Transition	2085.971	636143.059	2775069.084	2120.971	636143.140	2775104.077		35						0.6
				Straight	2120.971	636143.140	2775104.077	2144.726	636142.642	2775127.826	23.755		N 1^12'10.92" W					
				Transition	2144.726	636142.642	2775127.826	2179.726	636143.267	2775162.800		35						0.6
11	20	46	7.65	Arc	2179.726	636143.267	2775162.800	2199.099	636146.356	2775181.911		19.373		150	Right	7.0	50	0.6
				Transition	2199.099	636146.356	2775181.911	2234.099	636156.780	2775215.300		35						0.6
				Straight	2234.099	636156.780	2775215.300	2257.351	636164.567	2775237.210	23.252		N 19^33'56.73" E					
				Transition	2257.351	636164.567	2775237.210	2302.351	636176.392	2775280.523		45						0.9
12	32	29	30.1	Arc	2302.351	636176.392	2775280.523	2314.059	636177.070	2775292.206		11.709		100	Left	7.0	50	0.9
				Transition	2314.059	636177.070	2775292.206	2359.059	636170.332	2775336.596		45						0.9
				Straight	2359.059	636170.332	2775336.596	2408.634	636159.243	2775384.915	49.575		N 12^55'33.37" W					
				Transition	2408.634	636159.243	2775384.915	2438.634	636150.615	2775413.592		30						0.9
13	47	29	59.44	Arc	2438.634	636150.615	2775413.592	2470.811	636131.543	2775439.201		32.177		75	Left	7.0	40	0.9
				Transition	2470.811	636131.543	2775439.201	2500.811	636106.540	2775455.683		30						0.9

HORIZONTAL ALIGNMENT REPORT

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	DEG	MIN	SEC		CHAINAGE (m)	EASTING	NORTHING	CHAINAGE (m)	EASTING	NORTHING								
				Straight	2500.811	636106.540	2775455.683	2608.021	636013.298	2775508.596	107.209		N 60^25'32.81" W					
				Transition	2608.021	636013.298	2775508.596	2643.021	635983.571	2775527.030		35						0.6
14	62	27	20.06	Arc	2643.021	635983.571	2775527.030	2771.529	635922.780	2775635.810		128.508		150	Right	7.0	50	0.6
				Transition	2771.529	635922.780	2775635.810	2806.529	635922.659	2775670.789		35						0.6
				Straight	2806.529	635922.659	2775670.789	2917.265	635926.581	2775781.455	110.736		N 2^01'47.25" E					
				Transition	2917.265	635926.581	2775781.455	2952.265	635926.461	2775816.434		35						0.6
15	21	12	22.49	Arc	2952.265	635926.461	2775816.434	2972.783	635923.404	2775836.706		20.518		150	Left	7.0	50	0.6
				Transition	2972.783	635923.404	2775836.706	3007.783	635913.207	2775870.166		35						0.6
				Straight	3007.783	635913.207	2775870.166	3028.056	635906.548	2775889.315	20.274		N 19^10'35.23" W					
				Transition	3028.056	635906.548	2775889.315	3058.056	635898.617	2775918.192		30						0.9
16	105	7	51.86	Arc	3058.056	635898.617	2775918.192	3165.672	635952.889	2776000.534		107.616		75	Right	7.0	40	0.9
				Transition	3165.672	635952.889	2776000.534	3195.672	635982.554	2776004.631		30						0.9
				Straight	3195.672	635982.554	2776004.631	3237.314	636024.091	2776007.569	41.641		N 85^57'16.63" E					
				Transition	3237.314	636024.091	2776007.569	3282.314	636068.515	2776014.082		45						0.9
17	28	11	39.45	Arc	3282.314	636068.515	2776014.082	3286.522	636072.514	2776015.392		4.208		100	Left	7.0	50	0.9
				Transition	3286.522	636072.514	2776015.392	3331.522	636112.178	2776036.432		45						0.9
				Straight	3331.522	636112.178	2776036.432	3352.403	636129.840	2776047.572	20.881		N 57^45'37.18" E					
				Transition	3352.403	636129.840	2776047.572	3387.403	636160.129	2776065.067		35						0.6
18	27	31	47.3	Arc	3387.403	636160.129	2776065.067	3424.476	636195.201	2776076.785		37.073		150	Right	7.0	50	0.6
				Transition	3424.476	636195.201	2776076.785	3459.476	636229.924	2776081.010		35						0.6
				Straight	3459.476	636229.924	2776081.010	3478.705	636249.088	2776082.589	19.229		N 85^17'24.48" E					
				Transition	3478.705	636249.088	2776082.589	3508.705	636278.704	2776087.030		30						0.9
19	76	21	11.57	Arc	3508.705	636278.704	2776087.030	3578.651	636328.116	2776132.926		69.946		75	Left	7.0	40	0.9
				Transition	3578.651	636328.116	2776132.926	3608.651	636334.728	2776162.133		30						0.9
				Straight	3608.651	636334.728	2776162.133	3718.224	636351.750	2776270.376	109.573		N 8^56'12.91" E					
				Transition	3718.224	636351.750	2776270.376	3758.224	636356.641	2776310.058		40						0.6

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HIP/CURVE NO.	DEFLECTION ANGLE			ELEMENT	START			END			LENGTH (m)	CHORD LENGTH (m)	BEARING (dd mm ss)	RADIUS (m)	HAND OF ARC	SUPERELEVATION (%)	DESIGN SPEED	EXTRA WIDENING
	DEG	MIN	SEC		CHAINAGE (m)	EASTING	NORTHING	CHAINAGE (m)	EASTING	NORTHING								
20	28	10	58.12	Arc	3758.224	636356.641	2776310.058	3816.601	636351.415	2776367.992		58.377		200	Left	7.0	60	0.6
				Transition	3816.601	636351.415	2776367.992	3856.601	636339.501	2776406.158		40						0.6
				Straight	3856.601	636339.501	2776406.158	3873.595	636333.900	2776422.203	16.994		N 19^14'45.22" W					
				Transition	3873.595	636333.900	2776422.203	3913.595	636321.986	2776460.369		40						0.6
21	48	15	25.26	Arc	3913.595	636321.986	2776460.369	4042.044	636332.732	2776586.163		128.449		200	Right	7.0	60	0.6
				Transition	4042.044	636332.732	2776586.163	4082.044	636350.946	2776621.756		40						0.6
				Straight	4082.044	636350.946	2776621.756	4138.327	636378.243	2776670.976	56.283		N 29^00'40.04" E					
22	6	46	38.86	Arc	4138.327	636378.243	2776670.976	4197.471	636409.915	2776720.885		59.144		500	Right	3.2	60	--NA--
				Straight	4197.471	636409.915	2776720.885	4249.098	636440.106	2776762.763	51.627		N 35^47'18.90" E					
				Transition	4249.098	636440.106	2776762.763	4279.098	636455.962	2776788.168		30						0.9
23	72	20	0.08	Arc	4279.098	636455.962	2776788.168	4343.782	636455.549	2776850.864		64.684		75	Left	7.0	40	0.9
				Transition	4343.782	636455.549	2776850.864	4373.782	636439.359	2776876.057		30						0.9
				Straight	4373.782	636439.359	2776876.057	4426.151	636408.175	2776918.130	52.369		N 36^32'41.18" W					
				Transition	4426.151	636408.175	2776918.130	4461.151	636386.689	2776945.749		35						0.6
24	14	47	3.62	Arc	4461.151	636386.689	2776945.749	4490.660	636366.225	2776966.986		29.509		250	Left	6.4	60	0.6
				Transition	4490.660	636366.225	2776966.986	4525.660	636339.423	2776989.483		35						0.6
				Straight	4525.660	636339.423	2776989.483	4579.749	636297.193	2777023.280	54.089		N 51^19'44.81" W					
				Transition	4579.749	636297.193	2777023.280	4609.749	636275.110	2777043.508		30						0.9
25	60	39	51.2	Arc	4609.749	636275.110	2777043.508	4659.159	636257.724	2777088.806		49.409		75	Right	7.0	40	0.9
				Transition	4659.159	636257.724	2777088.806	4689.159	636260.603	2777118.614		30						0.9
				Straight	4689.159	636260.603	2777118.614	4709.820	636263.955	2777139.002	20.661		N 9^20'06.39" E					
				Transition	4709.820	636263.955	2777139.002	4739.820	636266.834	2777168.810		30						0.9
26	59	23	23.62	Arc	4739.820	636266.834	2777168.810	4787.561	636250.503	2777212.817		47.741		75	Left	7.0	40	0.9
				Transition	4787.561	636250.503	2777212.817	4817.561	636228.875	2777233.530		30						0.9
				Straight	4817.561	636228.875	2777233.530	4998.524	636090.139	2777349.718	180.963		N 50^03'17.22" W					
				Transition	4998.524	636090.139	2777349.718	5043.524	636057.972	2777381.043		45						0.9

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HIP/CURVE NO.	DEFLECTION ANGLE			ELEMENT	START			END			LENGTH (m)	CHORD LENGTH (m)	BEARING (dd mm ss)	RADIUS (m)	HAND OF ARC	SUPERELEVATION (%)	DESIGN SPEED	EXTRA WIDENING
	DEG	MIN	SEC		CHAINAGE (m)	EASTING	NORTHING	CHAINAGE (m)	EASTING	NORTHING								
27	40	58	39.1	Arc	5043.524	636057.972	2777381.043	5070.043	636044.925	2777404.042		26.519		100	Right	7.0	50	0.9
				Transition	5070.043	636044.925	2777404.042	5115.043	636034.541	2777447.723		45						0.9
				Straight	5115.043	636034.541	2777447.723	5142.870	636030.151	2777475.202	27.827		N 9^04'38.12" W					
				Transition	5142.870	636030.151	2777475.202	5172.870	636024.436	2777504.639		30						0.6
28	23	16	48.23	Arc	5172.870	636024.436	2777504.639	5203.817	636013.507	2777533.533		30.947		150	Left	7.0	50	0.6
				Transition	5203.817	636013.507	2777533.533	5233.817	635998.312	2777559.385		30						0.6
				Straight	5233.817	635998.312	2777559.385	5333.012	635945.223	2777643.177	99.195		N 32^21'26.35" W					
				Transition	5333.012	635945.223	2777643.177	5363.012	635930.027	2777669.029		30						0.6
29	17	4	24.45	Arc	5363.012	635930.027	2777669.029	5377.710	635924.093	2777682.469		14.698		150	Right	7.0	50	0.6
				Transition	5377.710	635924.093	2777682.469	5407.710	635915.229	2777711.116		30						0.6
				Straight	5407.710	635915.229	2777711.116	5490.043	635893.526	2777790.537	82.333		N 15^17'01.90" W					
				Transition	5490.043	635893.526	2777790.537	5520.043	635883.726	2777818.835		30						0.9
30	50	3	1.11	Arc	5520.043	635883.726	2777818.835	5555.559	635860.964	2777845.666		35.516		75	Left	7.0	40	0.9
				Transition	5555.559	635860.964	2777845.666	5585.559	635834.643	2777859.948		30						0.9
				Straight	5585.559	635834.643	2777859.948	5631.181	635793.183	2777878.987	45.622		N 65^20'03.00" W					
				Transition	5631.181	635793.183	2777878.987	5656.181	635771.062	2777890.576		25						0.9
31	46	33	17.54	Arc	5656.181	635771.062	2777890.576	5696.184	635744.544	2777919.969		40.003		80	Right	7.0	40	0.9
				Transition	5696.184	635744.544	2777919.969	5721.184	635735.285	2777943.162		25						0.9
				Straight	5721.184	635735.285	2777943.162	5738.593	635729.681	2777959.644	17.409		N 18^46'45.47" W					
				Transition	5738.593	635729.681	2777959.644	5768.593	635718.174	2777987.291		30						0.9
32	41	33	24.67	Arc	5768.593	635718.174	2777987.291	5792.990	635702.704	2778006.019		24.398		75	Left	7.0	40	0.9
				Transition	5792.990	635702.704	2778006.019	5822.990	635677.727	2778022.540		30						0.9
				Straight	5822.990	635677.727	2778022.540	5897.121	635613.312	2778059.227	74.130		N 60^20'10.14" W					
				Transition	5897.121	635613.312	2778059.227	5932.121	635582.267	2778075.344		35						0.6
33	18	24	19.17	Arc	5932.121	635582.267	2778075.344	5945.306	635569.918	2778079.952		13.185		150	Left	7.0	50	0.6
				Transition	5945.306	635569.918	2778079.952	5980.306	635535.904	2778088.109		35						0.6

HORIZONTAL ALIGNMENT REPORT

HIP/CURVE NO.	DEFLECTION ANGLE			ELEMENT	START			END			LENGTH (m)	CHORD LENGTH (m)	BEARING (dd mm ss)	RADIUS (m)	HAND OF ARC	SUPERELEVATION (%)	DESIGN SPEED	EXTRA WIDENING
	DEG	MIN	SEC		CHAINAGE (m)	EASTING	NORTHING	CHAINAGE (m)	EASTING	NORTHING								
				Straight	5980.306	635535.904	2778088.109	5984.739	635531.556	2778088.975	4.433		N 78^44'29.30" W					
				Transition	5984.739	635531.556	2778088.975	6014.739	635502.640	2778096.764		30						0.9
34	61	0	24.12	Arc	6014.739	635502.640	2778096.764	6064.596	635466.131	2778129.363		49.858		75	Right	7.0	40	0.9
				Transition	6064.596	635466.131	2778129.363	6094.596	635455.130	2778157.216		30						0.9
				Straight	6094.596	635455.130	2778157.216	6144.576	635439.905	2778204.821	49.980		N 17^44'05.18" W					
				Transition	6144.576	635439.905	2778204.821	6174.576	635428.904	2778232.673		30						0.9
35	62	0	23.18	Arc	6174.576	635428.904	2778232.673	6225.742	635391.184	2778265.767		51.166		75	Left	7.0	40	0.9
				Transition	6225.742	635391.184	2778265.767	6255.742	635362.136	2778273.051		30						0.9
				Straight	6255.742	635362.136	2778273.051	6352.560	635266.866	2778290.294	96.818		N 79^44'28.36" W					
				Transition	6352.560	635266.866	2778290.294	6372.560	635247.250	2778294.183		20						0.6
36	45	48	26.13	Arc	6372.560	635247.250	2778294.183	6512.458	635132.512	2778369.158		139.897		200	Right	5.6	50	0.6
				Transition	6512.458	635132.512	2778369.158	6532.458	635121.073	2778385.562		20						0.6
				Straight	6532.458	635121.073	2778385.562	6571.048	635099.531	2778417.579	38.590		N 33^56'02.23" W					

VERTICAL ALIGNMENT REPORT

VERTICAL CURVE REPORT

CURVE NO.	IP		TYPE OF CURVE	CURVE LENGTH	M VALUE	START		END		GRADIENT		K' VALUE
	CHAINAGE	LEVEL				CHAINAGE	LEVEL	CHAINAGE	LEVEL	IN	OUT	
1	658.104	1691.564	Hog	150	-0.708	583.104	1692.106	733.104	1688.189	-0.723	-4.500	39.714
2	1249.407	1664.956	Sag	220	1.365	1139.407	1669.906	1359.407	1665.464	-4.500	0.462	44.337
3	1968.964	1668.283	Hog	200	-1.241	1868.964	1667.821	2068.964	1663.783	0.462	-4.500	40.306
4	2838.000	1629.176	Sag	200	1.164	2738.000	1633.676	2938.000	1629.334	-4.500	0.158	42.937
5	3226.454	1629.789	Hog	100	-0.311	3176.454	1629.710	3276.454	1628.624	0.158	-2.330	40.193
6	3544.000	1622.390	Sag	100	0.291	3494.000	1623.555	3594.000	1622.390	-2.330	0.000	42.918
7	3915.654	1622.390	Hog	200	-1.000	3815.654	1622.390	4015.654	1618.390	0.000	-4.000	50.000
8	4761.000	1588.576	Sag	150	0.750	4686.000	1591.576	4836.000	1588.576	-4.000	0.000	37.500
9	5051.000	1588.576	Hog	150	-0.750	4976.000	1588.576	5126.000	1585.576	0.000	-4.000	37.500
10	5846.104	1556.772	Sag	350	3.937	5671.104	1563.772	6021.104	1565.522	-4.000	5.000	38.889

2.2.2 Proposed Cross Section Details

Cross-section of the improved facility should be adequate to cater to the traffic expected over the design period and offer safe and convenient traffic operation at speeds consistent with the terrain conditions and functional classification of this road. The cross-sectional parameters (land /shoulder width etc.) shall be as per standards specified in IRC SP: 73-2018. Following typical cross-sections have been envisaged for the subject road. Chainage wise cross-section details are given in **Table- 2.6**

TABLE 2.6: Chainage Wise Cross-Section Details

Proposed Chainage (Km)		Length of TCS (m)	Length of CD (m)	Net Length (m)	TCS No.
From	To				
0	50	50		50.00	TCS-4
50	90	40	2.00	38.00	TCS-3
90	170	80		80.00	TCS-7
170	190	20		20.00	TCS-1B
190	200	10	3.00	7.00	TCS-2
200	220	20		20.00	TCS-5
220	240	20		20.00	TCS-4
240	260	20		20.00	TCS-1B
260	390	130		130.00	TCS-4
390	475	85	3.00	82.00	TCS-2
475	540	65		65.00	TCS-4
540	560	20		20.00	TCS-1B
560	680	120	2.00	118.00	TCS-2
680	690	10		10.00	TCS-1A
690	750	60	2.00	58.00	TCS-2
750	770	20		20.00	TCS-4
770	990	220		220.00	TCS-7
990	1050	60		60.00	TCS-1A
1050	1130	80		80.00	TCS-3
1130	1150	20		20.00	TCS-6
1150	1180	30		30.00	TCS-5
1180	1270	90	3.00	87.00	TCS-2
1270	1290	20		20.00	TCS-3
1290	1320	30		30.00	TCS-6
1320	1340	20		20.00	TCS-4
1340	1400	60		60.00	TCS-1A
1400	1470	70		70.00	TCS-2
1470	1500	30		30.00	TCS-1C
1500	1660	160	5.00	155.00	TCS-2
1660	1670	10		10.00	TCS-1C
1670	1710	40		40.00	TCS-4
1710	1730	20		20.00	TCS-3
1730	1870	140		140.00	TCS-4
1870	1950	80	2.00	78.00	TCS-1A
1950	1970	20		20.00	TCS-4
1970	2080	110		110.00	TCS-1A
2080	2100	20		20.00	TCS-3
2100	2110	10	2.00	8.00	TCS-9

Proposed Chainage (Km)		Length of TCS (m)	Length of CD (m)	Net Length (m)	TCS No.
From	To				
2110	2150	40		40.00	TCS-6
2150	2180	30		30.00	TCS-3
2180	2270	90		90.00	TCS-7
2270	2320	50		50.00	TCS-1B
2320	2330	10		10.00	TCS-7
2330	2360	30		30.00	TCS-1B
2360	2400	40	30.00	10.00	TCS-1C
2400	2420	20		20.00	TCS-3
2420	2630	210	2.00	208.00	TCS-1B
2630	2650	20		20.00	TCS-4
2650	2670	20		20.00	TCS-5
2670	2720	50		50.00	TCS-2
2720	2730	10		10.00	TCS-5
2730	2790	60		60.00	TCS-4
2790	2830	40		40.00	TCS-2
2830	2860	30		30.00	TCS-2
2860	2890	30	5.00	25.00	TCS-5
2890	2920	30		30.00	TCS-7
2920	2940	20		20.00	TCS-10
2940	2980	40	2.00	38.00	TCS-2
2980	3050	70		70.00	TCS-1A
3050	3180	130		130.00	TCS-2
3180	3220	40		40.00	TCS-1A
3220	3260	40	2.00	38.00	TCS-3
3260	3300	40		40.00	TCS-1A
3300	3580	280		280.00	TCS-8
3580	3600	20		20.00	TCS-1B
3600	3650	50	40.00	10.00	TCS-2
3650	3660	10		10.00	TCS-1C
3660	3750	90		90.00	TCS-8
3750	3760	10		10.00	TCS-1C
3760	3820	60		60.00	TCS-7
3820	3870	50		50.00	TCS-3
3870	3910	40	2.00	38.00	TCS-9
3910	3960	50		50.00	TCS-7
3960	4010	50		50.00	TCS-10
4010	4060	50		50.00	TCS-7
4060	4130	70	30.00	40.00	TCS-1A
4130	4350	220		220.00	TCS-7
4350	4440	90	40.00	50.00	TCS-1B

Proposed Chainage (Km)		Length of TCS (m)	Length of CD (m)	Net Length (m)	TCS No.
From	To				
4440	4530	90		90.00	TCS-7
4530	4560	30		30.00	TCS-4
4560	4730	170		170.00	TCS-7
4730	4850	120		120.00	TCS-10
4850	4970	120	90.00	30.00	TCS-1A
4970	5000	30		30.00	TCS-7
5000	5030	30		30.00	TCS-10
5030	5060	30		30.00	TCS-7
5060	5110	50	2.00	48.00	TCS-10
5110	5150	40		40.00	TCS-7
5150	5180	30		30.00	TCS-10
5180	5280	100		100.00	TCS-2
5280	5320	40	3.00	37.00	TCS-2
5320	5370	50		50.00	TCS-10
5370	5410	40		40.00	TCS-7
5410	5460	50		50.00	TCS-2
5460	5500	40		40.00	TCS-1A
5500	5590	90		90.00	TCS-4
5590	5690	100	2.00	98.00	TCS-1B
5690	5790	100		100.00	TCS-3
5790	5840	50		50.00	TCS-1C
5840	5850	10	2.00	8.00	TCS-2
5850	5870	20		20.00	TCS-10
5870	5940	70		70.00	TCS-7
5940	5970	30	2	28.00	TCS-1A
5970	6090	120		120.00	TCS-7
6090	6120	30		30.00	TCS-4
6120	6180	60		60.00	TCS-7
6180	6270	90		90.00	TCS-3
6270	6440	170		170.00	TCS-1C
6440	6460	20		20.00	TCS-3
6460	6571	111	2	109.00	TCS-1A
Total Length		**6571**	**280.00**	**6291.00**	

2.2.3 Pavement Details

2 lane road will be developed in place of existing single lane road. Considering Design traffic of 20 msa and Design CBR of 10% following pavement thickness has been adopted over existing and New/Widening portion.

TABLE 2.7: Pavement Thickness As Per Convential Method

Design CBR (%)	Design Traffic (MSA)	GSB (mm)	WMM (mm)	DBM (mm)	BC (mm)	Total Thickness (mm)
10%	20	200	250	70	40	560

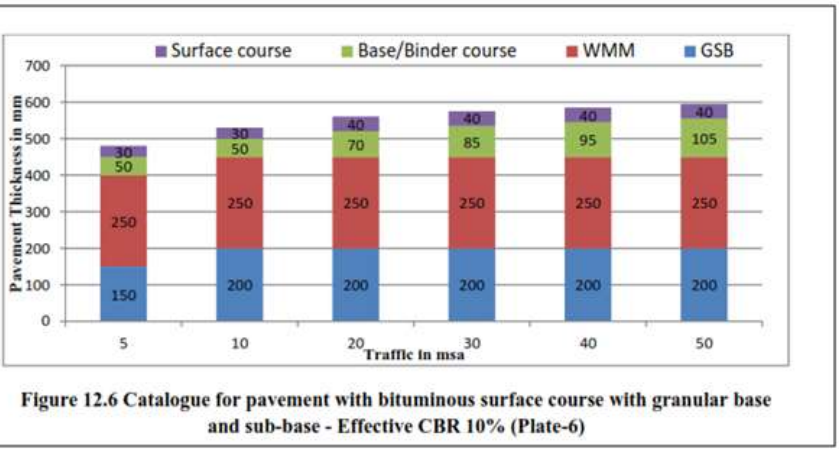


Figure 12.6 Catalogue for pavement with bituminous surface course with granular base and sub-base - Effective CBR 10% (Plate-6)

However, Innovative method of flexible pavement design has been done considering WMM and Cement Treated Sub-base layer for the above-mentioned design traffic and CBR and the required pavement thickness has been considered for alternate cost option.

TABLE 2.8: Pavement Thickness As Per Non Convential Method

Design CBR (%)	Design Traffic (MSA)	CT Sub-base (mm)	WMM (mm)	DBM (mm)	BC (mm)	Total Thickness (mm)
10%	20	200	150	50	30	430

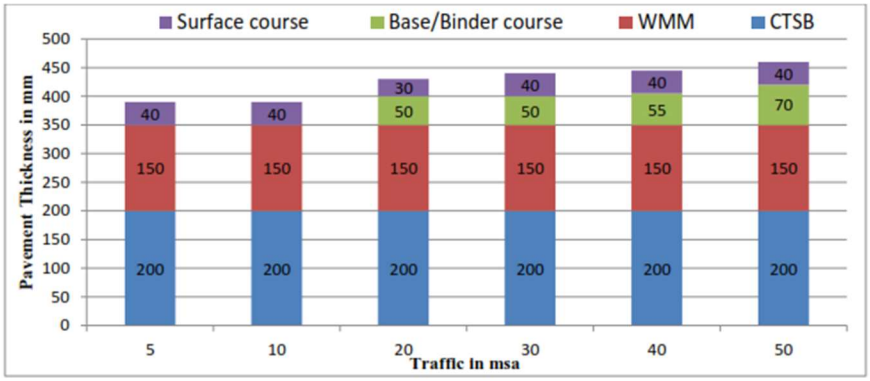


Figure 12.46 Catalogue for pavement with bituminous surface course with CTSB and granular base course - Effective CBR 10% (Plate-46)

2.2.4 Muck Disposal

The muck from hill cutting and construction activities will be safely disposed at suitable locations. Principle adopted for selecting muck dumping areas was to avoid sensitive areas like dense vegetation, natural water courses and areas prone to landslides. During the selection of the dumping sites preference was given on the following aspects.

- The muck does not fall/ flow into stream/river.
- Dumping sites should be at least 30 m (horizontal) away from the High Flood Level of the River/ stream.
- The sites are free from active landslides or creeps.
- The sites should not fall within pristine forest nor are these habitats of threatened species of flora and fauna.
- The sites are located close to its source in order to avoid long distance haulage.

Requirement of total muck disposal area has been given below in **Table 2.9**:

TABLE 2.9: Details Of Muck Disposal Area

Muck ID		**M-01**
Design Chainge	**From**	**5+070**
	To	**5+300**
Village		**Hunphun (Ukhrul)**
X (Longitude)		**94°20'53.74"E**
Y (Latitude)		**25° 6'24.53"N**
Quantity of Muck/Debris generated in Cum		**880162**
Estimated Quantity of Muck/Debris proposed to be utilized for Filling in cum		**301934**
Estimated Quantity of Rock material obtained from cutting will be used as retaining structure in cum		**63514**
Estimated quantity of muck/debris proposed to be dumped in cum.		**514714**
Estimated quantity of muck/debris dumped in Valley Side within Proposed ROW in Cum		**32855**
Estimated quantity of muck/debris dumped in other location in Cum		**481859**
Avg. Dumping Height in M.		**20**
Avg. Dumping Area (Sqm.)		**24093**
Avg. Dumping Area (Ha.)		**2.4093**

2.2.5 Bridges & Culverts

Bridges:

There are 5 Nos. of bridge in the project stretch. Details are given below in **Table 2.10**:

Sl. No.	Location (km)	Total Length (Clear Span) (m)	Remarks. If any
1	2+379	30	PSC-I Girder
2	3+624	40	PSC-I Girder
3	4+105	30	PSC-I Girder
4	4+375	40	PSC-I Girder
5	4+906	90	Steel Truss

Culverts:

There are 20 nos. of culverts has been proposed for new construction on the project road. Details are given below in **Table 2.11**:

Sr. No.	Proposed chainage (Km)	Proposal Type	Size Clear Span X Height (M X M)
1	0.066	Box Culvert	2.0 X 2.0
2	0.190	Box Culvert	3.0 X 4.0
3	0.451	Box Culvert	3.0 X 4.0
4	0.579	Box Culvert	2.0 X 3.0
5	0.714	Box Culvert	2.0 X 2.0
6	1.207	Box Culvert	3.0 X 4.0
7	1.549	Box Culvert	5.0 X 4.0
8	1.878	Box Culvert	2.0 X 2.0
9	2.107	Box Culvert	2.0 X 2.0
10	2.549	Box Culvert	2.0 X 2.0
11	2.838	Box Culvert	5.0 X 4.0
12	2.954	Box Culvert	2.0 X 3.0
13	3.254	Box Culvert	2.0 X 2.0
14	3.874	Box Culvert	2.0 X 2.0
15	5.100	Box Culvert	2.0 X 2.0
16	5.300	Box Culvert	3.0 X 4.0
17	5.604	Box Culvert	2.0 X 2.0
18	5.843	Box Culvert	2.0 X 2.0
19	5.954	Box Culvert	2.0 X 2.0
20	6.529	Box Culvert	2.0 X 2.0

2.2.6 Junction Improvement

The details of 1 no major & 11 nos. minor junctions are given in **Table-2.12**.

TABLE- 2.12: Details of Major & Minor Junction

Major Intersections:

Sl. No.	Location of intersection (Km)	Type of intersection	Other features	Remarks
1	5+600	3 Legged	RHS- Towards Tolui	At-grade improvement proposed

Minor Intersections:

Sl. No.	Location of intersection (Km)	Type of intersection	Other features
1.	0+200	Y-Type	3-legged
2.	0+500	X-Type	4-legged
3.	0+550	X-Type	4-legged
4.	0+850	X-Type	4-legged
5.	1+500	X-Type	4-legged
6.	2+700	X-Type	4-legged
7.	3+100	X-Type	4-legged
8.	5+520	Y-Type	3-legged
9.	5+580	Y-Type	3-legged
10.	5+750	Y-Type	3-legged
11.	6+500	Y-Type	3-legged

2.2.7 Service Roads

There is no Service Road proposed along the project stretch.

2.2.8 Drains

PCC triangular open drain has been proposed. Details are given bellow in **Table-2.13**

TABLE- 2.13: List of Triangular Drain

TCS Type	Length of TCS (m)	Side OF Drain	Net Length in formation (m)	Length of Drain
TCS-1A	841.00	Single Side	715.00	715.00
TCS-1B	560.00	Single Side	516.00	516.00
TCS-2	1135.00	Single Side	1070.00	1070.00
TCS-3	530.00	Single Side	526.00	526.00
TCS-4	735.00	Single Side	735.00	735.00
TCS-5	110.00	Single Side	105.00	105.00
TCS-6	90.00	Single Side	90.00	90.00
TCS-7	1460.00	Single Side	1460.00	1460.00
TCS-8	370.00	Both Side	370.00	740.00
TCS-9	50.00	Single Side	46.00	46.00

TCS Type	Length of TCS (m)	Side OF Drain	Net Length in formation (m)	Length of Drain
TCS-10	370.00	Single Side	368.00	368.00
	6571.00		6001.00	6371.00

Total Length of PCC Triangular V Drain = 6371.00 m

2.2.9 Road Markings/Signage/Road Furniture

Retro-reflective signage as per IRC standard mounted on post or overhead gantry, required for safety and traffic control will be provided at suitable locations. Thermoplastic road markings, road studs, delineators, crash barriers etc. will be provided at required locations to ensure adequate safety of the road users.

2.2.10 Bus Bay & Passenger Shelter

4 nos. of Bus Bays with passenger shelter are provided at 2 locations of the proposed road:

TABLE- 2.14: List of Proposed Pick Up Bus Stop

Sr. No.	Location (Design Chainage) in Km	Remarks
1	0+000	At the start point of Bypass, i.e., connection with NH-202
2	5+600	At km 8.840 of existing NH-102A,

2.2.11 Protection Works

For proper protection of proposed road on hill and valley side, breast wall, retaining wall and gabion wall have been proposed from road safety point of view. Details of Breast Wall, Retaining Wall and Gabion Wall are given in **Table- 2.15** to **Table -2.17** respectively.

TABLE- 2.15: Details 0f Breast Wall (Height=3.0 m above GL)

Chainage (m)		Side	Length
From	To		
0	50	Right	50
200	220	Right	20
220	240	Right	20
260	390	Right	130
475	540	Right	65
750	770	Right	20
1130	1150	Right	20
1150	1180	Right	30
1290	1320	Right	30
1320	1340	Right	20
1670	1710	Right	40
1730	1870	Right	140
1950	1970	Right	20
2110	2150	Right	40

Chainage (m)		Side	Length
From	To		
2630	2650	Right	20
2650	2670	Right	20
2720	2730	Right	10
2730	2790	Right	60
2865	2890	Right	25
3300	3580	Left	280
3660	3750	Left	90
4530	4560	Right	30
5500	5590	Right	90
6090	6120	Right	30
Total Length of Breast Wall (m) =			1300

TABLE- 2.16: Details of RR Masonry Retaining Wall (Height=3.0 m above GL)

Chainage (m)		Side	Length
From	To		
50	65	Left	15
67	90	Left	23
1050	1130	Left	80
1130	1150	Left	20
1270	1290	Left	20
1290	1320	Left	30
1710	1730	Left	20
2080	2100	Left	20
2100	2106	Left	6
2108	2110	Left	2
2110	2150	Left	40
2150	2180	Left	30
2400	2420	Left	20
3220	3253	Left	33
3255	3260	Left	5
3820	3870	Left	50
3870	3873	Left	3
3875	3910	Left	35
5690	5790	Left	100
6180	6270	Left	90
6440	6460	Left	20
Total Length of Retaining Wall (m) =			**662**

TABLE- 2.17: Details of Gabion Wall

Proposed Chainage (m)		Side	Length (m)	Avg. Height (m)
From	To			
90	170	Right	80	8
190	200	Left	7	5

Proposed Chainage (m)		Side	Length (m)	Avg. Height (m)
From	To			
200	220	Left	20	5
390	475	Left	82	5
560	680	Left	118	8
690	750	Left	58	5
770	990	Right	220	8
1150	1180	Left	30	8
1180	1270	Left	87	8
1400	1470	Left	70	5
1500	1660	Left	155	8
2100	2110	Right	8	8
2180	2270	Right	90	8
2320	2330	Right	10	8
2650	2670	Left	20	8
2670	2720	Left	50	8
2720	2730	Left	10	8
2790	2830	Left	40	8
2830	2860	Left	30	5
2860	2890	Left	25	5
2890	2920	Right	30	8
2920	2940	Right	20	8
2920	2940	Left	20	5
2940	2980	Left	38	5
3050	3180	Left	130	5
3300	3580	Right	280	8
3600	3650	Left	10	8
3660	3750	Right	90	8
3760	3820	Right	60	8
3870	3910	Right	38	8
3910	3960	Right	50	8
3960	4010	Right	50	8
3960	4010	Left	50	5
4010	4060	Right	50	8
4130	4350	Right	220	8
4440	4530	Right	90	8
4560	4730	Right	170	8
4730	4850	Right	120	8
4730	4850	Left	120	8
4970	5000	Right	30	8
5000	5030	Right	30	8
5000	5030	Left	30	8
5030	5060	Right	30	8
5060	5110	Right	48	8
5060	5110	Left	48	5
5110	5150	Right	40	8

Proposed Chainage (m)		Side	Length (m)	Avg. Height (m)
From	To			
5150	5180	Right	30	8
5150	5180	Left	30	5
5180	5280	Left	100	5
5280	5320	Left	37	8
5320	5370	Right	50	8
5320	5370	Left	50	8
5370	5410	Right	40	8
5410	5460	Left	50	5
5840	5850	Left	8	5
5850	5870	Right	20	8
5850	5870	Left	20	5
5870	5940	Right	70	8
5970	6090	Right	120	8
6120	6180	Right	60	8
Length of 8 m Gabion Wall =			3001	m
Length of 5 m Gabion Wall =			786	m
Total Length of Gabion Wall =			3787	m

2.2.12 Slope Protection:

Hill side Typical Surficial Protection and Erosion Control Measures for cut height of side slope more than 25m are presented in described below:

(a) Coir Mat (10 m Height) = 23,135.64 sqm in 2244 m
(b) Bamboo plantation = 54,917 sqm in 8076 m
(c) Turfing with Sods = 17297.10 sqm in 2865 m

CHAPTER - 3
ENGINEERING SURVEYS, INVESTIGATION AND ANALYSIS

3.1 Introduction

Different types of field studies, engineering surveys and investigations are required to gather data and information for preparation of the report for the project road stretches. The aim of the investigations is to develop an adequate supportive database for selecting and preparing the most appropriate and economic proposal to meet the functional and structural efficiency of the road as well as safety requirements.

The following are the necessary engineering survey and investigations need to be carried out at site to assess the existing characteristics of the road:

(a) Reconnaissance Survey
(b) Road Inventory
(c) Pavement Condition Survey
(d) Inventory and Condition Survey of Existing Structures
(e) Topographical Survey
(f) Traffic Survey
(g) Sub-grade Investigation
(h) Quarry Material Survey
(i) Sub-Soil Exploration

Sub-soil exploration work will be started at bridge locations after approval of the alignment.

3.2 Engineering Surveys and Investigations

3.2.1 Reconnaissance Survey

The consultants made an in-depth study of the available maps of the project area and other relevant information collected. A detailed reconnaissance survey was conducted for the entire stretch of the project road and detail features such as land use, habitation, water routes, river, intersecting roads, utilities such as electrical lines (HT/LT), etc. has been noted. This enabled the Consultants to visualize the possible problems to be encountered while selecting the realignment. The detailed ground reconnaissance of project influence area was utilized for planning and programming the detailed surveys and investigations.

3.2.2 Road Inventory

Detailed inventory of the project road stretches has been prepared through visual inspection with sample measurements to assess the existing status. Features like existing kilometerage, terrain, land use, width of pavement and shoulders, height of embankment, geometric deficiencies, important road junctions, railway level crossings, utilities, other roadside features etc. were recorded. The inventory is essentially included to collect physical information on the road and its environment for enabling preliminary assessment of the project. The existing road is mostly single lane with earthen shoulder. Brief summary of the Carriageway & Shoulder details are in Table 3.1.

Table 3.1: Brief summary of Existing Carriageway

S.No.	Existing Chainage (Km)			C/W (m)
	From	To	Length	
1	0.000	4.100	4.100	7.00
2	4.100	4.900	0.800	5.50
3	4.900	9.840	4.940	4.20
Sub Total (Km)			9.840	

3.2.3 Pavement Condition Survey

Pavement condition survey has been carried out as per the standard format. The existing pavement surface is of bituminous type and surface condition along the road varies from fair to poor. Some portion of the stretches, the existing pavement is partially damaged with cracks, potholes, raveling, rutting and considerable amount of patching. Few stretches have been observed where bituminous layer is fully exposed. Detailed field study including pavement condition, shoulder condition, embankment condition, drainage condition etc. were noted by visual means supplemented by sample measurements. The following measurements were involved:

- Cracking (as a percentage of carriageway area)
- Raveling (as a percentage of carriageway area)
- Pothole (as a percentage of carriageway area)
- Rut depth, mm
- Edge drop, mm

Shoulder and embankment conditions were determined visually and its extent will be noted.

3.2.4 Inventory and Condition Survey of Existing Structures

Inventory and condition survey of the existing structures were carried out to identify their number, type, condition and hydrological aspects. Mainly visual inspection and dimensional measurements were carried out during this survey. Data were collected in the standard format. The exercise enabled to collect the visible as-built information to the extent possible and condition to assess the individual requirements of the existing structures in route, like widening, repair and reconstruction. Brief summary of existing structures are in Table 3.2.

Table 3.2: Brief summary of Existing Structure Details

Type	Number	Remarks
Culvert (Total 597 nos.)		
Slab Culvert	3 Nos.	Slab Culverts mostly not in good condition may require reconstruction of those.
Pipe Culvert	22 Nos.	Pipe culvert, mostly not in good condition may require reconstruction of those.

Table 3.3: Details of Existing Structure Details

Sl No.	Existing Chainage (km)	Type of Culvert	Span/Dia.(m)	Width(m)
1	0+613	Pipe culvert	1x0.6	7.00
2	4+552	Slab Culvert	1x1.0	7.50
3	5+465	Pipe culvert	1x1.0	7.20
4	5+525	Pipe culvert	1x1.0	7.20
5	5+725	Pipe culvert	1x0.6	7.50
6	5+810	Pipe culvert	1x1.0	7.50
7	5+915	Pipe culvert	1x0.6	7.50
8	6+020	Pipe culvert	1x0.6	7.50
9	6+155	Pipe culvert	1x0.6	7.50
10	6+324	Pipe culvert	1x0.9	7.50
11	6+990	Pipe culvert	1x0.9	7.50
12	7+040	Pipe culvert	1x0.6	7.50
13	7+087	Slab Culvert	1x1.5	7.50
14	7+245	Pipe culvert	1x0.6	7.00
15	7+300	Slab Culvert	1x3.0	7.80
16	7+420	Pipe culvert	1x0.9	7.50
17	7+620	Pipe culvert	1x0.9	7.50
18	7+741	Pipe culvert	1x0.9	7.50
19	7+840	Pipe culvert	1x0.6	7.50
20	7+990	Pipe culvert	1x0.6	7.50
21	8+200	Pipe culvert	1x0.6	7.50
22	8+485	Pipe culvert	1x1.0	7.50
23	8+677	Pipe culvert	1x0.9	7.50
24	9+090	Pipe culvert	1x0.9	7.50
25	9+665	Pipe culvert	1x1.0	12.40

3.2.5 Topographic Survey

The specific objective of the topographical survey is to delineate accurately the complete existing natural and man-made features, so as to study and develop the existing road, creating an accurate Digital Terrain Model, which is also a fundamental requirement to design the highway through latest software. The detailed topographical survey for the existing road as well as realignment stretches were completed with fixing BM pillars according to the procedure outlined in the TOR. Summary of BM and GPS pillar list are in Table 3.4.

Table 3.4: Summary of Reference Pillars Details

❖ **BM Pillar List on Existing Road:**

SL.NO.	BM NO.	EASTING (M)	NORTHING (M)	RL (M)	Ex. Ch. (Km)	RHS/LHS
1	BM-0/1	636898.660	2775207.500	1829.239	0.220	LHS
2	BM-0/2	637105.194	2775447.815	1859.191	0.580	RHS
3	BM-0/3	637046.944	2775573.226	1867.446	0.718	LHS
4	BM-1/1	637193.555	2776055.541	1880.379	1.230	LHS
5	BM	637223.941	2776141.517	1878.526	1.300	RHS
6	BM-1/2	637305.843	2776350.157	1887.331	1.548	RHS
7	BM-1/3	637227.627	2776477.765	1887.743	1.703	RHS
8	BM-2/1	637303.316	2776917.113	1873.944	2.215	RHS
9	BM-2/2	637291.951	2777093.195	1861.043	2.460	RHS
10	BM-2/3	637324.068	2777259.916	1858.009	2.663	RHS
11	BM-3/1	637044.485	2777761.903	1858.236	3.248	LHS
12	BM-3/2	637161.394	2777945.986	1854.351	3.473	RHS
13	BM-3/3	637145.716	2778112.540	1844.107	3.673	RHS
14	BM-4/1	637351.513	2778569.692	1849.798	4.198	RHS
15	BM-4/2	637496.797	2778748.228	1847.453	4.493	RHS
16	BM-4/3	637521.034	2778905.534	1844.137	4.688	RHS
17	BM-5/1	637523.733	2779336.845	1811.775	5.165	RHS
18	BM-5/2	637317.519	2779380.034	1794.892	5.400	RHS
19	BM-5/3	637193.070	2779185.008	1776.796	5.648	RHS
20	BM-6/1	636922.299	2778789.948	1740.922	6.213	RHS
21	BM-6/2	636748.356	2778706.086	1726.702	6.430	RHS
22	BM-6/3	636454.753	2778666.616	1705.915	6.735	RHS
23	BM-6/4	636494.820	2778565.329	1698.277	6.840	RHS
24	BM-7/1	636773.888	2778505.262	1676.652	7.148	RHS
25	BM-7/2	636679.141	2778308.660	1660.126	7.395	RHS
26	BM-7/3	636483.765	2778293.904	1648.148	7.603	RHS
27	BM-8/1	636132.033	2778083.933	1618.559	8.093	RHS
28	BM-8/2	636249.323	2777928.967	1606.126	8.300	RHS
29	BM-8/3	636089.758	2777858.469	1589.211	8.555	RHS
30	BM-9/1	635673.129	2778006.932	1558.809	9.058	LHS
31	BM-9/2	635456.265	2778092.007	1570.853	9.300	LHS
32	BM-9/3	635335.220	2778269.058	1573.395	9.545	LHS

❖ **GPS Pillar List on Existing road:**

SL.NO.	GPS NO.	EASTING (M)	NORTHING (M)	RL (M)	Ex. Ch. (Km)	LHS/RHS
1	GPS-0	636869.233	2775004.140	1835.373	0.000	RHS
2	GPS-0A	636850.230	2774897.893	1836.500	0.000	LHS
3	GPS-1	637117.288	2775802.947	1880.294	0.960	LHS
4	GPS-2	637227.200	2776747.351	1877.586	2.025	RHS
5	GPS-3	637192.070	2777573.640	1858.894	3.008	LHS
6	GPS-4	637250.872	2778357.510	1841.095	3.953	RHS
7	GPS-5	637567.804	2779092.919	1833.579	4.910	LHS
8	GPS-5A	637549.229	2779151.733	1828.729	4.970	RHS
9	GPS-6	637101.404	2778969.754	1760.995	5.908	RHS
10	GPS-7	636564.103	2778576.767	1693.473	6.908	RHS
11	GPS-8	636291.882	2778166.818	1632.706	7.860	RHS
12	GPS-9	635874.792	2777894.578	1573.479	8.778	RHS
13	GPS-10	635166.260	2778319.043	1587.438	9.720	LHS
14	GPS-10A	635128.512	2778412.765	1593.902	9.825	RHS

❖ **GPS Pillar List on Project road:**

SL.NO.	GPS NO.	EASTING (M)	NORTHING (M)	RL (M)	De. Ch. (Km)	LHS/RHS
1	GPS-1B	2773275.373	635553.617	1683.034	0.000	LHS
2	GPS-2B	2773317.716	635649.931	1689.755	0.000	LHS
3	GPS-3B	2774573.199	635905.549	1665.437	1.480	LHS
4	GPS-4B	2775984.672	635886.645	1620.903	3.120	LHS
5	GPS-5B	2777937.793	635730.240	1559.142	5.720	LHS
6	GPS-6B	2778000.046	635679.312	1558.528	5.800	LHS

❖ **TBM List on Existing road:**

SL.NO.	TBM NO.	EASTING (M)	NORTHING (M)	RL (M)	Ex. Ch. (Km)	LHS/RHS	REMARKS
1	TBM-B6	637160.530	2775879.331	1879.123	1.050	LHS	ON THE CONCRETE STRUCTURE
2	TBM-B5	637170.672	2775876.358	1879.066	1.050	RHS	ON THE CONCRETE STRUCTURE
3	TBM-A9	637213.152	2776633.768	1880.552	1.913	RHS	ON THE BREAST WALL
4	TBM-A10	637222.875	2776633.933	1880.336	1.920	RHS	ON THE BREAST WALL
5	TBM-A8	637460.085	2778793.380	1844.077	4.553	RHS	ON THE PARAPET
6	TBM-A7	637448.598	2778791.125	1844.290	4.555	LHS	ON THE PARAPET
7	TBM-A2	637125.396	2778967.141	1762.361	5.885	LHS	ON THE PARAPET
8	TBM-A1	637117.129	2778974.010	1761.949	5.890	RHS	ON THE PARAPET
9	TBM-A4	636789.383	2778456.727	1673.581	7.200	LHS	ON THE PARAPET
10	TBM-A3	636782.720	2778458.670	1673.197	7.200	RHS	ON THE PARAPET
11	TBM-A5	636670.112	2778300.431	1659.753	7.408	RHS	ON THE PARAPET
12	TBM-A6	636672.604	2778293.671	1660.045	7.410	LHS	ON THE PARAPET
13	TBM-B4	635823.880	2777866.690	1568.757	8.835	LHS	ON THE PARAPET
14	TBM-B3	635818.583	2777864.624	1568.578	8.840	LHS	ON THE PARAPET
15	TBM-B1	635156.798	2778330.759	1588.330	9.735	LHS	ON THE RETAINING WALL
16	TBM-B2	635156.095	2778347.532	1588.358	9.745	RHS	ON THE RETAINING WALL

The survey has been done involving the following sequential steps:

1. Establishing Bench Marks
2. Traversing and Leveling
3. Cross-section Surveying/Detailing

Following features were recorded during detailing, in general:

- ✓ Carriageway crown, carriageway edges and two intermediate carriageway points
- ✓ Roadway edges (Shoulder break-points)
- ✓ Embankment toe-line
- ✓ Borrow pit / pond / ditch / toe drain profile, where present
- ✓ All break-points of natural ground
- ✓ Positions of individual entities such as trees, utility lines and poles, wells and tube wells, other pillars like ROW etc.
- ✓ Property lines and structures (with description)
- ✓ Salient points on bridges and culverts (e.g. abutment, headwall, inverts level, etc.)

The data for each survey point were recorded in terms of Northing, Easting and Elevation. To ensure standardization of works of different survey teams and to facilitate further CAD works, a rational coding system was developed and used.

The survey data collected in the field was downloaded in text file format and converted to graphic files using suitable software.

3.2.6 Traffic Survey

Following traffic surveys were conducted at site to estimate the present and future traffic of the project road.

- ✓ Average Daily Traffic (ADT)
- ✓ Seasonal Variation
- ✓ Annual Average Daily Traffic (AADT)

The details of the Traffic Survey Locations and Analysis are provided in Chapter - 7 of the Main Report.

3.2.7 Sub-Grade Investigation

Trial pits of size 1m x 1m were dug at the pavement shoulder interface at 0.5 km interval, extending through the pavement layers down to the sub-grade level to assess the following:

a) Visual classification of soil
b) Field density
c) Field moisture content
d) Atterberg Limits
e) Existing pavement composition
f) Available CBR

After the completion of field tests and collection of samples, the pits were backfilled with the excavated materials and compacted suitably so as not to discomfort the smooth movement of traffic of the existing road.

Composition of Existing Pavement

Brief summary of existing crust details is shown in Table 3.5.

Table 3.5: Summary of Crust Details

Chainage	Side	TP-NO.	Bituminous Surface	Base course (WBM)	Subgrade	Sub Grade
5+200	RHS	11	40	590		630
5+730	LHS	12	45	550		595
6+010	LHS	13	30	600		630
6+500	RHS	14	60	340	90	490
7+000	RHS	15	45	570		615
7+500	RHS	16	20	280	270	570
8+000	LHS	17	15	350		365
8+500	RHS	18	20	340	80	440
9+000	LHS	19	30	380		410
9+430	RHS	20	30	330		360

3.2.8 Quarry Material

The material investigation for road construction material required to be carried out to identify the potential sources of construction materials and to assess their general availability, engineering properties and quantities. This is one of the most important factors for stable, economic and successful implementation of the road program within the stipulated time. The material investigation is quite representative, but more exhaustive search may surely be explored by the contractors at the time of construction. For improvement work as well as for new construction the list of materials includes the following:

- Granular materials for sub-base works.
- Crushed stone aggregates for base, bituminous surfacing and cement concrete works.
- Sand for bituminous and cement concrete works, sub-base, filter materials and filling materials etc.
- Borrow earth/moorum materials for embankment, sub-grade and filling.

Objective

The following are the basic objective to make material investigation:

- Source locations indicating places, kilometer, availability and the status whether in operation or new source.
- Access to source, indicating the direction and nature of the access road i.e. left/ right of project road, approximate lead distance from the gravity center and type of access road.
- Ownership of land/ quarries, either government or private.
- Test results, indicating the quality of materials with respect to their suitability in construction.
- Probable use indicating the likely use of materials at various stages of construction work i.e. fill material, sub-grade, sub-base, base, bituminous surfacing and cross drainage structures.

The potential sources of construction materials were selected from consideration of the availability and suitability of the materials, easy access to the source and minimum hauling distance from the source in order to make the construction economical and feasible as far as possible.

A) Coarse Aggregate: -

Quarry Location	Material	Distance from Source to Start/ End Point of Project Road	Distance on Project Road (Half of Project Road)	Total Lead	Probable purpose of use of material
Local	Stone Aggregate, Boulder etc.	-	-	-	GSB, WMM, Bituminous and concrete works

B) Fine Aggregate: -

Quarry Location	Material	Distance from Source to Start/ End Point of Project Road	Distance on Project Road (Half of Project Road)	Total Lead	Probable purpose of use of material
Itok	Coarse Sand	15	3.40	18.40	Concrete, Filling works

C) Bitumen: -

Location	Material	Distance from Source to Start/ End Point of Project Road	Distance on Project Road (Half of Project Road	Total Lead	Probable purpose of use of material
Imphal	Bitumen	-	-	-	Wearing course

D) Cement: -

Location	Material	Distance from Source to Start/ End Point of Project Road	Distance on Project Road (Half of Project Road	Total Lead	Probable purpose of use of material
Imphal	Cement	-	-	-	Structural Work

E) Reinforcement: -

Location	Material	Distance from Source to Start/ End Point of Project Road	Distance on Project Road (Half of Project Road	Total Lead	Probable purpose of use of material
Imphal	Steel	-	-	-	Structural Work

3.2.9 Borrow Area Requirement

Total Earthwork in Cutting = 880161.66 cum. (Ref. Quantity Calculation for Road Works: Cost Estimation) Total Ordinary Rock Cutting volume = 17603263 cum.

So, Total Earthwork in soil = (880161.66 – 176032.33) cum. = 704129.33 cum.

Earthwork used for filling in embankment from Roadway cutting material =301933.50 cum.

Total Earthwork in Filling comes to is much lesser than the total earthwork in soil.

So, no Earthwork required for embankment construction from Borrow area.

3.2.10 Muck Disposal

The muck from hill cutting and construction activities will be safely disposed at suitable locations. Principle adopted for selecting muck dumping areas was to avoid sensitive areas like dense vegetation, natural water courses and areas prone to landslides. During the selection of the dumping sites preference was given on the following aspects.

- The muck does not fall/ flow into stream/river.
- Dumping sites should be at least 30 m (horizontal) away from the High Flood Level of the River/ stream.
- The sites are free from active landslides or creeps.
- The sites should not fall within pristine forest nor are these habitats of threatened species of flora and fauna.
- The sites are located close to its source in order to avoid long distance haulage.

Requirement of total Muck Disposal area has given below:

Muck ID		M-01
Design Chainage	**From**	5+070
	To	5+300
Village		Hunphun (Ukhrul)
X (Longitude)		94°20'53.74"E
Y (Latitude)		25° 6'24.53"N
Quantity of Muck/Debris generated in Cum		880162
Estimated Quantity of Muck/Debris proposed to be utilized for Filling in cum		301934
Estimated Quantity of Rock material obtained from cutting will be used as retaining structure in cum		63514
Estimated quantity of muck/debris proposed to be dumped in cum.		514714
Estimated quantity of muck/debris dumped in Valley Side within Proposed ROW in Cum		32855
Estimated quantity of muck/debris dumped in other location in Cum		481859
Avg. Dumping Height in M.		20
Avg. Dumping Area (Sqm.)		24093
Avg. Dumping Area (Ha.)		2.4093

3.2.11 Sub-Soil Exploration

There is no existing bridge observed in the present alignment.

Photographs

Photographs of field activities are given below:

	
Culvert Inventory	**Traffic Survey**
	
Traffic Volume Count Survey	**Axle Load Survey**
	
Pavement Condition Survey	**Road Inventory**

	
Road Inventory	**Road Inventory**
	
Pavement condition Survey	**Chaining with Roadometer**
	
Culvert Inventory	**Topographic Survey**

	
Topographic Survey work	**Trial Pit**
	
Geotechnical Investigation Work	**Traffic Survey**
	
Axle Load survey	**OD Survey**

CHAPTER - 4
METHODOLOGY

4.1 Objective

The main objective of the consultancy service is to establish the technical, economic and financial viability of the project. Feasibility of the project shall be established on the requirements with regard to rehabilitation, up gradation and improvement of road, based on the following activities: -

- Highway Design
- Pavement Design
- Type of Intersections & development
- CD & Bridge design
- Rehabilitation & Widening of Existing CD Works & Bridges
- Road Safety Feature,
- Quantities and Cost Estimates
- Social & Environmental Impacts

The project involves a series of inter-related activities, both in the field and in the design office. Methodology for carrying out these activities is described in the following paragraphs.

4.2 General

As per requirements of the study, the consultants had carried out different types of field studies, engineering surveys and investigations to gather data and information necessary for Feasibility Study (FS). The aim of investigation was to develop adequate supportive database for selecting and preparing the most appropriate proposal to meet the functional and structural efficiency and safety requirements. The engineering investigations and surveys have been carried out in line with the specifications laid out in the Quality Assurance Plan submitted.

A competent team of suitably qualified key professionals as per the requirements of TOR and other supporting staff has been selected for carrying out the services and moved to site from time to time.

The major aspects of surveys and investigations relevant to the present study cover the following:

4.3 Topographic Survey

The specific objective of the topographical survey in the highways is to delineate accurately the complete existing natural and man-made features, so as to study and develop the existing road to a 2-lane with hard shoulder configuration; creating an accurate Digital Terrain Model, which is also a fundamental requirement to design the highway in the latest computerized road surface design. Longitudinal and cross sections at suitable interval as per TOR have been taken for the purpose of developing the DTM base for design. The obtained data has been used to design the cross-drainage system allowing the storm water / flood water to flow out smoothly. The topographical survey was taken up for DTM using most modern Survey technique with the help of GPS, Total Station, LiDAR and approved commercial software.
The topographical survey work includes:

- Establishment of a network Planimetric control points, as well as, height control points.
- Detailed topographical survey
- Detailed height control work taking longitudinal and cross sections all along the stretch for creating a mathematical base for development
- Transfer of the designed road alignment on to the ground in mathematical data system.

Reconnaissance survey was taken up to fix appropriate location for GPS Pillars and reference pillars, considering correct & optimum use of them during further surveys.

Dual frequency GPS instruments were used to obtain absolute values of points in spherical co-ordinate, that is, in Longitude & Latitude. Prefabricated pillars about 5km away were installed throughout the length of the highway and proposed diversions, if any, whose Longitude & Latitude values were fixed by GPS instrument. These values of GPS pillars were thereafter converted to its metric components. These points were formed the base of absolute values to which Total station traverse using these co-ordinate systems were tied to. These pillars were located in such a distance from the road center line, so that these are not disturbed during project activities.

These pillars have corrected BM values on them so that they will be serially numbered and their description will be duly provided to ensure easy identification and accessibility in future. They were constructed in accordance to the specification given in the Terms of Reference.

During geodetic control surveys, height control survey was also taken up and Reduced levels referred to Mean Sea level were obtained and assigned to all pillars, GPS pillars and reference pillars are as per TOR. Prior to detailed survey, XYZ values were distributed to all reference pillars.

These control survey pillars were formed the basic data system, the mathematical base on which the crucial test of three-dimensional topographic survey was founded. The major task of delineating the total highway stretch in 3D system along with all bridges / culverts and all features within the ROW, trees, plantations etc., and the surrounding natural landscape were noted for future environment.

Topographical Survey consists of:

- ❖ GPS traverse about 5 km apart with a pair of points consisting of absolute values in global terms and in metric terms.
- ❖ Total Station traverse from one GPS pillar to the next GPS pillar.
- ❖ Assigning Reduced levels / heights to all road side features referred to MSL. Also, long section at regular interval and cross sections at an interval as per TOR to delineate the exact existing road surface along the alignment. The cross-sections were taken at 50m or closer interval as required.
- ❖ Ground verification of the Terrain Modeling, with reduced level values.
- ❖ Total mapping of the alignment.
- ❖ Check terrain modeling by drawing sections at all required places, on the mathematically created model of the road.

The pillars were established along the road within the ROW at suitable places at 250m intervals. Both the GPS and BM pillars have unique serial numbers. They were constructed to facilitate detailed survey.

All topographical features, utility service lines, existing on the road have been surveyed; bearing the data in XYZ system. Existing road were surveyed in detail, taking XYZ values at Road center, Road edges, Road shoulders, Toes and normal ground away from toe line. Trees above 300mm girth were also surveyed. Buildings, hutments, goomties and all existing features, natural or man-made were surveyed, and each point will have XYZ values. Road curves were surveyed

with special attention for development of proper existing geometries and cross roads were surveyed with proper weightage on the type of road, keeping in view for improved junctions and or intersections.

Longitudinal sections levels were taken at 25 m intervals longitudinally or closer at curves or if the topography demands and cross-sections were taken at 50m or closer interval as required.

- ❖ Existing road center (carriageway)
- ❖ Edges of the carriageway
- ❖ Edges of the shoulders
- ❖ Edges of berm
- ❖ At suitable interval beyond Valley & Hill sides up to corridor of impact.

The closer intervals of taking cross sections were chosen according to topographical condition at the point.

Longitudinal and cross sections for major and minor streams were measured as per recommendations contained in IRC: SP:13-2004 and IRC-5-1985 which will be followed in totality.

Coding and matching of different topographical features between Total Station and Computer Software have been finalized in compatible terms.

On completion of topographical survey, the drawing has been prepared by using AutoCAD software and PC compatible data of total station. Ground verification of a few check plots and all details of the detailed survey was guard against omissions or discrepancies.

All digital data in XYZ format from the ground survey by Total Station and LiDAR were used for mapping by means of Auto-Cad at site and also at the Corporate office, using the proprietary software: "MX ROAD or INROADS". This software was used for Digital Terrain Modeling for the proposed carriageway of the Highway.

4.5 Road Inventory

A detailed inventory of the project road has been prepared through dimensional measurements and visual inspection to assess the existing status as per IRC SP:19-2001 and also keeping in mind that these will become part of concession agreement as Scheduled. Features like chainage, terrain, land use, width of pavement and shoulders, height of embankment, geometric deficiencies, important road junctions, utilities etc. were recorded in the prescribed format. The road inventory data for the project road length was collected for each kilometer and part thereof as warranted by appreciable change in the physical features as mention below: -

- Terrain
- Land-use pattern
- Carriageway width, surfacing type
- Shoulder surfacing type and width
- Sub-grade, local soil type @ every 500m or change of feature whichever is earlier
- Horizontal and vertical curve
- Road intersection type and details
- Retaining structure details, height of embankment or cut
- Location of water bodies and other utility services
- Existing ROW information
- Culverts, bridges and other structures
- General drainage conditions

The team of Highway and Bridge Engineer & supporting staff carried out road inventory covering the above detail on roads and the site data has been computerized in main office.

4.6 Pavement Condition Survey and Investigation

Pavement Condition Survey has been carried out by the Pavement Engineer with supporting Staff and following pavement distress has been noted along the entire project stretch. All the data has been compiled in the main office.

- Cracking (as a percentage of carriageway area)
- Raveling (as a percentage of carriageway area)
- Pothole (as a percentage of carriageway area)
- Rut depth, mm
- Edge drop, mm

4.7 Pavement Investigations

Pavement Investigation has been done by means of trial pit excavation @ 500 m interval at pavement shoulder interface in case of existing road. For the road along new alignments, the test pits for sub grade soil has been carried out @ 5 km or for each soil type, whichever is more. The Survey was carried out to determine the following

- Existing pavement composition and thickness
- Sub-grade Characteristics and Strength

4.8 Drainage

Existing Drainage pattern along the corridor has been surveyed and following information has been noted by Bridge Engineer and his side team. The investigations are regarding:

- Road side Drainage
- Inventory of Cross Drainage Works and Bridges
- Condition and Structural Adequacy
- Hydraulic adequacy

The above details have been included in Appendix of Feasibility report.

4.9 Sequence of Activities

Based on an in-depth study of the scope of services contained in the TOR for the project, the consultants have evolved a methodology where in the work has been divided into a set of Task Series that are listed below:

Task Series and Individual Task Elements

- **Initial Activities**
    - Project Start-Up and Inception
    - Team Mobilization & Start-up Meeting
    - Secondary Data Collection and review
    - Reconnaissance Survey
    - Standards and Code of Practices
    - Finalization of Traffic Survey Stations and Locations
    - Preparation of Inception Report & Quality Assurance Plan

- **Engineering Survey**
  - Engineering Surveys/Investigations
  - Reconnaissance
  - Road Inventory
  - Topographic survey
  - Longitudinal & Cross Sections
  - Details of utility services & other physical features

- **Traffic Survey and Analysis**
  - Average Daily Traffic (ADT)
  - Seasonal Variation
  - Annual Average Daily Traffic (AADT)
  - Axle Load Survey
  - Traffic Demand Estimates

- **Pavement Survey**
  - Pavement Condition Survey
  - Pavement Investigation using trial pit at pavement shoulder interface
  - Sub-grade Characteristics and Strength

- **Cross Drainage Survey**
  - Investigations for Bridges and Structures
  - Inventory of Bridges, Culverts and Structures
  - Hydraulic and Hydrological Investigation
  - Condition Survey for Bridges, Culverts and Structures

- **Material Survey**
  - Material Investigations

- **Design Work Desk Study**
  - Detailed Engineering Design
  - Design Standard
  - Geometric Design
  - Pavement Design
  - Design of Embankments (if required)
  - Design of Bridges & Structures
  - Drainage Design
  - Traffic Safety features, Road Furniture and Road Markings
  - Arboriculture and Landscaping

- **Miscellaneous Engineering work**
  - Bus bay with passenger shelter
  - Protection work & traffic safety

- **Environment & Social Study**
  - Environmental & Social Screening
  - Environmental Impact Assessment

- Social Impact Assessment
- Reporting Requirements of EIA & EMP
- Reporting Requirements of RAP

- **Cost Estimate**
  - Estimation of Quantities and Project Costs
  - Rate Analysis
  - Detailed Estimates for Quantities and Project Cost

All the above survey/collection of information have been carried out and used against respective design of project road.

4.10 Detailed Methodology Adopted

The methodology evolved for the assignment has been structured into a set of inter-related but distinctive 'Task' elements, which are designed to carry out specific tasks. The output of each 'Task' element or activity in the network of various 'Tasks' is either an input to another 'Task' or a distinct output as per scope of works. The details concerning objectives and work assigned to each 'Task Series' and individual 'Task' elements are discussed in this section.

4.11 Secondary Data Collection and Review

During the project secondary data have been collected and they are as follows:

- Fuel seal Data
- Information regarding type of forest
- Information regarding Land Revenue Maps / Community Land

The data thus collected are reviewed and taken up further for necessary action.

4.12 Reconnaissance Survey

The following documents and data have been collected the process of procurement during the reconnaissance survey by the team:

- Climate of the area surrounding the project road
- Road inventory and condition
- Year of original construction, year and type of major maintenance/rehabilitation works.
- Condition of bridges and cross-drainage structures
- Type and location of existing utility services
- Hydraulic data
- Survey and evaluation of locally available construction materials

4.13 Standards & Codes of Practice

All activities related to field studies, design and documentation have been done as per the latest guidelines/circulars of The MORTH and relevant publications of the Indian Roads Congress (IRC) and Bureau of Indian Standards (BIS).

4.14 Finalization of Traffic Survey Stations and Locations

After the reconnaissance survey and desk studies of the maps available of the project area, Traffic survey stations and their locations have been finalized by discussing with NHIDCL.

4.15 Traffic Demand Estimates

The traffic demand estimates for the passenger as well as freight will be made by the consultants keeping in view the past and existing traffic levels, operational characteristics, divertible traffic from other road forecasts made for similar roads. Traffic projections are carried out using the growth rate prescribed in IRC: 37-2018 and hill road manual. The projections are done vehicle type-wise. The projected volumes are incorporated / utilized to obtain the total cumulative number of standard axles expected for 20 years design period.

4.16 Preparation of Quality Assurance Plan

Immediately upon the award of the consultancy work, based on our extensive experience in this field and our knowledge of the project, a detailed draft Quality assurance Plan (QAP) has been prepared which covers all aspects of field studies, investigations, analysis, design and documentation. The system also ensures responsibilities to be shared by concerned key personnel.

The Consultants have used the system recently completed / on-going projects of similar nature and ensured effective implementation of procedures, checks, calibrators and control networks outlined in the system for traffic surveys, engineering surveys and investigations, design of road, pavement, bridges and structures, environmental and social impact assessment, economic and financial analysis and documentation.

The QAP will be provided to all the team personnel and to NHIDCL official to control and monitor the quality of work and project deliverables.

4.17 Hydraulic and Hydrological Investigation

Hydrological investigation has been carried out for those structures, whose waterways are found to be inadequate from local inquiry and records of pasts flooding patterns and drainage patterns. The task is preceded by desk study of available data on topography (topographic maps), storm duration, rainfall statistics, top soil characteristics, vegetative cover etc. so as to assess the catchment areas for all proposed drainage provisions. The findings of the desk study are further supplemented and augmented by a reconnaissance along the area. All-important hydrological features will be noted during this field reconnaissance.

The information on high flood level (HFL), low water levels (LWL) (if available) are collected from past records, local inquiries and visible signs, if any, on the banks of streams and structures existing. Local inquiries are also be made with regard to the sections getting water logged/flooded during heavy rains.

The existing stream is checked for the adequacy of the waterway and the proposed bridge is provided accordingly. Wherever it is found inadequate, the hydrological studies will be made to bring out the pertinent data required for design covering the following parameters:

- Catchment area;
- Rainfall;
- Run-off duration and intensity relationship;
- Catchment run-off characteristics and

- Channel slopes and discharge characteristics

The hydrological studies will be performed using widely accepted procedures. For culvert and bridge locations where the stream channels are established, the discharge will be computed using the standard procedure adopting the Area – Velocity method. For other locations where the stream channels are not well defined, the flow will be estimated using widely used empirical methods.

4.18 Condition Survey for Bridges, Culverts and structures

The consultant inspected the existing structures and their condition and structural assessment survey conducted by the senior experts. For the bridges, identified in distress condition, if any, supplementary testing will be carried out as per IRC-SP: 35-1990. All the existing bridges and culverts are already catering for the present-day heavy traffic and loading and hence load tests may not be needed as could be judged from preliminary reconnaissance survey.

4.19 Geotechnical Investigations and Pavement Investigations

Geo-technical Investigations and sub-soil explorations as per Terms of Reference would be conducted for proposed bridge locations after approval of alignment.

The strength of Sub-grade layers has been evaluated in the field using DCPT tests and Laboratory samples from Trial Pits. Trial pits have been dug at every 500m in existing road portion on alternate side of road of 1m x 1m x 1m size. For the road along new alignment, the test pits for sub grade soil has been carried out @ 5 km or for each soil type, whichever is more. The laboratory testing of soil samples includes:

- Soil characterization (grain size distribution and Atterberg Limits);
- Moisture content, natural density;
- Laboratory CBR (un soaked and 4-day soak compacted at three energy levels) and swell

The parameters for design will be selected after careful consideration of the engineering strength values and geological information. The investigations for high embankment will be carried out as per IRC Special Publications No.75. For proposing fill materials behind the abutments requisite tests will be done.

4.20 Material Investigation

The borrow areas adjacent to the right of way and off-road locations has been explored. However, the soil / earth generated from cutting would be sufficient for the filling purpose and soil from borrow area wouldn't be required.

The investigation for Stone aggregate and sand comprises of qualitative and quantitative assessment of potential quarries and determination of their suitability for use in:

- graded crushed stone base and sub-base
- bituminous base and wearing courses; and,
- Concrete works.

The potential sources of hard stone samples for ascertaining their suitability in road construction and concrete works includes:

- Sieve Analysis;

- Specific gravity;
- Water absorption;
- Los Angeles Abrasion Value (LAV);
- Aggregate impact value (AIV);
- Flakiness Index;
- Elongation Index;
- Bitumen affinity and stripping value;
- Chemical tests (total soluble salts, chloride content, sulphate content, alkali-silica reaction); and,
- Soundness.

Potential source of sand has been identified. The testing for sand samples in the laboratory includes.

- Grain size analysis;
- Specific Gravity;
- Water Absorption
- Fineness Modulus
- Deleterious Materials (Fineness 75 micron) Silt & Clay contents only

4.21 Pavement Design

The pavement design for the road is done on the basis of cumulative number of standard axles and the CBR of the sub-grade. The composition of pavement is recommended keeping in view the construction and maintenance costs. For pavement overlays, the deflection criteria are considered.

Pavement design will accord with the established codes and procedures. Flexible, bituminous pavement is designed for the New & Widening pavement whereas the structural condition has necessitated replacement of existing pavement. The design life of the pavement is taken as 15 years.

4.22 Design of Embankments

Final design for high embankments will be done based on the profile and terrain model developed from the topographical survey using available design software. The design will provide for maximum utilization of locally available materials consistent with economy.

4.23 Design of Bridges and Structures

According to the conceptual design of various improvement proposals, the consultant will identify the tentative structural arrangement of bridges and other cross drainage structures etc. for all the improvement alternatives. The Consultant will also carry out the preliminary design for these structures for sizing of various components of structures and prepare general arrangement drawings of all structures. The structure will be designed considering:

- use of modern construction technologies, such as precasting, composite constructions etc.,
- adequate diversion facility during construction,
- minimal maintenance costs,
- topographical and geotechnical characteristics of the embankments,

- aesthetic requirement, and
- cost considerations

Consideration will be given as far as possible to the possibilities of standardization of structures and adoption of the construction methods to the practices in India, in accordance with acceptable international practice.

General arrangement drawings will be prepared and shall be suitable for preliminary quantity estimates. The Consultant will also propose the scheme of various phases of construction for all the structures.

The consultant will review the preliminary design of all structural components of various structures and formulate the final design standards for each of the structures proposed in the improvement scheme. During finalization of the standards, a close liaison will be assured with NHIDCL

The consultant will carry out the structural design for bridges and other cross drainage structures including design of foundations, geometric features and typical sections. The detailed engineering design will include the following:

- General plans and layout
- Design of superstructure
- Design of sub-structure
- Design of foundations
- Reinforcement schedules
- Construction schedules

Detailed drawings will be prepared and shall be suitable for estimating, bidding and construction purposes.

The Bill of Quantities will allow the renderers to properly price the works with prices for each type of formwork, concrete, pre-stressing units, reinforcing steel etc.

The General Arrangement Drawings (GAD) would be prepared and the same would be done in accordance with design, the relevant IRC and Bureau of Indian Standards Codes:

- Geometry;
- Structural design of Bridges components;

The following types of loading will generally be considered while evolving GADs

- Dead load;
- Superimposed dead loads;
- Live loads with impacts;
- Wind loads and seismic effects;
- Temperature forces;
- Water current forces if any; and
- Earth pressures

The bridges will be designed for the live load which gives the worst effects at the point under consideration. Appropriate relationships for earth pressure effects will be taken into consideration. The coefficients for active and passive earth pressure will be calculated based on

properties of soil used for backfilling behind abutments and wing walls. Continuous structures would be designed to accommodate a differential settlement (at least 10mm) of supports. The type of foundations, either open or pile shall be decided taking into consideration, the properties of soil and the type of foundations for the nearby structures.

4.24 Drainage Design

The requirements for adequate drainage both along and across the project will be studied and determined. This will establish which of the existing culverts are adequate. Hydrologic and hydraulic studies will be performed to determine the additional drainage facilities required and the appropriate improvements to existing culverts. The study will also report on the adequacy of existing embankment heights.

Within each catchment area the design of existing bridges, in respect of scour, flooding width, stream velocity etc. will be supported by the results of hydrologic and hydraulic studies that extend a sufficient distance upstream. This analysis will be augmented by discussion with local, informed sources.

Side drainage will be designed through an appraisal of local practice and the economic construction methods. Particular attention will be given to the need for scour protection within embankments and the discharge point of new drainage into existing drainage channels.

4.25 Traffic Safety Features, Road Furniture and Road Markings

Suitable designs will be furnished for traffic safety features and road furniture including traffic signals in urban areas, signs, markings, overhead sign boards, crash barriers, delineators, fencing in selected stretches etc. Generally, IRC guidelines and MORT&H Specifications will be followed. The locations of these features will be given in the reports and also shown in the drawings.

4.26 Miscellaneous Works

The Consultant will make suitable designs and layouts for miscellaneous road works items and project facilities like bus bays, truck Lay byes etc.

4.27 Environmental Impact Assessment

The Environmental Screening and Preliminary Assessment has already been done. The Consultant will carry out analysis and make environmental impact assessment analysis, such as short and long term, direct and indirect, and positive and negative in respect of different parameters such as physical (air, water etc.), Natural (vegetation, wetlands, conservation area) and social (land use, noise, topography etc.).

The objective of the study will be ascertaining in the existing baseline conditions and assess the effects as a result of construction of the Highway. While assessing impact, the consultant will study available Acts, legislation and Rules with a view to ensuring compliance with various requirements. Local people will be consulted on various issues.

The changes likely to occur in different components of the environment viz. physical, biological, socio-economic etc. will be studied and analyzed. The area of Study will be ROW of the proposed project road. Based on project particulars and the existing environmental conditions, potential impacts will be identified that are expected to be affected, and wherever possible, these will be quantified. Both positive and negative impacts will be evaluated to have an idea about resultant impacts. These impacts will be assessed for various phases of project cycle namely, location,

design, construction and operation. The standard methodology will be adopted for impact prediction and assessment.

The issues in each phase will be considered as follows:

❖ Impacts due to Project Location

- Loss of lands,
- Encroachment into forest lands and loss of trees and forest produce,
- Encroachment into grazing lands,
- Encroachment into nature reserve,
- Loss of historical and cultural monuments,
- Effect on water resources inside and outside the project, and
- Erosion and situation risk.

❖ Impact due to Project Design

- Drainage problem,
- Impacts related to design structures,
- Visual and landscape impacts, and
- Slope stability.

❖ Impacts due to Project Construction

- Soil pollution at construction sites,
- Pollution by construction spoils,
- Health risks,
- Cultural hazards and
- Noise and air pollution,

❖ Impacts due to Project Operation

Positive:

- Quick service,
- More employment,
- Better safety,
- Tourism and recreation,
- Less fuel consumption and air pollution
- Regional development

Negative:

- Air pollution,
- Noise pollution,
- Solid/soil waste problems etc.
- Associated regional development problems, and
- Increase severance of communities.

4.28 Social Assessment

The section provides details on the approach and process adopted to carry out the requisite surveys, consultations, collection and compilation of information from various sources in preparation of the LAP and RAP.

After initial interactions with project officials and also with revenue officials at the different block offices in the district, a list of villages were collected to ascertain the ROW details along the entire stretch. It helped to confirm the exact ROW available and to plan for additional land that needs to be acquired and/or transferred from other government departments or villagers.

In parallel, social screening exercise was carried on broad indicators such as:

i. Estimates of the total impacted population along the entire stretch;

ii. Potential impacts on the privately-owned land and commercial structures particularly in town areas and

iii. Impacts on common property resources. A field surveyor and a sociologist carried out the social screening to prepare an inventory of the potentially impacted structures and also held sporadic interactions with the local population living en-route. For the purposes of survey as required under the Scope of work, the corridor of impact was taken as thirty meters either side of the existing center-line. Impacts on land owned privately and by the community were noted and recorded. Besides, Common Property Resources that lay en-route on either side of the project road were observed and recorded. Preliminary interactions with the impacted persons were sought to elicit their perceptions and apprehensions of the project. Interactions with the locals were carried to discuss their concerns specifically relating to safety, road widening, potential impacts to their properties and expected impacts.

Further, upon super imposition of the road design alignment onto the existing road land, the exact requirement of land both for widening and provision of key project facilities shall be known. The census survey would be undertaken as soon as adequate engineering details and proposed ROW is known. Impacts will be assessed in the immediate and extended influence zone of the road. The inventory of social resources in the probable impact zone will form the baseline for assessment of likely social impacts. Assessment of the impacts will form the basis of entitlement framework and the Resettlement Action Plan. A full census of all likely PAPs within the area of direct influence (the existing ROW in most of the cases) will be carried out along the highway corridor. The survey will identify in a comprehensive manner, the physical location of the PAPs. Following which, the consultant shall conduct base line socio economic and census survey to

- assess the impacts, establish ownership and
- prepare the land acquisition plan and assist MoRTH in acquisition of land following establish of ownership of the land – government.
- prepare resettlement and rehabilitation plan
- Assess feasibility & effectiveness of income restoration strategies and suitability to relocation sites.

4.29 Estimation of Costs and Budgeting for LA & R&R

The consultant has in discussions with the concerned project official and local concerned village secretary has taken note of the procedure for acquiring the private land. Further, the structures (residential and commercial) and also crops too have been obtained. To estimate the resettlement budget, the cost of impact of private properties and also for administration of suitable R&R measures has been considered.

4.30 Reporting Requirements to EIA

The Consultant will prepare a report as per the requirement of MoRTH which will include

- Environmental setting of the project
- Identification and categorization of potential impacts
- Analysis of alternatives with the avoidance and environmental management solutions
- Public consultation process
- Policy, legal and administrative framework
- EMP reports for each contract packages including environmental enhancement measures and environmental monitoring plans

4.31 Reporting Requirements of RAP

Requirements for preparing Resettlement Action Plans are stringent and surveys previously undertaken will ensure that such plans are capable of implementation before the new right-of-way is confirmed and design is finalized. The RAP would broadly cover the following:

- The need for resettlement in the project and evaluation of measures to minimize resettlement
- Descriptions and result of public consultation and plan for continued participation of PAPs. Census and survey results – number affected and how they are affected.
- Arrangements for monitoring and evaluation
- Implementation schedule for resettlement
- Matrix of scheduled activities linked to land acquisition procedures
- Payment of compensation and resettlement during acquisition
- An itemized budget and unit costs for different assets

The detail environment & social survey will be carried out by environment and social expert after approval of alignment and data will be incorporated in the final feasibility report.

4.32 Estimation of Quantities and Project Costs

Rate Analysis

Rate analysis has been done based on the Manipur Schedule of Rates for NH and MoRTH Works 2016, published by Public Works Department (National Highways), Government of Manipur.

Detailed Estimates for Quantities and Project Costs

Based on the designs and drawings, bill of quantities will be prepared by the consultants for the following items as under:

- Site clearance and Dismantling;
- Earthwork and Sub-grade;

- Sub-base, Base Courses & Shoulder;
- Bituminous Courses;
- Junction Improvement;
- Traffic Signs, Road Marking and Other Road Appurtenances;
- Passenger Shelter;
- Drainage and Protective works;
- Bridges and culverts

The format for bill of quantities will be as adopted by the consultants for similar type of National Highway projects in India and as agreed by MoRTH.

Project base costs for the Project will be prepared with the unit costs derived as explained above and the quantities developed by detailed engineering design activity.

After discussion with NHIDCL, suitable allowances for physical and price contingencies will be made to produce final engineering estimates for the contract packages decided during DPR stage.

Cost estimate along with rate analysis and BOQ prepared based on improvement proposal suggested in design and submitted in volume-II of Draft Feasibility Report.

CHAPTER – 5
SOCIO-ECONOMIC PROFILE

5.1 Introduction & Background

The State

Manipur is one of the Border States in the northeastern part of the country having an international boundary of about 352 km long stretch of land with Myanmar in the southeast. It is bounded by Manipur in the north, Assam in the west and Mizoram in the south. It has a total area of 22,327 sq km. It lies between 23.8°N to 25.7°N latitude and 93.5°E to 94.8°E longitude.

Geographically, the state of Manipur could be divided into two regions, viz. the hill and the valley. The valley lies in the central part of the state and the hills surround the valley. The average elevation of the valley is about 790m above the sea level and that of the hills is between 1500m and 1800m. The hill region comprises of ten districts viz. Senapati, Kangpokpi, Tamenglong, Noney, Churachandpur, Pherzawl, Chandel, Tengnoupal, Ukhrul, Kamjong and the valley region consists of six districts, viz. Imphal East, Imphal West, Thoubal, Jiribam, Kakching and Bishnupur. The hill districts occupy about 90 percent (20,089 sqkm) of the total area of the state and the valley occupies only about tenth (2,238 sq. km) of the total area of the state.

The Economy

Manipur has a literacy rate of 79.21% (According to 2011 census) per cent. The main languages of the state are Meitei/Meeteilon (Manipuri), Tangkhul, Kabui Kuki, Hmar, Paite, Thadou, Bishnupriya Manipuri, English, Hindi and local dialects. There are forests of teak, pine, oak, uningthou, leihao, bamboo, and cane. Rubber, tea, coffee, and cardamom are grown in hill areas. Rice and cash crops make up the main vegetation cover in the valley. Agriculture is the main mode of living of the people. People of Manipur are also engaged in handloom sector which is the largest cottage industry in Manipur. The main vegetables and fruits are Cauliflower, Cabbage, Tomato, Pea &litchi, cashew nuts, walnuts, orange, lemon, pineapple, papaya, peach, pear, banana and plum. The major minerals are Limestone, Asbestos, Copper, Lignite, Nickel, Chromites, Salts etc. Small industries like Handlooms, Handicrafts, Sericulture, Food Processing, Bamboo Processing, IT, Hydro Power and Tourism are present in the state.

The Environment

The climate of Manipur is largely influenced by the topography of this hilly region. Lying 790 meters above sea level, Manipur is wedged among hills on all sides. This northeastern corner of India enjoys a generally amiable climate, though the winters can be a chilly. The maximum temperature in the summer months is 32 °C (90 °F). In winter the temperature often falls below 0 °C (32 °F), bringing frost. Snow sometimes falls in hilly regions due to the Western Disturbance. The coldest month is January, and the warmest July.

The state is drenched in rains from May until mid-October. It receives an average annual rainfall of 1,467.5 millimeters (57.78 in). Rain distribution varies from 933 millimeters (36.7 in) in Imphal to 2,593 millimeters (102.1 in) in Tamenglong. The precipitation ranges from light drizzle to heavy downpour. The normal rainfall of Manipur enriches the soil and helps in agriculture and irrigation. The South Westerly Monsoon picks up moisture from the Bay of Bengal and heads toward Manipur, hits the eastern Himalaya ranges and produces a massive amount of rain. The climate is salubrious with approximate average annual rainfall varying from

933 millimeters (36.7 in) at Imphal to 2,593 millimeters (102.1 in) at Tamenglong. The temperature ranges from sub 0 to 36 °C (32 to 97 °F).

Poverty

As per the estimates, Manipur saw the highest rise of 9.2 percentage points in poverty between 2004-05 and 2009-10, followed by Mizoram (5.7 percentage points), Assam (3.5 percentage points) and Meghalaya (1 percentage point).

Indigenous People

The Meitei constitute a majority of the state's population. According to 1891 census Meitei were recorded as a forest tribe. In 1901 Meitei were listed as main tribe of Manipur. They live primarily in the state's valley region.

Besides the Meitei people, the Thadous have the second highest percentage of the population. The third is the Nagas who are further sub-divided into sub-tribes: Tangkhul, Maram, Poumai Naga, Sumi, Angami, Ao, Chakhesang, Chang, Khiamniungan, Konyak, Liangmai, Lotha, Pochury, Rongmei, Zeme, and Mao.

Different tribes are speaking in different languages. These language are Meitei/Meeteilon(Manipuri), Tangkhul, Kabui Kuki, Hmar, Paite, Thadou , Bishnupriya Manipuri, English, Hindi and local dialects.

HIV/AIDS & Human Trafficking Risks

Two out of the six high HIV-prevalence states in India – Manipur and Manipur – are in the Northeast and now feature what epidemiologists call a 'generalized' epidemic with a strong IDU-HIV link. This is a larger challenge for Government and NGOs fighting the epidemic in the region in particular and the world at large.

According to estimates by the National Aids Control Organization (NACO – 2006) there are 50,000 IDUs injecting drug use in the region, the majority of them in Manipur, Manipur, Mizoram and, of late, Meghalaya. Easy availability of drugs, stress arising from socio-political unrest and frustration born of the lack of employment opportunities for the growing educated youth mass in the region are often cited as the major causes of drug use a serious social disease.

5.2 Social Assessment

Objective

The objective of Social Assessment report is to present a socio-economic profile of the subproject area with particular reference to indigenous people, communicable diseases especially HIV/AIDS, human trafficking, poverty level, local economy like agriculture, industry, health and educational status in accordance with guidelines and recommendations of Government of India and the State Government of Manipur.

Project Road

Proposed Ukhrul-Toloi-Tadubi road Package-1 including Ukhrul Bypass will starts near Km 538 of NH-102A (about 6 Km before Ukhrul Town) & meets existing Ukhrul-Toloi-Tadubi Road at Ex chainage 8+840 (De. Ch. 5+600 Km) and then follow the existing road for about 1 Km & ends at De. Ch. 6+571 Km. Hence total length will be 6.571 Km

Project Description

The project road lies in Ukhrul districts of Manipur. The project road is located in mountainous Terrain. The entire road passes through major village / localities namely Hundung & Hunphun in the State of Manipur.

Project Impact Area

The Project Impact Area (PIA) has been defined as the 2.5 km width of a band on both sides of the project road. In broad sense the PIA may be considered as Ukhrul district as a whole.

The Project Districts

The project road passes through Ukhrul district in the state of Manipur. Brief features of the districts are summarized below:

Ukhrul District

Ukhrul District was first marked out as a Sub-Division in 1919 by the then British-India. Later it was upgraded to a District in the year 1969 by the Govt. of India. The District now has 7(seven) Sub-Divisions which are co-terminus with the 8(eight) Development Blocks. The area of the district was 1,754 Sq.Km. according to the CSI Publication 1976. Later Tengnoupal District, now called Chandel was carved out from this district on 15th July, 1983 and the area of the Manipur East District was sliced down to 4,544 Sq Km and the title of the district was changed into Ukhrul District in 1983. Ukhrul District (currently including Kamjong District) is bounded by Myanmar in the East, Chandel District in the South, Imphal East and Senapati Districts in the West and Manipur State in the North. The terrain of the district is hilly with varying heights of 913m to 3114m (MSL). The district HQ Ukhrul is linked with Imphal, the state capital by a NH 150 about 84 Km. By ordinary passenger bus it takes about 3 hours.

Statistics of Ukhrul District in Manipur

Description	As per Census-2011
Actual Population	2.37 Lacs
Area Sq. Km	4544
Density/km2	40
Sex Ratio (Per 1000)	943
Child Sex Ratio (0-6 Age)	923
Average Literacy	81.40%
Male Literacy	85.52%
Female Literacy	76.95%
Total Child Population (0-6 Age)	24,413
Male Population (0-6 Age)	94,718
Female Population (0-6 Age)	89,280

Major Indicators of the Social parameters in three Districts

Sl No	District	Ukhrul
1	Headquarters	Ukhrul
2	Sub-districts	Ukhrul, Jessami, Chingai and Lungchong Maiphei
3	Area in Sq Km	4544
4	Population (Census 2011)	2.37 Lacs

Indigenous People Development Plan (IPDP)

Indigenous People Development Plan (IPDP) is an integral part of the Social, Economic and Resettlement Plan of any of the infrastructural projects taken up by the authorities when a considerable number Schedule Tribe population is affected or displaced from their natural habitat. IPDP is also required if after the completion of the project there would be substantial change in the region which might affect the traditional customary right over land of the tribal people or alter their lifestyle in such a manner that they are uprooted or not in a position to follow their tradition, culture or profess their customs or religion.

The Mitigation measures of HIV/ AIDS & Human Trafficking Risks

Awareness campaign should be conducted at regular intervals in the PIA and the road construction sites. Distribution of IEC materials, organizing audiovisual shows and street drama giving a proper idea of the menace of the disease should be undertaken by some reputed NGOs.

Village quacks and ANMs to be trained in detecting and responding to cases of HIV/AIDS at initial level. There should facility at PHCs / referral hospital preferably within PIA to detect the infected persons early.

Counseling by NGOs to be given free of charges to the poor migrating families to create awareness against possible spread of HIV/AIDS outside the area.

The Gender Issue

Along with men in the Project areas, women will benefit from (i) easier access to markets, (ii) increased local retailing opportunities, and (iii) easier access to health care centers and education facilities as well. Women may also benefit more than men from the increased access to schools and health centers.

5.3 Project Road Benefit

Project Road strategically inter connects with NH-202. The development of the road as per 2-lane can boost the agricultural and industrial development of the surrounding area which can be viewed as boosting economic growth and poverty reduction, bringing substantial social and economic development in the region.

The social benefits arising due to the project will be triggered off due to improved accessibility to various services such as easy access to markets, health facilities, schools, workplace etc which in turn increases the income of the locals, and ultimately elevating their standard of living. The possible direct and indirect positive impacts of the project are listed below.

- Road network will not only link the village communities to better national markets, but also open up wider work opportunities in distant places. People can shuttle to distant worksites and engage in construction, mining, factories, business as well as domestic works.
- The immediate benefits of road construction and improvement will come in the form of direct employment opportunities for the roadside communities and specially those who are engaged as wage labourers, petty contractors and suppliers of raw materials.
- Effective drainage system to ensure that there will be no pooling of water
- Safety measures for Highway signs, Pavement marking, Traffic signals, Truck lay byes, Bus stops and Bus bays
- Rectification of geometric deficiencies (both Horizontal & Vertical).

- Slope protection.
- Provision of crash barrier at Bridge approaches.
- Improvement of all Major and Minor Intersections.
- Facilities for public amenities such as Restrooms, Telephone booths, Toilets, Shops and Trauma Centres.

Other benefits: -

- It will give a major fillip to the quest for all weather connectivity.
- It will reduce travel time between towns and cities by 50% to 60%.
- It will enhance the spirit of enterprise.
- Help the locals to ply their trade.
- Provide direct employment in road construction and allied activities.
- Lower accident and provide quick accessibility to services like hospital, market, office etc.
- Will help in growth of tourism activities immensely.

CHAPTER - 6
INDICATIVE DESIGN STANDARDS

6.1 Geometric Design Standars (For Highways)

PROPOSED DESIGN BASIS

The following guiding principles form the basis of all good highway design:

- A uniform application of design standards for any area is essential from the viewpoint of road safety and the smooth flow of traffic. The selection of optimum design standards reduces the possibility of early obsolescence of the facility, which can be MORT&H thought about by any inadequacy in the original standards.
- Faulty geometric standards, after construction, are frequently difficult to rectify at a later date and they are always costly. As such, both horizontal and vertical geometry should be accorded due importance at the initial design stage itself and selected standards should not be compromised without the most careful deliberation.
- The design should thus be consistent within any area and the standards proposed for the different elements should be compatible with one another. It is sometimes necessary to reduce the selected design speed for economic reasons but any abrupt changes in the design speed must be avoided.
- The selected design should minimize the total transportation cost, including initial construction costs, costs for maintenance of the facility, and the cost borne by the road users.
- Safety should be built-in into design elements.
- "Ruling" standards should be followed as a matter of routine. "Minimum" standards should be followed only where serious restrictions are imposed by technical or economic consideration.

6.2 Design Controls

6.2.1 Design Standard

In general, the design standard follows the provisions of Hill Road Manual (IRC: SP-48-1998) and recommendations in IRC: 52-2019. Some of the salient provisions made in them and followed in preparation of this DPR are indicated here under. In general, the project road will have two lane configuration.

IRC GUIDING STANDARDS FOR HIGHWAYS

The preliminary designs of proposed Highways will be carried out in accordance with the provisions of the following IRC Codes/guidelines.

Sl. No.	Name of Code	Descriptions
1	IRC:35-2015	Code of Practice for Road Markings (Second Revision)
2	IRC:37-2018	Guidelines for the Design of Flexible Pavements (Fourth Revision) (with CD)
3	IRC:38-1988	Guidelines for Design of Horizontal Curves for Highways and Design Tables (First Revision)
4	IRC:44-2017	Guidelines for Cement Concrete Mix Design for Pavements (Third Revision)

5	IRC:52-2019	Guidelines for the Alignment Survey and Geometric Design of Hill Roads (Third Revision)
6	IRC:67-2012	Code of Practice for Road Signs (Third Revision)
7	IRC:73-1980	Geometric Design Standards for Rural (Non- Urban) Highways
8	IRC:82-2015	Code of Practice for Maintenance of Bituminous Surface of Roads" (First Revision) (with CD)
9	IRC:90-2010	Guidelines of Selection, Operation and Maintenance of Bituminous Hot Mix Plant (First Revision)
10	IRC:103-2012	Guidelines for Pedestrian Facilities (First Revision)
11	IRC:108-2015	Guidelines for Traffic Forecast on Highways (First Revision)
12	IRC:109-2015	Guidelines for Wet Mix Macadam (First Revision)
13	IRC:111-2009	Specifications for Dense Graded Bituminous Mixes
14	IRC:119-2015	Guidelines for Traffic Safety Barriers
15	IRC: SP:19-2020	Manual for Survey, Investigation and preparation of road project (Second Revision)
16	IRC: SP:23-1983	Vertical Curves for Highways
17	IRC: SP:42-2014	Guidelines on Road Drainage (First Revision)
18	IRC: SP:48-1998	Hill Road Manual
19	IRC: SP:73-2018	Manual of Specifications and Standards for Two Laning of Highways with Paved Shoulder (Second Revision)
20	IRC: SP-93-2017	Guidelines on requirements for Environmental Clearance for Road Projects

6.2.2 Terrain Classification

The project road passes through mountainous and steep terrain. The topography is mostly rural in nature with some built-up portion.

6.2.3 Design Speed

The project has been designed as per NH standard having two lane carriageway configuration considering the minimum design speed of 40 km/h and ruling design speed of 60 km/h for mountainous and steep terrain as per the guideline specified in Geometric Design as per IRC:SP:73-2018.

6.2.4 Sight Distance

Stopping sight distance is the clear distance ahead needed by a driver to bring his vehicle to a stop before meeting a stationary object on his path. Intermediate sight distance is defined as twice the stopping sight distance and the vertical profile will be designed as per this sight distance. However, safe stopping sight distance is the absolute minimum from safety angle and must be ensured regardless of any consideration with proper road safety measures.

Design values for stopping sight distance and intermediate sight distance for various speeds:

Design Values (meters)		
Speed (km/h)	**Stopping sight distance**	**Intermediate sight distance**
40	45	90
50	60	120
60	90	180

Criteria for measuring sight distance:

Sl. No.	Sight Distance	Driver's eye sight	Height of object
1.	Safe stopping distance	1.2 m	0.15 m
2.	Intermediate sight distance	1.2 m	1.20 m

6.2.5 Right-Of-Way (ROW)

Proposed Right of Way has been considered 30m to 55m at Proposed Bypass for accommodating the following cross section.

6.2.6 Cross-Sectional Parameters

In Rural Area

Carriageway = 7.0 m
Hard Shoulder = 2 x 1.50 m
Earthen Shoulder = 1 x 1.00 m
Total Roadway Width = 11.0 m

6.2.7 Widening Of Carriageway At Curve

On horizontal curves with radius up to 300 m, width of pavement and roadway shall be increased as per the table given below:

Radius of Curve	Extra Width
75-100 m	0.9 m
101-300 m	0.6 m

6.2.8 Cross-Slope/Camber

Bituminous surfacing has been proposed. The pavement in the straight reaches is to be provided with a crown in middle and surface on either side is to have slope of 2.5% towards edge. In reaches with winding alignment where straight sections are few and far between, the carriage way is to be given a unidirectional cross fall of 2.5% having regard to super-elevation at the flanking horizontal curves and ease of drainage.

The cross fall of earth shoulders is to be at least 0.5% more than that of carriage way subject to a minimum of 3.0%.

6.2.9 Horizontal Alignment

As a general rule, the horizontal alignment should be fluent and should blend well with the surrounding topography. In a given section there should be consistency and no element of surprise or unexpected situation for the driver.

RADII OF HORIZONTAL CURVES

The desirable minimum and absolute minimum radii of horizontal curves for mountainous terrain are given in the table below:

Name of the terrain	Ruling minimum radius (m)	Absolute minimum radius (m)
Mountainous and Steep Terrain	150	75

TRANSITION CURVES

Transition curves are necessary for vehicles to progress from a straight alignment into a circular curve or between curves of different radius. The transition curve also facilitates a gradual application of the super elevation and any widening of the carriageway which may be required for horizontal curves.

The minimum length of the transition curve shall be determined from the following two considerations, the larger of the two values being adopted for design:

i) $Ls = \frac{0.0215\ V^3}{CR}$

Where, Ls = length of transition in metres

V = speed in km/hr

R = radius of circular curve in metres

$C = \frac{80}{75+V}$

Subject to a maximum of 0.8 and minimum of 0.5

ii) The rate of change of superelvation (i.e. the longitudinal grade developed at the pavement edge compared to through grade along the centre line) should be such as not to cause discomfort to traveller of to make the road appear unsightly. The formula for minimum length of transition on this basis for Mountainous and Plain Terrain are :

$Ls = \frac{1.0\ V^2}{R}$ and $Ls = \frac{2.7\ V^2}{R}$

SUPERELEVATION

Super elevation provided on horizontal curves is based on the following formula:

$$e = \frac{V^2}{225R}$$

Where

e = super elevation (metre/metre).

V = speed (km/hr)

R = radius (metres)

Super elevation shall be limited to 7%, if radius of curve is less than the desirable minimum. It shall limited to 5% if the radius is more than desirable minimum.

RADIUS OF HORIZONTAL CURVES

The radius of horizontal curve is obtained from following formula:

$$R = \frac{V^2}{127(e+f)}$$

Where,

V = Vehicle speed (km/hr)

e = Super elevation ratio (metre/metre)

f = Coefficient of side friction between vehicle tyre and pavement (taken as 0.15)

R = Radius in metres

SET-BACK DISTANCE AT HORIZONTAL CURVES

Set-back distance from the centreline of the carriageway for obtaining requisite sight distance across the inside of horizontal curves is calculated from following equation (vide **figure-6.1** for definitions) :

$$M = R - (R - N)\cos\theta$$

where,

θ = $S/2(R-N)$ radians

m = the minimum set-back distance from centreline of the road to sight obstruction in meters at middle of the curve

r = radius of centreline of the road in metres

n = distance between the centreline of road and the inside lane in metre (n = 1.5 may be taken considering possible widening at curve)

s = stopping sight distance (minimum),
intermediate sight distance (if feasible)

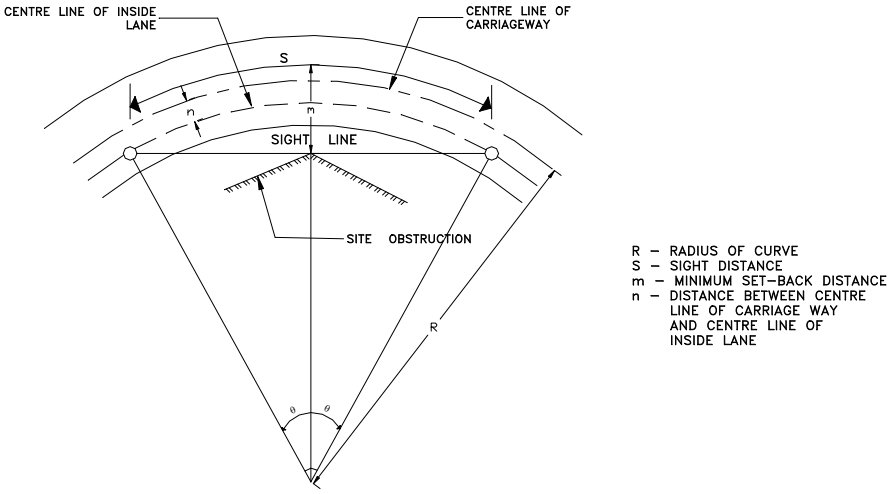
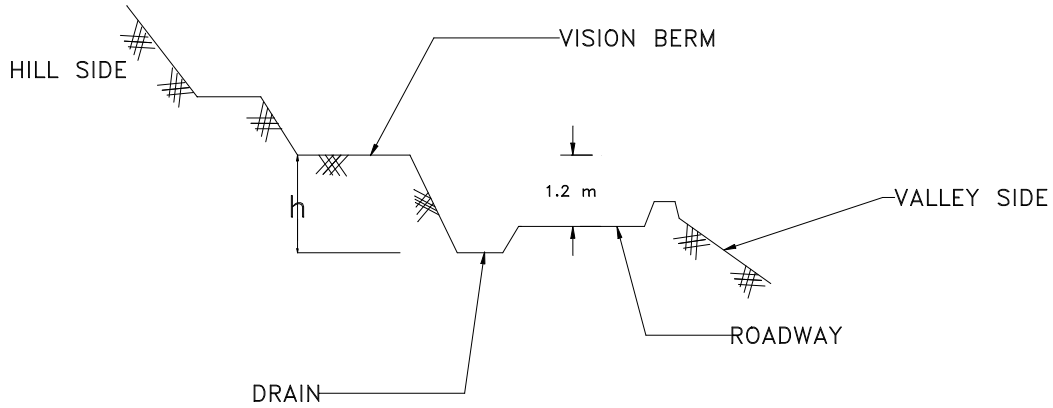
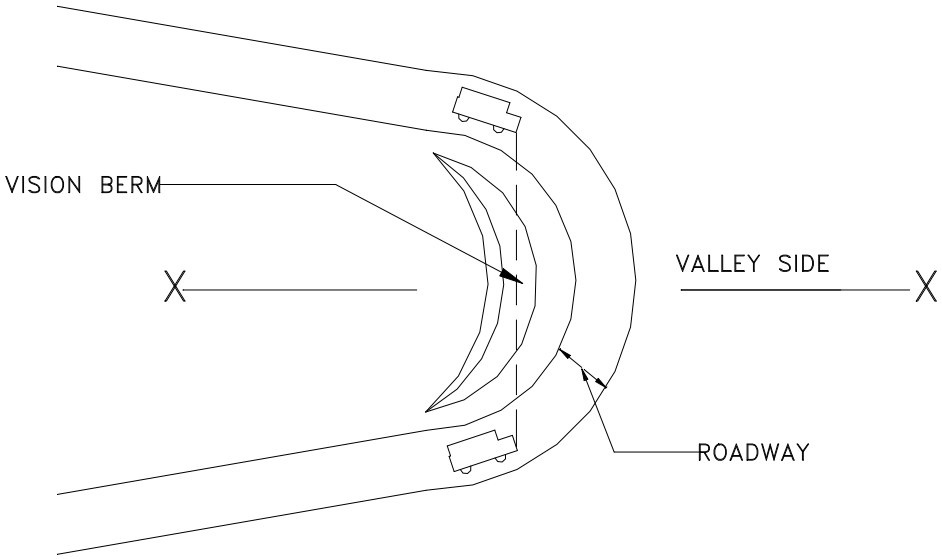


FIG. 6.1: VISIBILITY AT HORIZONTAL CURVES

Provision of lateral clearance with intermediate sight distance is often not economically feasible in hill roads. However, vision berms, as shown in **figure-6.2**, may be provided by benching on hill sides in curves to provide better sighting of vehicles wherever considered necessary.



SECTION AT X–X



PLAN

FIG: 6.2 VISION BERMS

6.2.10 Vertical Alignment

GRADIENT

Vertical curves should be provided at all grade changes exceeding those indicated below. The minimum lengths of curve for satisfactory appearance are shown alongside:

Nature of Terrain	Ruling Gradient	Limiting Gradient
Mountainous	5.0%	6.0%
Steep	6.0%	7.0%

VERTICAL CURVES

The project road passes through mountainous terrain with mostly in rural area. Ruling gradient shall be adopted as far as possible. Limiting gradient shall be adopted in difficult situations for short lengths.

Design Speed (km/hr)	Maximum Grade Change (%) not requiring a vertical curve	Minimum Length of vertical curve (m)
40	1.2	20
60	0.8	40

SUMMIT CURVES

The length of summit curves is governed by the choice of sight distance. For the project road length is calculated for safe stopping sight distance on the basis of following formula:

- **For Safe Stopping sight distance**

Case (i) When length of the curve exceeds the required sight distance i.e. L > S

$$L = \frac{NS^2}{4.4}$$

Where,

N = Deviation angle i.e. the algebraic difference between the two grades

L = Length of parabolic vertical curve in metres

S = Sight distance in metres

Case (ii) When length of the curve is less than the required sight distance i.e. L < S

$$L = 2S - \frac{4.4}{N}$$

- **For Intermediate sight distance**

Case (i) When length of the curve exceeds the required sight distance i.e. L > S

$$L = \frac{NS^2}{9.6}$$

Case (ii) When length of the curve is less than the required sight distance i.e. L < S

$$L = 2S - \frac{9.6}{N}$$

VALLEY CURVES

The length of valley curves should be such that for night travel, the head light beam distance is equal to the stopping sight distance. The length of the curve is calculated as under:

Case (i) When the length of the curve exceeds the required sight distance, i.e. L > S

$$L = \frac{NS^2}{1.50 + 0.035S}$$

Case (ii) When the length of the curve is less than the required sight distance i.e. L < S

$$L = 2S - \frac{1.5 + 0.035\,S}{N}$$

In both cases,

N = Deviation angle i.e. the algebraic difference between the two grades

L = Length of parabolic vertical curve in metres

S = Stopping sight distance in metres

6.3 Flexible Pavement Design Standards

Design of New Flexible Pavement

Design of new pavement has been carried out based on IRC 37-2018 "Guidelines for the Design of Flexible Pavements" for design life of 20 years. Procedure for the same is given below:

Step 1: To find out initial traffic in the year of completion of construction in terms of the number of the number of commercial vehicles per day (CVPD)

Step 2: To determine traffic growth rate factor by studying the past trends of traffic growth

Step 3: Design life of Pavement

Step 4: To find out Vehicle Damage Factor to convert the number of commercial vehicles of different axle loads and axle configuration to the number of standard axle load repetition. It may be obtained by conducting axle load survey at site.

Step 5: To find out lane distribution factor of traffic over the carriageway

Step6: To determine design traffic in cumulative number of standard axles (msa) by the following formula mentioned below:

$$N = [365 \times \{(1+r)^n - 1]/r\}] \times A \times D \times F$$

Where,

N = Cumulative number of standard axles to be catered for in the design in terms of msa

A = Initial traffic in the year of completion of construction in terms of number of commercial vehicles per day

D = Lane Distribution Factor

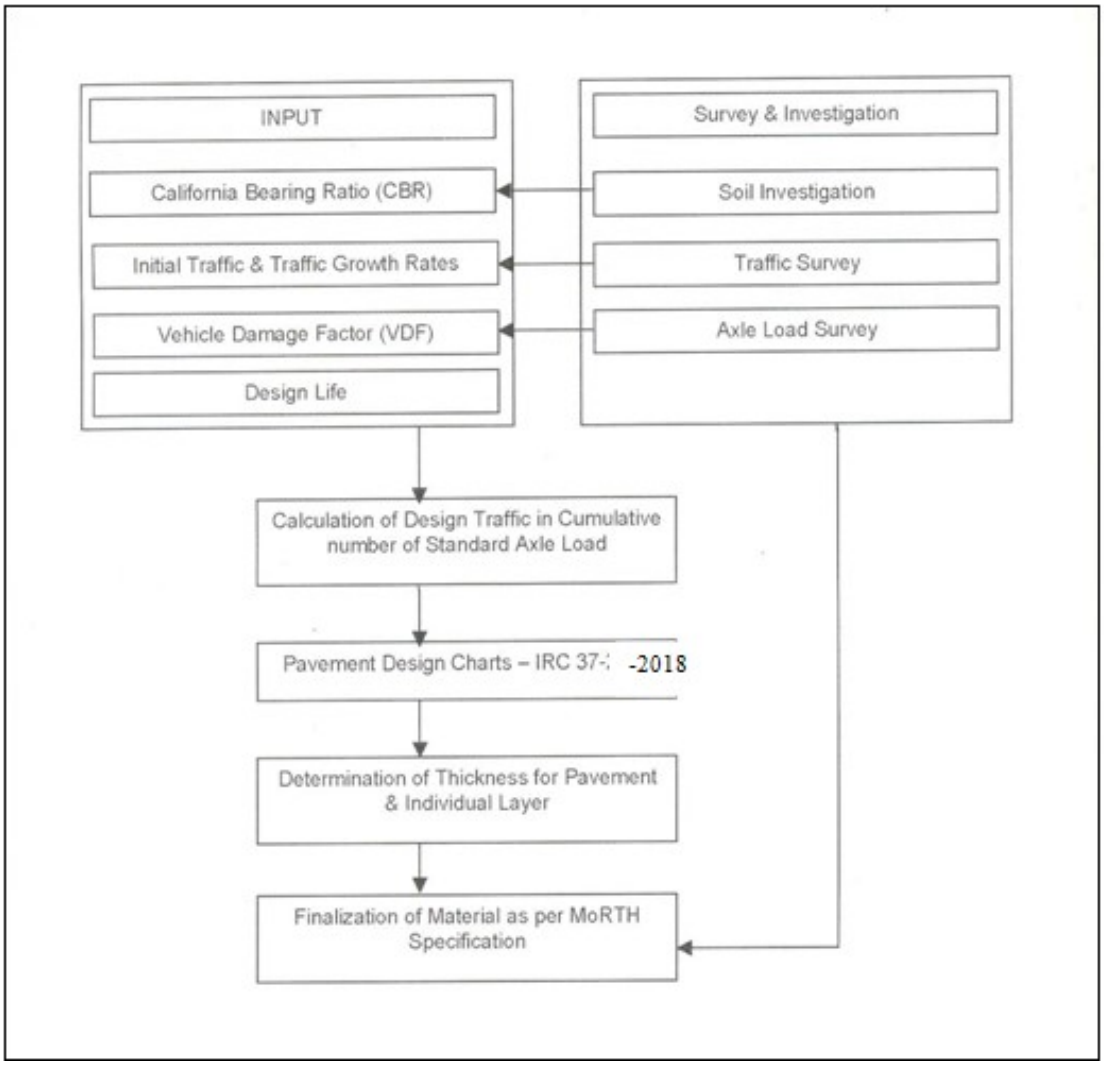
n = Design life in years

r = Annual growth rate of commercial vehicles

F = Vehicle damage factor

Step 7: To determine total pavement thickness and crust composition by charts/graphs with respect to CBR and cumulative number of standard axles.

Methodology flow chart for the design of new Flexible pavement has been given below.



6.4 Geometric Design standards for Bridges and Cross- Drainage Structure

SPECIFICATIONS

The project will use the MoRTH specifications for Road and Bridge Works (Fifth Revision). Where there are no appropriate standards within the MoRTH guidelines, AASHTO specifications may be utilized.

The following Indian standards will be incorporated wherever appropriate:

Ordinary Portland cement	IS: 269
High Strength Ordinary Portland cement	IS: 8112
Admixtures (where permitted)	IS: 6925 and IS: 9103
Thermo mechanically treated deformed Bars (TMT/H.Y.S.D)	IS: 1789
Prestressing Steel:	

Uncoated stress relieved low relaxation	
Strands for 19 T 13 cables	IS: 14268
Sheathing: "Drossbatch" 0.4 mm thick	IS: 18-1985, appendix: 1
Water	IRC: SP: 33, Clause 5.1 (ii)
Bearings	IRC: 83-2018 (Part II) or BS: 5400
Foundations	IRC: 78-2014 and IRC-SP: 33-1989

DESIGN STANDARDS

(a) GEOMETRIC DESIGN

i) The overall width (out to out of kerb) of the deck slab will be kept equal to the top width of the approach embankment.

ii) The span arrangement and span lengths provided will be such that piers/abutments are in line with those of the existing bridges/culverts and ensure smooth flow of water. The new spans are either equal to or a multiple of the spans of old structure.

iii) The linear water way provided will be determined from the consideration of design discharge, effective and adequate drainage.

(b) LOADING STANDARD

i) All structures will be designed for 3 lanes of IRC class A with due consideration to reduction allowed for a multi-lane bridge and single lane of class 70-R +single lane of class A whichever produces worst effect. IRC Class Special vehicle will also be considered in design of structures.

ii) LL on footpath will be taken as 5 KN/m2

iii) Environmental loadings such as earth pressure, water current, seismic forces and temperature effect will be taken as per IRC/BIS Codes. 15-1893 will be followed in evaluating dynamic increment of earth pressure.

(c) GUIDING STANDARDS FOR STRUCTURES

The Structural planning of new bridges or culverts will be guided by the layout of existing structures.

The preliminary designs of proposed structures will be carried out in accordance with the provisions of the following IRC Codes/guidelines.

- IRC:5-2015 -- Section I, General Features of Design
- IRC:6-2017 -- Section II, Loads and Stresses
- IRC:112-2020 -- Code for concrete road bridges
- IRC:22-2015 -- Section VI, Composite Construction
- IRC:40-2002 -- Section IV, Brick, stone & Block Masonry
- IRC:45-1972 -- Recommendations for estimating the Resistance of soil Below Maximum Scour level in the Design of Well Foundations of Bridges.
- IRC:78-2014 -- Section VII, Foundations and Structure
- IRC:83-2015 -- Section IX,(Part 1), Metallic Bearings
- IRC:83-2018 -- Section IX,{Part II), Elastomeric Bearings
- IRC:83-2018 -- Section IX,(Part III), POT Bearings
- IRC:87-2018 -- Guidelines for the Design & Erection of False work for Road Bridges

- IRC: SP-33-1989 -- Guidelines on Supplemental Measures for Design, Detailing and Durability of Important Bridge Structures
- IRC:89-2019 -- Guidelines for design and construction of river training and control works for road bridges (1st Revision)
- IRC: SP:84-2019 -- Four Lane Highway with Paved Shoulder Manual
- IRC: SP:13-2004 -- Guidelines for design of small bridges and culverts

Where IRC Codes are silent relevant BIS Codes will be followed. And where even BIS codes are silent, international codes / MOST, MORTH guidelines will be adopted.

(d) SEISMIC DESIGN

The project road falls in Seismic Zone V, as per the classification specified in IRC: 6. All bridges will be designed for Seismic forces as per clause 219 of the said code.

(e) SOIL PARAMETERS

The Soil parameters used in the preliminary design of foundations for Bridges will be taken from the report of soil investigation and information obtained from local authorities / existing bridge design data.

The following soil parameters will be used for material for back fill behind abutment of bridges and culverts and the abutment structure will be designed accordingly.

φ = 30°

δ = 20°

γ_d = 20 KN/m3

γ_{sub} = 10 KN/m3

A 600 mm thick granular material filter behind abutment and adequate weep holes in abutment walls will be provided for proper drainage.

(f) HYDRAULIC DESIGN:

The relevant hydraulic data for fixing linear water way of bridges will be taken from the river hydraulic survey done by us and hydraulic data obtained from Flood Control and Irrigation Department.

For the cross: drainage structures, both the empirical and rational analytical approach as detailed out in IRC-SP-13-2004 will be used to check the adequacy of the waterways provided. Synthetic unit hydrograph method as developed by CWC will be used if relevant subzone flood estimation reports are available in time.

(g) FOUNDATIONS:

For major bridges, either well or pile foundation and for minor bridges well, pile or open foundation will be adopted based on the soil boring data for those bridges.

(h) SUBSTRUCTURE:

RC wall type piers and wall type / spill through type abutment will be provided in the bridges, matching the requirements, site conditions and constraints. Their design will be carried out in conformity with IRC-78-2000. The shape, size and alignment will be matching with the existing structure from aesthetic and hydraulic considerations.

(i) SUPERSTRUCTURE:

I) MORT&H standard drawings of RC Beam and slab and PSC super-structure will be adopted wherever applicable. RC slab will form the deck for all new culverts, Multi-cell box structure may be adopted in the minor bridges and culverts, if found appropriate.

II) **BEARINGS:**

Neoprene/metallic/POT bearings will be used in the bridges as required for specific span, loads etc. and tar paper will be used in the culverts.

III) **RAILINGS:**

Reinforced concrete railings in M-30 grade concrete following MOST standard will be provided.

IV) **EXPANSION JOINTS**:

Buried type expansion/strip seal joints as per MoRTH standard will be used.

V) **WEARING COURSE**:

65mm thick asphaltic concrete wearing course will be adopted.

VI) **APPROACH SLAB:**

R.C. approach slabs, 3.50 m long and 300 mm thick in M-30 concrete will be used at either end of the bridges and culverts to ensure riding comfort and to reduce vehicular surcharge on the abutment walls. One end of the approach slab is supported on R.C. bracket projecting out, from dirt wall while the rest of the slab is placed on compacted soil as per the guidelines issued by MORT&H. A leveling course, 10 cm thick in M-20 / M-15 grade concrete will be used under the approach slab.

VII) **DRAINAGE SPOUTS:**

100mm ~ drainage spout will be used for deck drainage at least one on both sides of carriageway per span.

VIII) **TMT REINFORCEMENT AND PRESTRESSING CABLES:**

Fe-500 high yield strength deformed bars conforming to IS-1786 will be used as reinforcement in all R.C. works. Uncoated stress relieved low relaxation strands conforming to IS-14268 will be used in PSC works.

(J) PROTECTION WORKS

Protection works in the major bridge will be provided matching the protection work used in the existing bridges. IRC-89-1997 will be followed in detailing the protection works.

i) Return walls of appropriate length will be provided in all bridges and culverts to stop the spilling of earth into the waterway,

ii) Flooring will be provided over the base raft of culverts to guard against deterioration of the base raft

iii) Perimetral cut-off walls around the base raft of culverts and boulder apron on both upstream and downstream sides will be provided to reduce chances of scouring.

iv) The perimetral cut-off walls will also increase the effective depth of foundation in addition to their protective functions.

CHAPTER – 7
TRAFFIC SURVEYS AND ANALYSIS

7.1 Introduction

National Highways & Infrastructure Development Corporation Limited (NHIDCL) has decided to upgrade to 2-lane with hard shoulder standard of Ukhrul-Toloi-Tadubi Pkg-1 (Ukhrul Bypass) (6.571 km) of NH-102A in the State of Manipur on EPC mode. NHIDCL is the employer and executing agency for this development project.

Package-1, length 6.571 km i.e Ukhrul – Toloi - Tadubi section of NH-102A near km 538 of NH-202 to Ex. Km 9.840 of NH-102A is to be upgraded under this study.

7.2 Traffic Surveys

In order to understand the characteristics and the volume of traffic using the project road, data on existing road network, traffic volume on the project road were collected through primary surveys. The findings from the analysis of this data.

7.3 Classified Traffic Volume Counts

Classified directional traffic volumes were counted for 7 days 24 hours at one locations on the project road, to obtain the following.

- ✓ Average Daily Traffic (ADT)
- ✓ Seasonal Variation
- ✓ Annual Average Daily Traffic (AADT)

The details of the above are presented in the following sections.

7.4 Average Daily Traffic (ADT)

The traffic volumes counted in 15 minutes intervals have been aggregated to one-hour volumes. The hourly volumes have been aggregated into daily volumes for the entire survey period (7-days). The daily volumes are then averaged for ADT. To express the classified vehicular count in terms of PCUs, the PCU factors as given in IRC-108: 1996 have been considered. For ready reference, the PCU Factors considered in the analysis are given in Table

PCU Factors Considered for the Study

Sl. No.	Vehicle Type		PCU Factor
1	**Two-Wheeler**		0.50
2	**Car/Jeep/ Van/Taxi/ Auto**		1.00
3	**BUS**	Mini	1.50
4		Standard	3.00
5	**LCV**		1.50
6	**Truck**	2-Axle	3.00
7		3 -Axle	3.00
8		Multi-Axle	4.50
9	**Agricultural Tractor**	With Trailer	4.50
10		Without Trailer	1.50
11	**Cycle**		0.50
12	**Cycle Rickshaw**		2.00

Sl. No.	Vehicle Type		PCU Factor
13	**Hand Cart**		3.00
14	**Animal Drawn**	Bullock Cart	8.00
15		Horse	4.00

The summary of ADT, as observed on the Project Road, in terms of vehicles and PCUs at different survey locations is given below.

ADT as Observed on the Project Road

Vehicle Type	Traffic Count
Two-Wheeler	977
Car/Jeep/Van/Taxi/Auto	855
Mini Bus	15
Standard Bus	40
LCV	18
2-Axle	137
3-Axle	2
Multi-Axle	0
Tractor with Trailer	0
Tractor without Trailer	1
Cycle	19
Cycle Rickshaw	3
Hand Cart	28
Bullock Cart	6
Horse Cart	0
Total Motorized Vehicles (Number)	**2045**
Total Non-Motorized Vehicles (Number)	**57**
Total Motorized Vehicles (PCU)	**1932**
Total Non-Motorized Vehicles (PCU)	**150**
Total Commercial Vehicle per day (Number)	**213**
Total PCU per day	**2082**

7.4.1 Temporal Variation

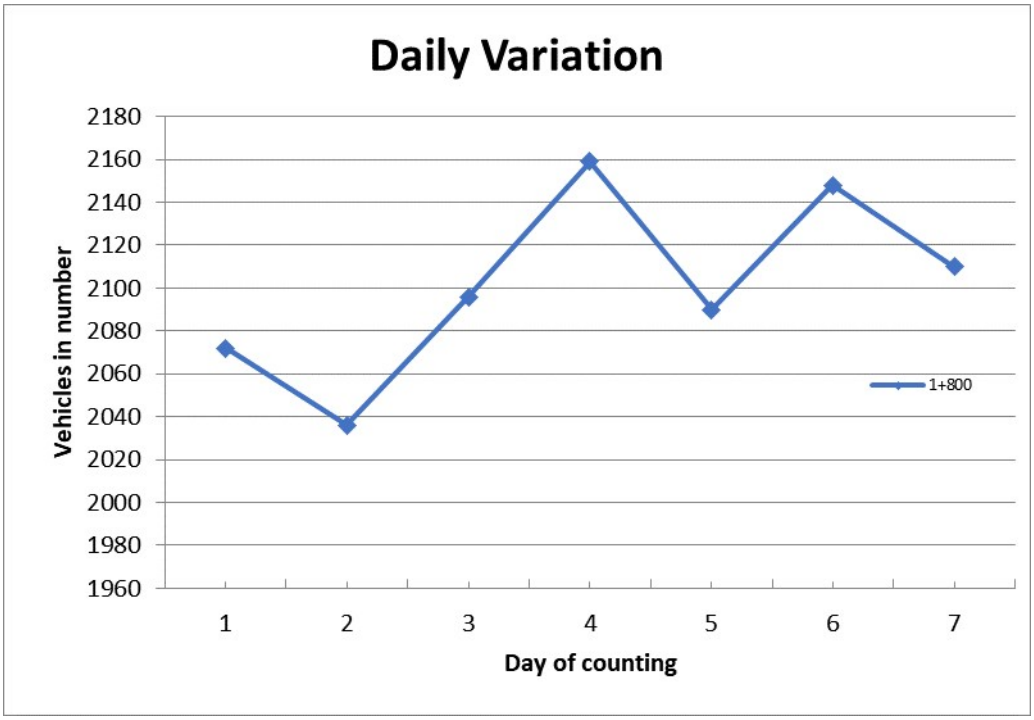
Analysis has been carried out to understand the following parameters on temporal variation of traffic on the Project Road

- Daily variation of traffic,
- Hourly variation of traffic, and
- Peak Hour Factor (PHF)

The results and findings from the above analysis are given below.

7.4.2 Daily Variation

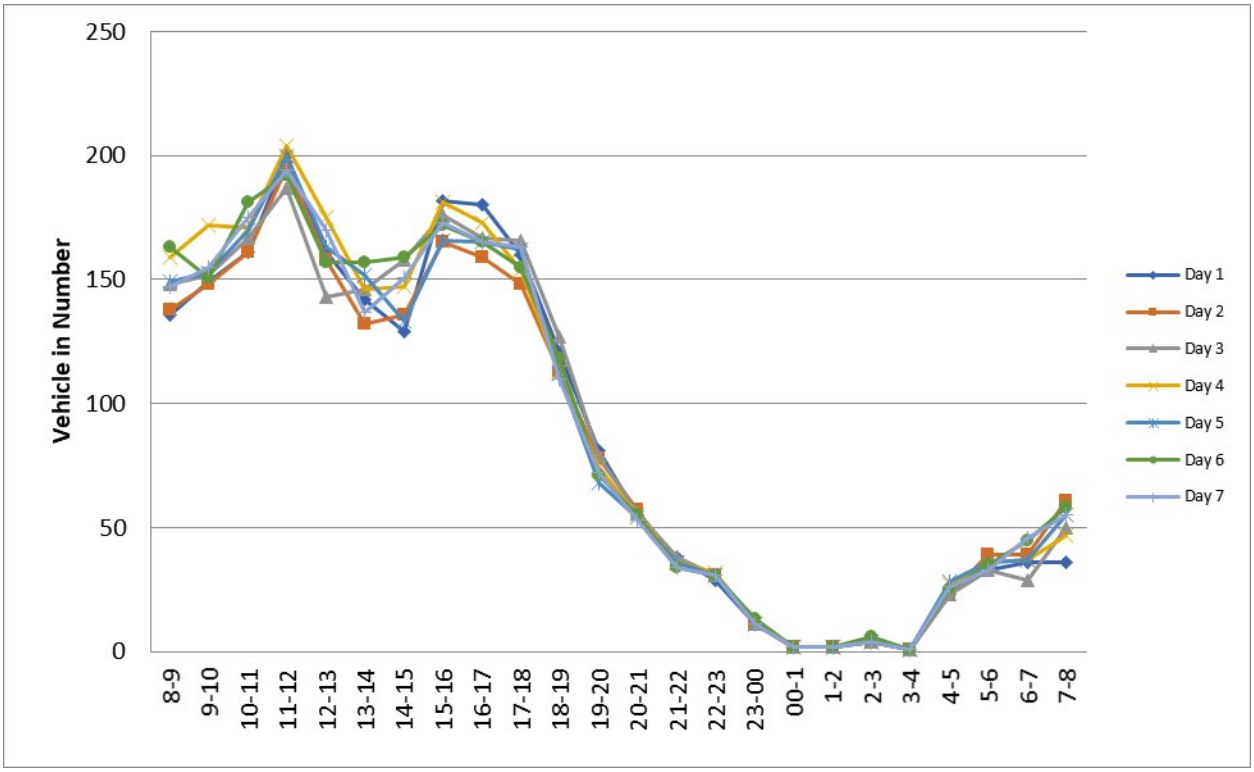
Figure below presents daily variations in traffic in terms of no. of vehicles per day at count location.



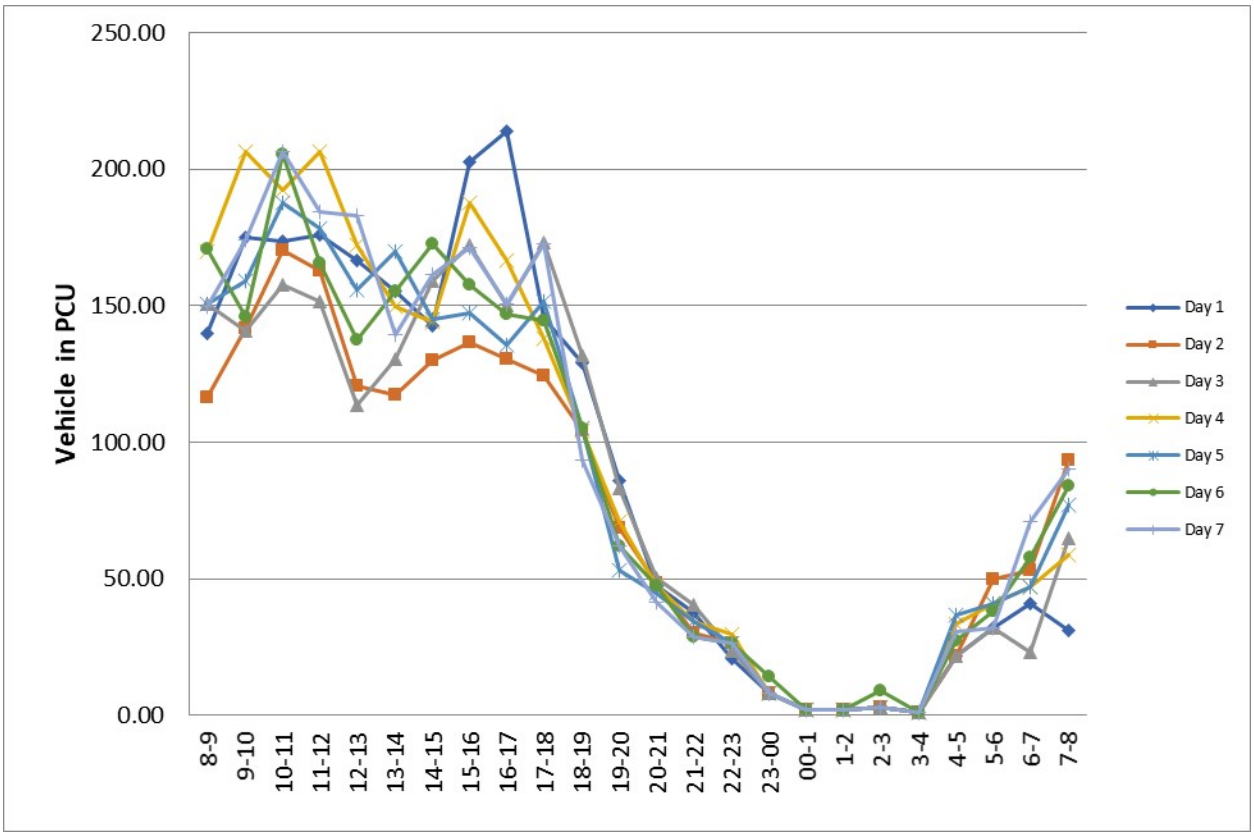
Daily Variation of Traffic

7.4.3 Hourly Variation

Similar to daily variation, analysis has also been carried out for hourly variation. The hourly variations will be useful in the Capacity and LOS analysis, in planning of various road side infrastructure facilities, etc. The hourly variations in traffic (in Vehicles and PCUs per Day) observed at both the count stations on the Project Road have been presented in the following figures.



Hourly Variation of Traffic (Number)



Hourly Variation of Traffic (PCU)

From these above figures on hourly variation the following can be derived:

- The passenger traffic found at all the locations and therefore on the Project Road, moves mostly during the day time, and it is very low particularly in the night.

7.4.4 Peak Hour Factors

Hourly variations observed in traffic at all the count locations have been analyzed for PHFs (Peak Hour Flow as a percentage of the total day flow), and are summarized in Table 3.

Table 7.3: Peak Hour Factors as Observed on the Project Road

Sr. No.	Peak Hour	PHF (%)
1	10.00 a.m. - 11.00 a.m.	9.33

The above PHFs represent a nearly uniform traffic distribution. As described earlier, this smaller PHF implies that the traffic on the project road is spread over a larger duration of time in a day.

7.4.5 Directional Distribution

Like hourly variations, directional distribution of traffic will be useful in the Capacity and LOS analysis and in planning of various road side infrastructure facilities, etc.

The directional distribution observed at the count stations on the Project Road have been presented below.

Directional Distribution

		Package-I			
Time Interval (Hour)		Traffic (PCU)		Directional Distribution (%)	
From	To	Up	Down	Up	Down
8	9	75	75	50	50
9	10	79	84	49	51
10	11	92	93	50	50
11	12	88	87	50	50
12	13	82	68	55	45
13	14	72	74	49	51
14	15	72	79	48	52
15	16	77	91	46	54
16	17	69	88	44	56
17	18	77	73	51	49
18	19	57	53	52	48
19	20	31	38	45	55
20	21	21	26	45	55
21	22	19	15	55	45
22	23	15	10	60	40
23	0	4	5	45	55
0	1	1	1	50	50
1	2	1	1	50	50

Time Interval (Hour)		Package-I			
		Traffic (PCU)		Directional Distribution (%)	
From	To	Up	Down	Up	Down
2	3	2	2	41	59
3	4	1	0	57	43
4	5	13	15	45	55
5	6	20	18	52	48
6	7	23	26	46	54
7	8	30	42	42	58
		1017	**1064**	**49**	**51**

The overall directional distribution is 49:51

7.4.6 Traffic Composition

While detailed traffic counts are presented in Appendix to Main Report, for ready reference and easier appreciation, the composition of traffic at various count locations has been shown in Figure 4

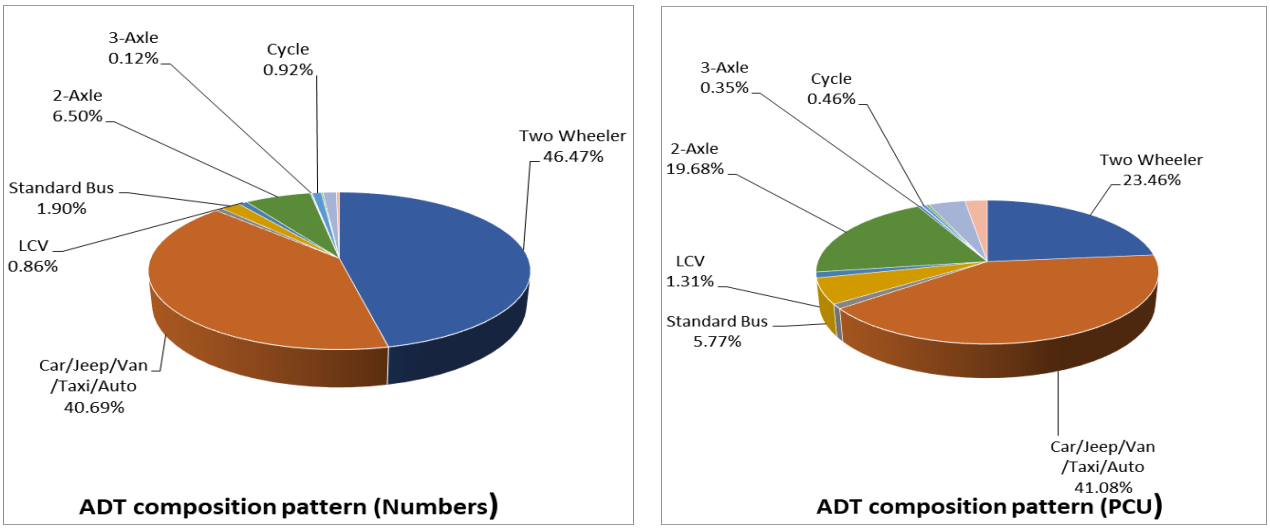


Figure 7.4: Traffic Composition

The traffic composition shown in the above figures has been summarized in table below

Traffic Composition

Type of Vehicle	ADT (NUMBER)	% of Total
Two-Wheeler	977	46.47
Car/Jeep/Van/Taxi/Auto	855	40.69
Mini Bus	15	0.71
Standard Bus	40	1.90
LCV	18	0.86
2-Axle	137	6.50
3-Axle	2	0.12
Multi-Axle	0	0.00
Tractor with Trailer	0	0.00
Tractor without Trailer	1	0.05
Cycle	19	0.92
Cycle Rickshaw	3	0.16
Hand Cart	28	1.32
Bullock Cart	6	0.30
Hand Cart	0	0.00

Type of Vehicle	ADT (PCU)	% of Total
Two-Wheeler	488	23.46
Car/Jeep/Van/Taxi/Auto	855	41.08
Mini Bus	23	1.08
Standard Bus	120	5.77
LCV	27	1.31
2-Axle	410	19.68
3-Axle	7	0.35
Multi-Axle	0	0.00
Tractor with Trailer	0	0.00
Tractor without Trailer	2	0.08
Cycle	10	0.46
Cycle Rickshaw	7	0.32
Hand Cart	83	3.99
Bullock Cart	50	2.42
Hand Cart	0	0.00

7.5 Seasonal Correction

The traffic plying on any road generally varies over different periods of year depending on the cycle of different socio-economic activities in the regions through which it passes. Therefore, in order to have more realistic picture of the traffic on the project road, it is required to assess seasonal variation in traffic to estimate Annual Average Daily Traffic (AADT) and Peak Season ADT. Therefore, the ADT observed during the survey duration is multiplied by a Seasonal Correction Factor (SCF) to derive AADT and Peak season ADT. The seasonal correction factor is generally

derived from secondary data sources such as past month-wise traffic data on the project road, sales of fuel at different filling stations along the project highway etc. In the absence of any other data, either of the project road or in the vicinity, only the monthly figures of fuel sales collected from one petrol bunk on the project road is considered in the estimation of seasonal variation and seasonal correction factors.

7.5.1 Seasonal Correction Factor

For the present study, firstly the petrol and diesel sale figures have been used from four different petrol pumps on the project road. The petrol and diesel fuel sale data have been collected and analyzed for estimation of Average Seasonal Correction Factor (ASCF) and Peak Seasonal Correction Factor (PSCF). As the traffic surveys were conducted in the month of February, the above factors for the month of February is considered.

Average Seasonal Correction Factor for Petrol operated vehicles =	1.00
Average Seasonal Correction Factor for Diesel operated vehicles =	0.96
Average Seasonal Correction Factor for Petrol and Diesel operated vehicles =	**0.98**
Peak Seasonal Correction Factor for Petrol operated vehicles =	1.40
Peak Seasonal Correction Factor for Diesel operated vehicle =	1.29
Average Peak Seasonal Correction Factor for Petrol and Diesel operated vehicles =	**1.35**

The Average Seasonal Correction Factor (ASCF) has been applied on the ADT observed at the count location to derive AADT which will be used for pavement design and Economic Analysis. On the other Peak Seasonal Correction Factor (PSCF) has been applied on the ADT to derive Peak Season ADT which will be used for the Capacity Assessment.

The following observation can be made from the above tables

- An Average Seasonal Correction Factor of 1.00 and Peak Seasonal Correction Factor of 1.40 are applied on ADT for all Petrol based motorized modes to derive AADT and Peak Season AADT respectively
- An Average seasonal correction factor of 0.96 and Peak Seasonal Correction Factor of 1.29 are applied on ADT for all Diesel based traffic like buses, trucks, tractors, etc. to derive AADT and Peak Season AADT respectively.
- An average of ASCF 0.98 and average of PSCF 1.35 has been calculated based on petrol and diesel sales percentage of total fuel consumption on the project road are applied on ADT.

7.6 Annual Average Daily Traffic (AADT)

The Average seasonal correction factors for petrol and diesel driven vehicles, described in the previous sections have been applied to ADT to derive AADT. The ADDT is used for pavement design and economic analysis. AADT of project road is used for capacity assessment are given in the following table 5.

Table 7.5: Estimates of AADT as observed on the project road

Vehicle Type	Traffic Number
Two-Wheeler	977
Car/Jeep/Van/Taxi/Auto	838
Mini Bus	14
Standard Bus	38
LCV	17
2-Axle Truck	131
3-Axle Truck	2
Multi-Axle	0
Tractor with Trailer	0
Tractor Without Trailer	1
Cycle	19
Cycle Rickshaw	3
Hand Cart	28
Bullock Cart	6
Horse Cart	0
Total Motorized Vehicles (Number)	2019
Total Non-Motorized Vehicles (Number)	57
Total Motorized Vehicles (PCU)	1891
Total Non-Motorized Vehicles (PCU)	150
Total Commercial Vehicle per day	205
Total PCU per day	2041

7.7 Traffic Growth Rates

As per IRC: SP 48-1998, Hill Road manual, 7.5% growth of traffic is considered for hill road when past data is not available. The growth rates of different category of vehicles are presented below in table 6.

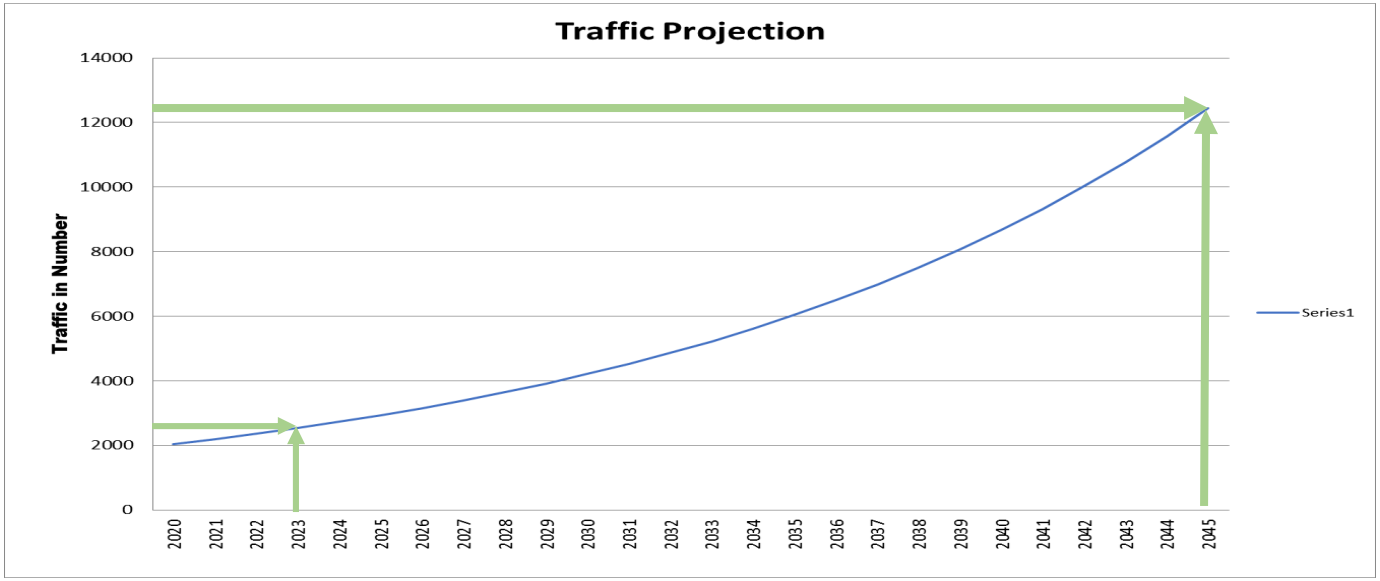
Table 7.6: Projected Growth Rate of Traffic, (%)

Vehicle Category	2020 – 2023	2023-2028	Beyond 2028
Car	7.5%	7.5%	7.5%
Two-Wheeler	7.5%	7.5%	7.5%
Bus	7.5%	7.5%	7.5%
LCV	7.5%	7.5%	7.5%
Truck	7.5%	7.5%	7.5%
Tractor	7.5%	7.5%	7.5%

Table 7.7: Traffic Projection

Year	AADT																Total in Numbers	Total in PCU	Remarks
	Growth Factors	Two-Wheeler	Car/Jeep/ Van/Taxi/ Auto	Mini / RTVs Bus	Stand. Bus	LCV	2-Axle	3 - Axle	Multi-Axle	Agri. Tract. With Trailor	Agri. Tract. Without Trailor	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Horse Cart			
2020	7.5%	977	838	14	38	17	131	2	0	0	1	19	3	28	6	0	2076	2041	
2021	7.5%	1050	901	15	41	19	141	3	0	0	1	21	4	30	7	0	2232	2194	
2022	7.5%	1129	968	17	44	20	152	3	0	0	1	22	4	32	7	0	2399	2358	
2023	7.5%	1213	1041	18	48	22	163	3	0	0	1	24	4	34	8	0	2579	2535	Base Year
2024	7.5%	1304	1119	19	51	23	175	3	0	0	1	26	4	37	8	0	2772	2726	
2025	7.5%	1402	1203	21	55	25	188	3	0	0	2	28	5	40	9	0	2980	2930	Opening Year
2026	7.5%	1507	1293	22	59	27	202	4	0	0	2	30	5	43	10	0	3204	3150	Two lane with Hard shoulder
2027	7.5%	1620	1390	24	64	29	218	4	0	0	2	32	5	46	10	0	3444	3386	
2028	7.5%	1742	1495	26	68	31	234	4	0	0	2	34	6	49	11	0	3702	3640	
2029	7.5%	1872	1607	28	74	33	251	4	0	0	2	37	6	53	12	0	3980	3913	
2030	7.5%	2013	1727	30	79	36	270	5	0	0	2	40	7	57	13	0	4279	4206	
2031	7.5%	2164	1857	32	85	39	290	5	0	0	2	43	7	61	14	0	4599	4522	
2032	7.5%	2326	1996	34	91	41	312	6	0	0	3	46	8	66	15	0	4944	4861	
2033	7.5%	2500	2146	37	98	45	336	6	0	0	3	49	8	71	16	0	5315	5225	
2034	7.5%	2688	2307	40	106	48	361	6	0	0	3	53	9	76	17	0	5714	5617	
2035	7.5%	2890	2480	43	114	52	388	7	0	0	3	57	10	82	19	0	6142	6039	
2036	7.5%	3106	2666	46	122	55	417	7	0	0	3	61	10	88	20	0	6603	6492	
2037	7.5%	3339	2866	49	131	60	448	8	0	0	4	66	11	95	21	0	7098	6978	
2038	7.5%	3590	3080	53	141	64	482	9	0	0	4	71	12	102	23	0	7631	7502	
2039	7.5%	3859	3312	57	152	69	518	9	0	0	4	76	13	110	25	0	8203	8064	
2040	7.5%	4148	3560	61	163	74	557	10	0	0	5	82	14	118	27	0	8818	8669	
2041	7.5%	4459	3827	66	175	80	599	11	0	0	5	88	15	127	29	0	9480	9319	

Year	AADT																Total in Numbers	Total in PCU	Remarks
	Growth Factors	Two-Wheeler	Car/Jeep/ Van/Taxi/ Auto	Mini / RTVs Bus	Stand. Bus	LCV	2-Axle	3 - Axle	Multi-Axle	Agri. Tract. With Trailor	Agri. Tract. Without Trailor	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Horse Cart			
2042	7.5%	4794	4114	71	189	85	644	11	0	0	5	95	16	136	31	0	10191	10018	
2043	7.5%	5153	4422	76	203	92	692	12	0	0	6	102	17	146	33	0	10955	10770	
2044	7.5%	5540	4754	82	218	99	744	13	0	0	6	109	19	157	36	0	11777	11578	
2045	7.5%	5955	5111	88	234	106	800	14	0	0	7	118	20	169	38	0	12660	12446	



Traffic Projection

7.8 Axle Load Surveys and Vehicle Damage Factors

For the purpose of preliminary pavement design required for the project, axle load surveys have been carried out on the project road:

- ✓ These surveys were carried for 1-day x24 hrs on **NH 202 (within 1Km from 0.000 Km of NH 102A) and Near Vanee on NH 02 (2Km from 115.00Kmof NH 102A).**
- ✓ The axle load spectrum observed on the project road, along with the derivation of vehicle damage factors (VDFs) as per the relevant IRC Codes are given in Table 8(a) & 8(b) which summarizes the VDF observed on the Project Road. Details of VDF Calculation are produced in Appendix to Main Report.

Table 7.8(a): On NH 202 (VDF Calculation)

Type of Vehicles	VDF Calculation			
	UP Direction		Down Direction	
	VDF	Frequency	VDF	Frequency
3 Axle truck	5.57	1	0.00	0
2 Axle truck	4.91	26	1.25	6
Bus	1.02	4	1.18	7
TOTAL		31		13
WEIGHTED VDF IN EACH DIRECTION	4.43		1.21	
Max. WEIGHTED VDF	4.43			
WEIGHTED VDF OF COMMERCIAL VEHICLE ON NH-102A				4.43

Table 7.8(b): On NH 02 (VDF Calculation)

Type of Vehicles	VDF Calculation			
	UP Direction		Down Direction	
	VDF	Frequency	VDF	Frequency
4 Axle truck	0.10	2	11.84	1
3 Axle truck	2.28	12	9.99	2
2 Axle truck	5.83	30	9.75	7
Bus	1.17	2	1.79	7
TOTAL		44		16
WEIGHTED VDF IN EACH DIRECTION	4.66		7.04	
Max. WEIGHTED VDF	7.04			
WEIGHTED VDF OF COMMERCIAL VEHICLE ON NH-102A				7.04

Hence, maximum VDF value 7.04 has been adopted for calculation of design msa of the project road.

7.9 Estimation of design ESA

(a) Traffic growth rate (Both direction): 7.5%

(b) Vehicle Damage Factors (F): 7.04

(c) Lane Distribution Factor (D): 0.50

7.9.1 ESA Computation

N: Cumulative number of standard axle to be created for in the design in terms of msa

A: Initial traffic in the year of completion of construction in terms of the number of commercial vehicles per day=193

D: Lane distribution factor (Refers IRC: 37-2018, Clause 4.5.1.3, page-16) = 0.5

F: Vehicle Damage Factor (Refers IRC: 37-2018, Clause 4.4.6), page-16) =7.04

n: Design life in years =20

r: Annual growth rate of commercial vehicles in decimal =0.075

N = (365*[(1+r)^n-1]*A*D*F)/r= 10.74 msa

As per IRC: SP 73-2018 (Para-5.4.1, Page No-47), design traffic shall not be less than 20 msa for flexible pavement, So, Pavement design has been done considering design traffic 20 msa.

CHAPTER – 8
ENVIRONMENTAL SCREENING & PRELIMINARY ENVIRONMENTAL ASSESSMENT

8.1 Environmental Screening

Environmental screening of the project is aimed to (i) recognize the applicability of relevant environmental legislations for the project (ii) identify the environmental issues that should be taken into account due to project interventions (ii) provide input to the engineering design team to consider various alternatives in the critical areas to (iv) determine the magnitude of potential environmental at planning/design stage (iii) identify need for further environmental studies like Initial Environmental Examination and Environmental Impact Assessment (EIA) and iv) suggest enhancement measures, if any.

8.2 Reconnaissance Survey

Reconnaissance survey was done to determine the extent of environmental study, design the nature of the environmental survey to be carried out along the road alignment. This will facilitate to identify valued environment components, key stakeholders and key informants. Reconnaissance survey and initial consultations also recognized the need to conduct any additional study like bio-diversity assessment and wild-life movement etc.

8.3 Approach and Methodology for IEE/EIA

- **Review of Country's Legal Framework:** India has a well-defined policy/legal framework for safeguard of environment. Prior to initiation of any civil work, it is essential to analyze the various permissions/clearances required for any developmental project. Same has been presented in later section of this chapter.
- **Primary Data Collection:** Environmental resource inventory will be prepared for all environmental features viz. terrain, land-use, landslide and erosion prone stretches, waterways/water bodies, road side vegetation, sensitive receptors, common property resources, utilities, drainage, flooding/water logging, industries, accident prone areas etc. within the area of interest/core zone. Information about this will be done by trained persons under the supervision of an expert team comprised of university researchers. Similarly, floral survey was also carried out. Baseline monitoring was conducted at the locations for which data was not available in environmental assessment report conducted by detailed design team.
- **Secondary Data Collection:** Secondary sources include published government reports, environmental impact assessments conducted in the similar region, government websites, recognized institutions and relevant government departments (forest, irrigation, pollution control board, fisheries, statistics, Indian Meteorological Department (IMD) and Manipur Space Application Centre (NSAC) etc. Recent Google images has been captured to view environmental features at regional scale.
- **Public Consultation:** Meaningful consultations were organized with the PWD, local people/beneficiary population to know the level of project acceptability, understand their concerns, apprehensions, and overall opinion. Information were gathered about existing baseline environmental condition viz. ambient levels and its effects on health, water resources, water logging/flooding, flora and fauna, socio-economic standing of local people, impact due to loss of land other assets and common property resources,

accident risk during construction and operation stage, perceived benefits and losses, etc. Information thus gathered was used to integrate it in project design and formulate mitigation measures and environmental management plan.

- **Other Tools, Surveys and Studies:** Assessment of land use/land cover map of larger area beyond the project site will be prepared for better planning and decision-making before creating any physical infrastructure in the region. Remote sensing and Geographic Information System (GIS) based land use map of the study area (10 km buffer) will be prepared through recent satellite imagery. A rapid bio-diversity assessment will be carried out to generate baseline on floral and faunal elements in the project area. The survey will also help in assessing impact on any rare threatened or endangered species of floral species in the project area. Rapid bio-diversity assessment will also recognize wild life movement along across and impact due to improvement work.
- **Assessment of Potential Impacts:** The assessment of the type, nature, direct, indirect, cumulative or induced impacts and their significance to the physical, biological, and socio-economic components of the environment will be done to ascertain whether the project is environmentally sustainable or not. Nature of impacts will be classified as significant, insignificant, short-term, long-term, reversible, irreversible etc. After identification of nature and extent of impacts, mitigation measures will be suggested.
- **Preparation of the Environment Management Plan:** The project specific Environment Management plan will be formulated with an aim to avoid, reduce, mitigate, or compensate for adverse environmental impacts/risks and propose enhancement measures. This includes
  a. Mitigation of potentially adverse impacts
  b. Monitoring of impacts and mitigation measures during project implementation and operation
  c. Institutional capacity building and training
  d. Compliance to statutory requirements
  e. Integration of EMP with Project planning, design, construction and operation.
- **Environment Monitoring Plan:** The monitoring and evaluation are critical activities in implementation of the project. Monitoring involves periodic checking to ascertain whether activities are going according to plan or not. It provides the necessary feedback for project management to ensure project objectives are met and on schedule. The reporting system is based on accountability to ensure that the environmental mitigation measures are implemented. Environmental monitoring program has the underlying objective to ensure that the intended environmental mitigations are realized and these results in desired benefits to the target population causing minimal deterioration to the environmental parameters. Such program targets proper implementation of the EMOP. The broad objectives are:

  - To evaluate the performance of mitigation measures proposed in the EMP.
  - To evaluate the adequacy of environmental assessment.
  - To suggest ongoing improvements in management plan based on the monitoring

- To enhance environmental quality through proper implementation of mitigation measures.
- To meet existing environmental regulatory framework and community obligations.

- **Performance Indicators:** The significant physical, biological and social components affecting the environment at critical locations serve as wider/overall performance Indicators. However, the following specific environmental parameters can be quantitatively measured and compared over a period of time and are, therefore, selected as specific Performance Indicators (PIs) for monitoring because of their regulatory importance and the availability of standardized procedures and relevant expertise. Performance indicators requiring quantitative measurements are:
  - Air quality with respect to PM2.5, PM10, CO, NOx and SO2 at selected location.
  - Water quality as per CPCB prescribed Standards
  - Noise levels at sensitive receptors (schools, hospitals, community/religious places).
  - Survival rates of trees planted as compensatory plantation.
- **Assessment of EA Capacity to address the environmental concern of the project:** EIA will assess the capacity of the executing agency for effective implementation of EMP. Accordingly, if needed, a training and awareness program will be formulated to enhance the capacity of officials for implementing proposed mitigation measures and monitoring the resultant effects, as well as create awareness amongst workers and public. The institutions/agencies like regional office of MoEF, SPCB/CPCB, and Indian Institute of Technologies can be consulted for such trainings. Independent subject's experts/consultants (e.g., for the environmental awareness program, impact assessment specialist will be the resource person) can also be the resource persons to impart trainings. These experts /agencies shall be appointed based on specific need for the training. A separate budget for training will be allocated under the Construction Supervision Consultant budget.

8.4 Country's Legal Framework and Regulatory Requirements

The Government of India has laid out various policy guidelines, acts and regulations for the safeguard and conservation environment. The Environment (Protection) Act, 1986 provides umbrella legislation for the protection of environment. As per this Act, the responsibility to administer the legislation has been jointly entrusted to the Ministry of Environment and Forests (MoEF) and the Central Pollution Control Board (CPCB)/Manipur State Pollution Control Board in the present context. Table below presents all relevant policies/acts/rules and regulations and its applicability to the project.

Applicable National Laws and Regulations for the Project

Sl.	Act / Rules	Purpose	Applicable	Reason for Applicability	Authority
1	Environment Protection Act-1986	To protect and improve overall environment	Yes	It is umbrella legislation and notifications, rules and schedules are promulgated under this act.	MoEF. (Govt. of Manipur) State Gov. SPCB
2	Environmental Impact Assessment Notification,14th Sep-2006[1] and its amendments	To accord environmental clearance to new development activities listed in schedule of EIA notification.	No	Project road is >100km but does not involve additional right of way greater than 40m in existing alignment and 60 m in bypass and realignment section.	MoEF. SEIAA
3	Fly Ash Notification, 1999 as amended upto 17th August 2003:	Reuse large quantity of fly ash discharged from thermal power plant to minimize land use for disposal	No	No thermal power plants within 100 km	MoEF
4	Office memorandum dated 18.05.12,by MoEF in view of Apex Court order dated 27.2.2012	Conserve top soil, aquatic biodiversity, hydrological regime etc. by haphazard and unscientific mining of minor minerals	Yes	In case of renewal of quarries and opening of new borrow areas	SEIAA
5	National Environment Appellate	Address Grievances regarding the process of environmental	Yes	Grievances if any will be dealt with, within this act.	NEAA

[1]**Category A- i)** New National High ways; and ii) Expansion of National High ways greater than 100 KM, involving additional right of way greater than 40m in existing alignment and 60 m in bypass and realignment section.

Category B- i) All new state High ways; and ii) Expansion projects in hilly terrain (above 1000 m above mean sea level and/or ecologically sensitive areas.

Note: A general condition applies to both of the above category: "Any project or activity specified in Category 'B' will be treated as Category A, if located in whole or in part within 5 km from the boundary of: (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified Eco-sensitive areas, (iv) inter-State boundaries and international boundaries".

Sl.	Act / Rules	Purpose	Applicable	Reason for Applicability	Authority
	Authority Act (NEAA) 1997	clearance.			
6	Forest Conservation Act (1980)	To check deforestation by restricting conversion of forested areas into non- forested areas	Yes	Road widening and improvement work requires diversion of significant forest land	Tree removal will be guided as per state government rules.
7	Air (Prevention and Control of Pollution) Act, 1981	To control air pollution by & Transport controlling emission of air Department. Pollutants as per the prescribed standards.	Yes	For construction; for obtaining NOC for establishment of hot mix plant, workers' camp, construction camp, etc.	SPCB
8	Water Prevention and Control of Pollution) Act1974	To control water pollution by controlling discharge of pollutants as per the prescribed standards	Yes	This act will be applicable during construction for (establishments of hot mix plant, construction camp, workers' camp, etc.	SPCB
9	Noise Pollution (Regulation and Control Act) 1990	The standards for noise for day and night have been promulgated by the MoEF for various land uses.	Yes	This act will be applicable as vehicular noise on project routes required to assess for future years and necessary protection measure need to be considered in design.	SPCB
10	Public Liability and Insurance Act 1991	Protection form hazardous materials and accidents.	Yes	Contractor need to stock hazardous material like diesel, Bitumen, Emulsions etc.	----
11	Explosive Act 1984	Safe transportation, storage and use of explosive material	Yes	Blasting may be involved in some locations	Chief Controller of Explosives

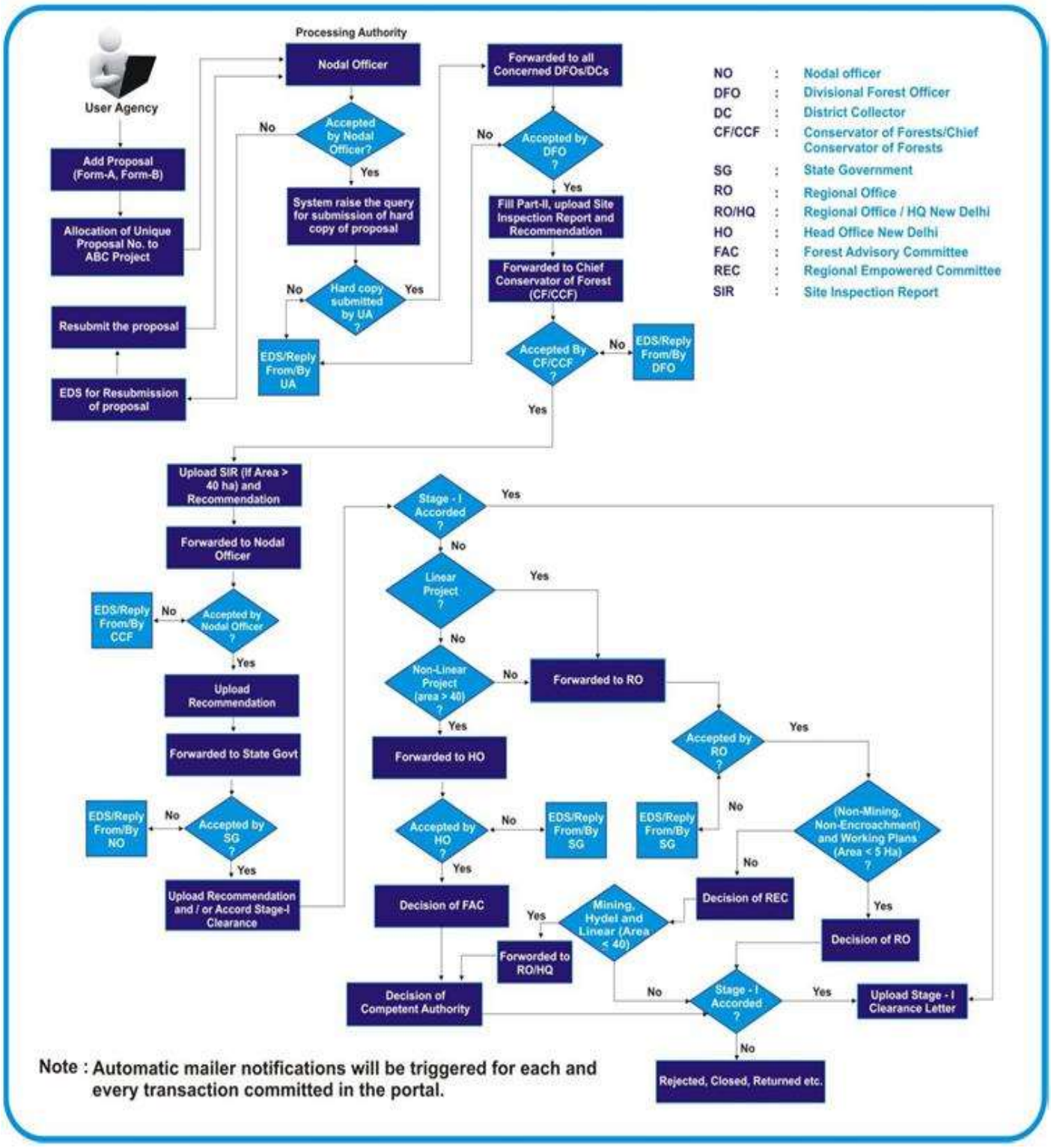
Sl.	Act / Rules	Purpose	Applicable	Reason for Applicability	Authority
12	Minor Mineral and concession Rules	For opening new quarry.	Yes	Regulate use of minor minerals like stone, soil, river sand etc.	District Collector
13	Central Motor Vehicle Act 1988 and Central Motor Vehicle Rules1989	To check vehicular air and noise pollution.	Yes	These rules will be applicable to road users and construction Machinery.	Motor Vehicle Department
14	National Forest Policy1952 National Forest Policy(Revised) 1988	To maintain ecological stability through conservation and restoration of biological diversity.	Yes	This policy will be applicable as project intervention requires forest land to be acquired.	Forest Department, Gol and Govt. of Manipur
15	The Mining Act	The mining act has been notified for safe and sound mining activity.	Yes	The construction of project road will require aggregate through mining from riverbeds and quarries	Department of mining. State Govt. of Manipur
16	The Building and Other Construction Workers (regulation of employment and conditions of service) Act, 1996	To regulate the employment and conditions of construction workers and to provide for their safety, health and welfare measure and for other matter incidental thereto	Yes	A large number of construction workers skilled, semiskilled or unskilled will be employed temporarily during Construction Phase of the project	Ministry of Labor and Employment

Recent Policy Initiatives: Ministry of Environment & Forest (MoEF) vide O.M. No. L-11011/47/2011-IA.II(M) dated 18th May, 2012 in view of the Order of Hon'ble Supreme Court dated 27.2.2012 in I.A. no. 12-13 of 2011 in SLP (C) no. 19628-19629 of 2009 in the matter of : Deepak Kumar etc. Vs State of Haryana and others has informed that it has been decided in the MoEF that: (i) All mining projects of minor minerals including their renewal, irrespective of the size of the lease would henceforth require prior environment clearance. (ii) Mining projects with lease area up to less than 50 ha including projects of minor mineral with lease area less than 5 ha would be treated as category "B" as defined in the EIA Notification, 2006 and will be

considered by the respective State/ UT Level Environment Impact Assessment Authority (SEIAAs). (iii) All the respective SEIAAs in dealing with the applications regarding environment clearance should be disposed within ten days from the date of receipt of the applications in accordance with law. All State Governments should take action as per the decision of the MoEF.

Procedure for Forest Clearance: MOEFCC has initiated online submission and disposal of forest clearance cases. The detail procedure is available on ministry website http://forestsclearance.nic.in/ However, the work-flow is unchanged which has been illustrated in Figure 8.1.

Figure 8.1: Procedure and Work Flow for Forest Clearance



Steps and Procedure for Obtaining Borrow Area Permit

Steps	Activities
1	Contractor identifies the Borrow Area (BA) quantity based on prospective BA identified in F/S/DPR
2	Contractor identifies the Borrow pits with quantity and raise Request for Inspection (RFI) to IE/CSC.
3	IE/CSC inspects borrow pit in the presence of Environmental Engineer of contractor and land owner with his lease document.
4	Contractor takes the sampling of soil in identified pit and test in lab. IE/CSC approves the pit based on the test report (Moisture contents, particle size etc.)
5	Contractor makes the agreement with land owner and get NOC from Gram Panchayat if necessary
6	If BA is more than 5Ha (B1 category), contractor submit application for clearance to State Environment Impact Assessment Authority (SEIAA) the project is treated as B1 EIA and Public Hearing needs to be carried out.
7	If BA is < 5Ha (B2 category), contractor submit application in Form 1M, Prefeasibility report and approved mine plan to District Environment Impact Assessment Authority (DEISAA). DEIAA gives clearance base on the recommendation of District Environment Appraisal Committee (DEAC).
8	Contractor pays Royalty amount to state government at the prescribed rate.
9	Contractor submit Borrow Area Redevelopment plan to IE/CSC.
10	Contractor raise RFI to IE/CSC for Borrow pit excavation
11	Contractor fulfils the compliance of EC agency observations if any.
12	Contractor will maintain haul road and ensure for fugitive dust suppression
13	Contractor does sampling of each pit at the time of excavation test and gets approval of IE/CSC.
14	Contractor raises RFI to IE/CSC before closing the pit.
15	Contract reclaims borrow pit as per owner agreement and gets clearance from him.

Key Considerations prior to selection of Borrow Areas

- Cluster shall be formed if the distance between peripheries of one lease to the other and is less than 500m in homogenous mineral area.
- Minimum distance between two clusters is 500 meters.
- Maximum depth of excavation 2000mm from existing ground level.
- In case of fertile land; 15 cm top soil is stock piled. further up to max.30 cm depth.
- Maintain 5m distance from the toe of the final section of the road/Embankment.

- BA should not be dug within 1500 m of village. If unavoidable should not exceed 30 cm in depth.
- Ridges not less than 8m width shall be left an interval of not exceeding 300m.

8.5 Muck Dumping Plan

Selection of Dumping Sites

The muck from hill cutting and construction activities will be safely disposed at suitable locations. Principle adopted for selecting muck dumping areas was to avoid sensitive areas like dense vegetation, natural water courses and areas prone to landslides. During the selection of the dumping sites preference was given on the following aspects.

- The muck does not fall/ flow into stream/river.
- Dumping sites should be at least 30 m (horizontal) away from the High Flood Level of the River/ stream.
- The sites are free from active landslides or creeps.
- The sites should not fall within pristine forest nor are these habitats of threatened species of flora and fauna.
- The sites are located close to its source in order to avoid long distance haulage.

Muck Disposal Plan

The loosely held muck can lead to the rise in SPM levels, sedimentation load in the river body and phyto-retardation of the nearby vegetation. Therefore, it requires stability with appropriate methods to avoid the subsequent ecological problems. The muck disposal plan involves both engineering and biological measures that depend on the eco-climatic conditions. A considerable amount of muck can be used as filling material at various project components, area/ bench development works and also as aggregates/boulders. Rest of the muck to be dumped and rehabilitated at designated dumping sites. For retaining the dumped material along the hill slopes, crated boulder toe walls will be constructed. Excavated muck would be dumped and compacted at these dumping areas with stable slopes. Planting/grass turf should be done for additional safety of slopes. The toe walls shall be kept at least 30 m away from the high flood level.

Muck Rehabilitation Plan

The muck rehabilitation plan involves both engineering and biological measures that depend on the terrain and eco-climatic conditions. Stability of the loosely held muck requires appropriate method of consolidation and biological measures so that the muck is not easily eroded leading to subsequent ecological problems.

Engineering measures

Crated boulder walls should be provided at the toe of each Muck Dumping Area and a minimum distance of 30m (horizontal) will be maintained from the High Flood Level (in case of Muck Dumping Yard near any water body). These toe walls will provide stability to the slope of dumped muck besides arresting spread of muck beyond the designated area.

Biological measure

Vegetation cover controls the hydrological and mechanical effects on soils and slopes. Therefore, biological measures to stabilize the loose slope are essential. However, such measures are dependent on the local environmental conditions. The stages in implementation of such measures are discussed below.

Selection of Plant Species

Different plant species may be utilized for different ecological and engineering functions.

Grasses are more suited for armoring the loose soil surface and shrubs or trees hold the soil up to the deeper level. The selection of plant species used for rehabilitation of soil/muck must take into account the climatic, soil and drainage conditions of the site. The dumping sites of project road are located in the altitudinal range of 1300 to 1600 m. The area has sub-tropical climate and major part of the precipitation is received during April to September. The period from November to February is relatively dry. Considering all these factors as well as the existing natural vegetation in the area, the species recommended for plantation are Chir pine, alder, broom grass, bamboo etc.

Planting of Trees

The selected species will be planted on the slopes of muck dumping areas. The plantation can be carried out in lines across the slope, usually following the contour to prevent the development of rill and trap material moving down the slope. Brush layers, fascines and palisades can be used because of their uses *i.e.* controls erosion, catches debris and provides strong, fibrous root reinforcement. Different plant species when used together will provide increased stability. Grasses planted in a line across a slope will provide a continuous chain of support in retaining debris, reinforcing soil of the area. Plant saplings may be raised on biodegradable pots and transplanted as such. The plantation should be done during monsoon season. The pit size has been recommended as 45 x 45 x 45 cm for trees and 30 x 30 x 30 cm for shrubs with some soil rich in nutrients. Compost from the local organic waste can be used. An integrated biotechnological approach will be very useful for sustenance and growth of plants. This approach involves the following steps:

- Assessment of the nutrient status of the soil and evaluation of the physical and chemical properties of the dumped material.
- Formulation of the appropriate blend of organic waste and soil to enhance the nutrient status of the rhizosphere.
- Isolation and screening of specialized strains of mycorrhizal fungi, rhizobium, azobacter and phosphate solubilizer (bio-fertilizer inoculums) which can be best suited for the dumped material.
- Mass culture of plant specific bio-fertilizer and mycorrhizal fungi.
- Plantation of dumping sites/areas using identified blend and bio-fertilizer inoculums.

The rich soil and farmyard manure requirement for nearly 100 pits will be about 1 cubic meter with approximate weight of 200 kg. The saplings will be planted at 3 m intervals along the contour and 5 m across it. Wherever terracing shall be prescribed, the same will be done on terraces at 3m intervals leaving one-meter space from the edge of the terrace. About 1100 seedlings shall be planted per Ha depending on the space available at the site. Shrubs and herbs will be planted in the interspaces. The required saplings will be locally procured from State Forest Department/ private nurseries on the prevalent rates.

Fencing

After rehabilitation of muck the dumping areas need to be protected for some time, from grazing by domestic animals, livestock, sheep and goats. For this reason, fencing over the muck deposits is required. Barbed wire strands with two diagonal strands, clamped to wooden/concrete posts placed 3 m apart is proposed for this purpose. Both the ends of the wooden fence posts should be coated with coal tar to ensure longevity of the intervention.

8.6 Applicable Indian Road Congress (IRC) Codes to the Project Road

Key IRC guidelines have been summarized below that have a direct/indirect bearing on the environmental management plan during design and construction phases of the project.

Applicable Indian Road Congress (IRC) Codes

S. No	Code Title/Theme	Code
1	Guidelines on requirement of environmental clearance for road projects	IRC:SP:93-2017
2	Guidelines on Landscaping and tree plantation	IRC:SP: 21-2009
3.	Guidelines for EIA of Highway projects	IRC:104-1988
4.	Guidelines for Borrow area identification, use and its rehabilitation	IRC:10-1961
5	Guidelines for Pedestrian Facilities	IRC: 103 -2012
6.	Ribbon developments on highways and its prevention	IRC: SP :15: 1996
7.	Manual on Landscaping of road	IRC: SP:21-2009
8.	Report on recommendations of IRC Regional workshops on highway safety	IRC: SP:27-1984
9.	Road safety for Children (5-12 years old)	IRC: SP: 32-1988
10.	Guidelines on road drainages (First Revision)	IRC: SP:42-2014
11	Highway safety code	IRC: SP:44-1994
12	Guidelines for safety in work zone	IRC: SP:55-2014
13	Hill road manual	IRC: SP:48-1998
14	Recommended Practice for Treatment of Embankment and Roadside Slopes for Erosion Control (First Revision)	IRC: 56–2011

8.7 Existing Baseline Environmental Conditions

Manipur is one of the northeastern states in India. It is bordered on its west and north by Assam, on its east by Myanmar (formerly known as Burma), on its north by Arunachal Pradesh, and on its south by Manipur. Manipur is one of India's smallest states, with a total area of 16,579 sq km (6400 sq mi). The Naga Hills run through this small state, which has Saramati as its highest peak at a height of about 12,600 ft. Dhansiri, Doyang, Dikhu and Jhanji are the rivers that flow through this state. The terrain is mountainous, thickly wooded, and cut by deep river valleys. There is a wide variety of plant and animal life. Manipur has a monsoon climate with generally high humidity; rainfall averages between 1800 to 2500 mm (70 to 100 inches) a year.

Climate: Manipur has a largely monsoon climate with high humidity levels. Annual rainfall averages around 70–100 inches (1,800–2,500 mm), concentrated in the months of May to September. Temperatures range from 70 °F (21 °C) to 104 °F (40 °C). In winter, temperatures do not generally drop below 39 °F (4 °C), but frost is common at high elevations. The state

enjoys a salubrious climate. Summer is the shortest season in the state that lasts for only a few months. The temperature during the summer season remains between 16 °C (61 °F) to 31 °C (88 °F). Winter makes an early arrival and bitter cold and dry weather strikes certain regions of the state. The maximum average temperature recorded in the winter season is 24 °C (75 °F). Strong northwest winds blow across the state during the months of February and March.

Geology: Several preliminary studies indicate significant recoverable reserves of petroleum and natural gas. Limestone, marble and other decorative stone reserves are plentiful, and other as yet unexploited minerals include iron, nickel, cobalt and chromium.

Soil: The soil of Manipur belongs to 4 orders, 7 sub-orders, 10 great groups, 14 sub-groups and 72 soil families. The 4 orders of soil found in Manipur are (i) Alfisols (ii) Entisols (iii) Inceptisols and (iv) Ultisols. Inceptisols dominate the soils of the State with 66% followed by Ultisols 23.8%, Entisols 7.3% and Alfisols 2.9% of the total 16.6 million Ha of the State geographical area.

Alfisols: Alfisols form in semiarid to humid areas, typically under a hardwood forest cover. They have a clay-enriched subsoil and relatively high native fertility. "Alf" refers to aluminium (Al) and iron (Fe). Because of their productivity and abundance, the Alfisols represent one of the more important soil orders for food and fiber production. They are widely used both in agriculture and forestry, and are generally easier to keep fertile than other humid-climate soils. Those in monsoonal tropical regions, have a tendency to acidify when heavily cultivated, especially when nitrogenous fertilizers are used.

Alfisols are moderately leached soils that have relatively high native fertility. These soils have mainly formed under forest and have a subsurface horizon in which clays have accumulated. Alfisols are primarily found in temperate humid and subhumid regions of the world.

Alfisols occupy 10.1% of the global ice-free land area and supports about 17% of the world's population. The combination of generally favorable climate and high native fertility allows Alfisols to be very productive soils for both agricultural and silvicultural use.

This type of soil order is found on the western flank of the State bordering Assam. They are deep and well drained of fine to fine loamy texture. Common families of Alfisols which have been identified in Naga land are:

(1)Fine typic Kanhapludalfs
(2) Fine loamy typic Paleudalfs

Entisols: An entisol has no diagnostic horizons, and most are basically unaltered from their parent material, which can be unconsolidated sediment or rock. Entisols are the second most abundant soil order (after inceptisols), occupying about 16% of the global ice-free land area.

Many Entisols are found in steep, rocky settings. However, Entisols of large river valleys and associated shore deposits provide cropland and habitat for millions of people worldwide.

This soil order is found on the Western and North Western part of the State on the low hill slope and narrow river valleys. Families which have been identified under this orders are :-

(1) Fine-loamy typic Udifluvents
(2) Fine-loamy typic Udorthents
(3) Coarse-loamy typic Udorthents
(4) Fine-loamy Lithic Udorthents
(5) Coarse loamy Lithic Udorthents

Inceptisols: Inceptisols (from Latin inceptum, "beginning") are soils that exhibit minimal horizon development. They are more developed than Entisols, but still lack the features that are characteristic of other soil orders.

Although not found under aridic climate regimes, Inceptisols nevertheless are widely distributed and occur across a wide range of ecological settings. They are often found on fairly steep slopes, young geomorphic surfaces, and on resistant parent materials. Land use varies considerably with Inceptisols. A sizable percentage of Inceptisols are found in mountainous areas and are used for forestry, recreation, and watershed. Inceptisols occupy an estimated 15% of the global ice-free land area

This soil dominates the entire State having fine loamy, fine clay, clay loam etc. soil textures with moderately shallow to deep soils with moderately to excessively drained. The identified families under this order are:

(1) Fine- loamy Umbric Dystrochrepts
(2) Fine loamy typic Dystrochrepts
(3) Fine Umbric Dystrochrepts
(4) Loamy , skeletal Umbric Dystrochrepts
(5) Fine typic Dystrochrepts

Ultisols: Ultisols (from Latin ultimus, "last") are strongly leached, acid forest soils with relatively low native fertility. They are found primarily in humid temperate and tropical areas of the world, typically on older, stable landscapes. Intense weathering of primary minerals has occurred, and much Ca, Mg, and K has been leached from these soils. Ultisols have a subsurface horizon in which clays have accumulated, often with strong yellowish or reddish colors resulting from the presence of Fe oxides.

Because of the favorable climate regimes in which they are typically found, Ultisols often support productive forests. The high acidity and relatively low quantities of plant-available Ca, Mg, and K associated with most Ultisols make them poorly suited for continuous agriculture without the use of fertilizer and lime Ultisols occupy 8.1% of the global ice-free land area and support 18% of the world's population.

This soil is sparely scattered in all parts of the State having fine loam, clay loam and clayey texture. The families under this order which have been identified so far are:

(1) Fine Humic Hapludults
(2) Fine Typic Paleudults
(3) Fine Typic Haplohumults
(4) Fine loamy typic Hapludults
(5) Fine typic Hapludults

8.6 Generic and Site-Specific Key Impacts Identified during Screening

Pre-construction Impacts:

There will be diversion of forest cover for widening the existing road. Private Land also needs to be acquired for widening since the existing road where ever exists predominantly single lane configuration. Road design has considered all major preconstruction impacts and taken avoidance measures at an early stage of planning.

(i) **Alignment**: Final alignment has been determined to minimize land acquisition, impact on structures, archaeological/cultural sites, interference with water sources, shifting of existing utilities etc.

(ii) **Water bodies:** construction of culverts and bridges during lean flow period. If technically not feasible, toe walls/retaining walls have been proposed. Aggregate will be procured from existing licensed quarries.

(iii) **Tree Cutting:** Proposed to restrict tree cutting upto formation width of the proposed road.

(iv) **Construction material Sourcing:** Borrow areas have been identified at non-agricultural land. Quarrying is not proposed.

(v) **Dust and air pollution:** No new borrow areas/quarry sites to be opened for the project. Aggregates will be sourced from existing licensed quarries. Waste disposal sites and asphalt mixing sites have been sited away from populated areas.

(vi) **Noise and Vibration:** Time regulation for blasting and construction near sensitive receptors and residential areas. There are two existing crusher plant in adjacent to proposed road.

(vii) **Soil Erosion, Cut and fill:** The design attempted to equalise cut and fill. Adequate erosion control measures included in design.

(viii) **Construction Camp and Waste Disposal:** No such facility is sited near any water bodies, forest area and settlements.

(ix) **Natural Hazards:** The project area is located in seismic zone V which is very high damage risk zone. Relevant IS codes shall be adopted while designing the civil structures to sustain the earthquake of highest magnitude in Seismic zone V. Retaining walls and breast walls need to be provided at all potential landslide locations.

Generic impacts attributable to any road up-gradation projects are:

(i) Increase of local air pollution and noise level due to construction and site clearance activities, earthworks, borrowing and quarrying, operation of hot mix plants etc;

(ii) Deterioration of surface water quality due to silt run-off, spillage from vehicles and discharge from labour camps;

(iii) Health impacts from labour camps;

(iv) Disruption to access/traffic;

(v) Occupational health and community safety. Operation stage impacts anticipated are road accidents, accidental spillage, submergence/overtopping of CD structures, water logging due to blockade of side drains, increased air pollution and noise level, survival of compensatory afforestation and avenue plantation etc.

All these are mainly associated with maintenance and monitor of effectiveness of mitigation measures taken during design and construction stage. Executing agency is mandated to undertake regular maintenance of the road conditions and its appurtenances.

Besides above, since the project is located in a mountainous terrain, following site-specific impacts achieves greater attention need to be addressed in detail during further stages of study.

Site Specific Potential Impacts due to Road upgradation and Widening

- **Landslides:** The lithology of the project area combined with high rainfall makes the hill slopes unstable. Destabilization of slopes due to hill cutting may cause extensive erosion

resulting to siltation in nearby water bodies may invite impact on properties. Hence, suitable protection measures are recommended viz.

(i) Retaining walls for stabilization of uphill, (ii) breast walls for down slopes and (iii) parapet walls/guard posts/railings/edge stones. Some Bio-engineering measures like bamboo terracing, bamboo crib walls, and bamboo knitting a slope, (ii) contour trenching, (iii) series of check dams on hill slopes etc. may also be recommended for slope stabilization. In addition to controlling soil erosion, this will generate employment to local people, manifold saving against masonry structures, increase productivity of hill slopes and reduce carbon emissions.

- **Soil Erosion/Silt Runoff:** Soil erosion may take place near cutting areas, at mountainous and un compacted embankment slope, and wherever vegetation is cleared. Soil erosion may have cumulative effect viz. siltation, embankment damage, drainage problem etc. Loss of soil due to run off from earth stock-piles may also lead to siltation. Need for opening borrows areas and quarries are not anticipated since abundant material will be available from hill cutting. However, if requirement emerged, it may cause some adverse impacts if left un-rehabilitated. It may pose risk to people, particularly children and animals of accidentally falling into it as well as become potential breeding ground for mosquitoes and vector born disease. Illegal quarrying may lead to unstable soil condition; destroy the landscape of the terrain, air and noise pollution. Opening of new quarries is not envisaged due to the proposed project. Quarry material will be sourced from existing licensed quarries. The dredging and use of dredged material, if involved, may have its impact in terms of localised sedimentation level increase and dispersion of pollutants present in the dredged material in the river water.

- **Blasting:** In case if blasting is required the blasting, operation may cause noise and vibration, destabilization of rock units and safety hazard and physical damage to downhill inhabitants, assets and properties. In forest areas, it may pose adverse impacts on faunal elements. Blasting, if required shall be restricted to daytime only. Blasting should be carried out as per "The Explosive Act, 1884 and the rules, 1983" pertaining to procurement, transport, storage, handling and use of explosives. Blasting schedules shall be carried out as per pre-announced scheduled which shall be also displayed in advance in areas where residents may be affected by the blasting operations. Red danger flags shall be displayed prominently in all directions during the blasting operations. The flags shall be planted 200 m and 500 m from the blasting site in all directions for blasting at. People, except those who actually light the fuse, shall be prohibited from entering this area, and all persons including workmen shall be excluded from the flagged area at least 10 minutes before the firing, a warning siren being sounded for the purpose. The Contractor shall notify each public utility body having services in proximity to the site of the work of his intention to use explosives. The Contractor shall adequately compensate in a timely manner for any damage to property/services and life caused by their blasting"

- **Debris Disposal**: Cutting the hillside to widen a road invariably generates debris. Disposing of this debris in the hilly areas is a challenging task as loose debris can potentially cause landsides, lead to unsightly scarring, and cause the hill slopes where it is dumped to lose their productivity. Although the road's technical design had reduced the generation of debris significantly by filling the valley portions with the debris

however significant amount would still need to be disposed. Dumping sites have been tentatively identified keeping in mind requisite environmental consideration viz. distance from water body, distance from forest and vegetated areas etc. during preliminary survey which needs further examinations viz its ownership and their consent and other technical considerations.

A fairly large proportion of people use hill slopes for agriculture where they still follow the traditional practice of 'jhum', or shifting cultivation, a 'slash and burn' method of cultivation that requires large tracts of land. The productivity of these slopes would therefore need to be retained and any land acquisition for project work or the disposal of debris would need to be done in close consultation with the local people since significant part of the land is jointly owned and administered by the community.

- **Alteration of Surface Water Hydrology/Drainage:** Diversion of rivers and major streams construction is not envisaged. Reconstruction/new construction of culverts will be done during lean flow period. Diversion of some nallahs may be required for a very short period. Their courses will be brought back to original within no time once construction is finished.
- **Ecological Resources:** There are no national parks, wildlife sanctuaries or any other similar eco-sensitive areas in the project area. Major portion of the project road is passing through reserve forest. These are Turu Hill Reserved Forest, Disai Valley Reserved Forest, Dayang Reserved Forest, Rengma Reserved Forest, Nambar Reserved Forest, Diphu Reserved Forest. Wildlife movement is reported along/across the project road. A rapid bio-diversity assessment will be carried out to generate baseline on floral and faunal elements in the project area. The survey will also help in assessing impact on any rare threatened or endangered species of floral species in the project area. Rapid bio-diversity assessment will also recognize wild life movement along across and impact due to improvement work. Tree enumeration will be conducted to identify no of trees likely to be affected. The list will include Girth size and species of all affected trees.
- **Forest Fires:** Risk of forest fire cannot be ruled out due to uncontrolled burning of grasses/shrubs for clearance of ROW, fuel accumulation due to accidental spillage or improper storage of explosives.

CHAPTER-9
INITIAL SOCIAL ASSESMENT & PRELIMINARY LAND ACQUISITION/RESETTLEMENT PLAN

ACRONYMS

ARO	:	Assistant Resettlement Officer
AWC	:	Anganwadi Centre
BDO	:	Block Development Officer
BPL	:	Below Poverty Line
BSR	:	Basic Schedule Rates
ADB	:	Asian Development Bank
CPR	:	Common Property Resource
DGM	:	Deputy General Manager
EA	:	Executing Agency
FGD	:	Focus group discussions
GoI	:	Government of India
GP	:	Gram Village Council
GRC	:	Grievance Redressal Committee
GSB	:	Granular sub base
HIV/AIDS	:	Human Immunodeficiency virus / Acquired immunodeficiency syndrome
IA	:	Implementing Agency
ICDS	:	Integrated Child Development Services
KII	:	Key Informant Interview
MT	:	Motorized traffic
NGO	:	Non-Government Organization
NH	:	National Highway
NRRP	:	National Rehabilitation and Resettlement Policy
OBC	:	Other Backward Castes
NMT	:	Non-motorized traffic
PHC	:	Primary health centre
PMU	:	Project Monitoring Unit
PT	:	Pedestrian traffic
PWD	:	Public Works Department
Rs	:	Rupee, Indian currency
R&R	:	Resettlement and Rehabilitation
SH	:	State Highway
SC	:	Scheduled Castes
ST	:	Scheduled Tribes

9.1 INTRODUCTION AND BACKGROUND

9.1.1 The Project

Manipur is one of the Border States in the north eastern part of the country having an international boundary of about 352 km. long stretch of land with Myanmar in the southeast. It is bounded by Manipur in the north, Assam in the west and Mizoram in the south. It has a total area of 22327 sq. km. It lies between 23.80 N to 25.70 N latitude and 93.50 E to 94.80 E longitude.

Geographically, the State of Manipur could be divided into two regions, viz. the hill and the valley. The valley lies in the central part of the State and the hills surround the valley. The average elevation of the valley is about 790 m above the sea level and that of the hills is between 1500 m and 1800m. The hill region comprises of five districts viz. Senapati, Tamenglong, Churachandpur, Chandel and Ukhrul and the valley region consists of four districts, viz. Imphal East, Imphal West, Thoubal and Bishnupur. The hill districts occupy about 90 percent (20089 sq km) of the total area of the State and the valley occupies only about tenth (2238 sq km) of the total area of the State. Imphal is the capital city of Manipur.

In the need of development of the newly created state the Government of India under the vehicle of National Highway Infrastructural Development Corporation Limited (NHIDCL) had initiated in constructing/upgrading the road conditions in the state. Most of the districts of Manipur, does not have any railway connectivity so there is an urgent requirement of the development of the roadways.

Realizing the above fact National Highway Infrastructural Development Corporation Limited (NHIDCL) has taken up one prestigious road network improvement projects namely developing a road on NH-102A with a minimum of 2-Lane with hard shoulder configuration on Engineering, Procurement & Construction (EPC) mode as will emerge out on preparation of Project Report.

Provision of a high-class access-controlled facility for high mobility in the form of NH may be useful in bypassing the city by external traffic, if it is not connected to the core by proper road network. It will not be helpful in decongesting the core area. Realizing this need NHIDCL has proposed 30 National Highways in its master plan. The National Highways not only provide connectivity between the cities but also serve as a connecting link between proposed townships and the cities. They also help in serving the traffic expected to be generated by the exploring activities in the outer municipalities. The NH with its service roads connected to the cities by fedder road network is expected to develop the Project Influence Area and will be in a position to cater the travel demand patterns generated by these developments.

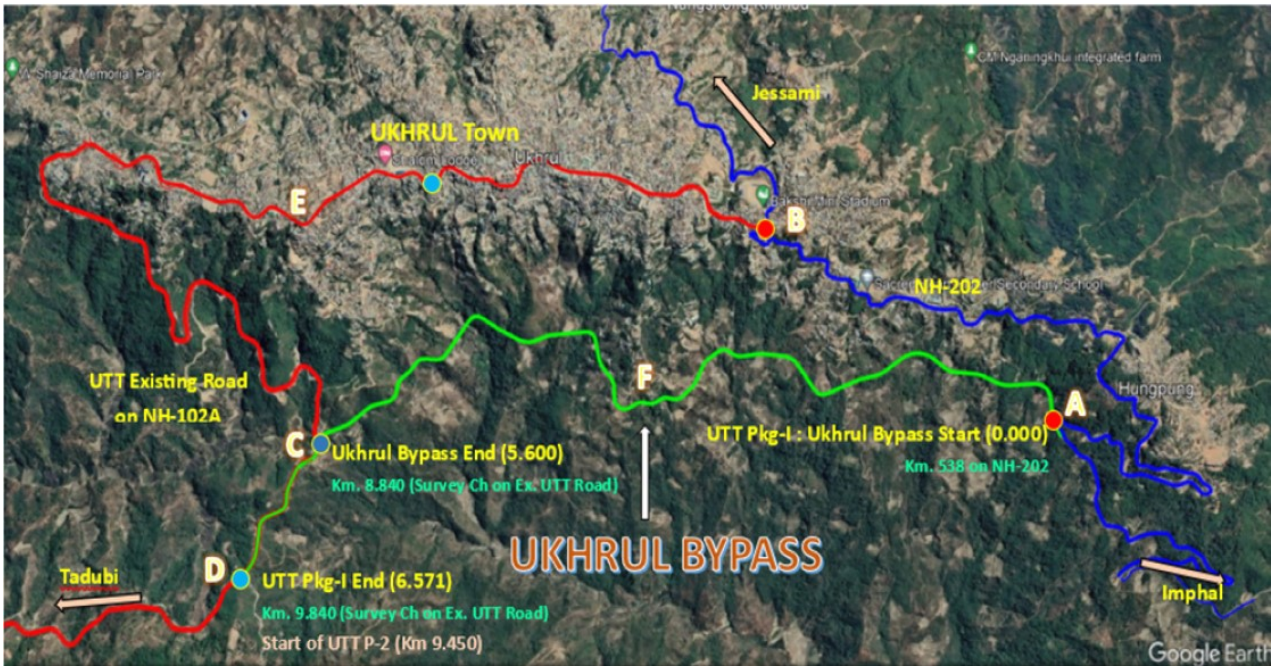


Figure 9.1: Map of the Project Road

Adequate attention has been given during the feasibility phases of the project preparation to minimize the adverse impacts on land acquisition and resettlement impacts. However, technical and engineering constraints are one of the major concerns during exploration of various alternative alignments. With the available options, best engineering solution have been adopted to avoid large scale land acquisition and involuntary resettlement impacts.

This Resettlement Plan (RP) is prepared to mitigate all unavoidable negative impacts caused due to the project, resettle the displaced persons and restore their livelihoods. This Full Resettlement Plan has been prepared on the basis of census survey findings and consultation with various stakeholders.

9.1.2 Scope of Land Acquisition and Resettlement Impacts

The existing ROW width in open area of mountainous terrain is 9-12 m. Therefore, the existing ROW does not cater the codal provision of 24m-55m ROW required for hill road in rural areas and 20m ROW in built-up area. Thus, the additional land may have to be acquired to accommodate the proposed 2-lane/Intermediate lane with hard shoulder configuration.

A project census survey will be carried out to identify the persons who would be displaced by the project and to make an inventory of their assets that would be lost to the project, which would be the basis of calculation of compensation.

9.1.3 Stakeholders Consultation and Participation

Focus Group Consultations with various stakeholders are carried out during various phases of project preparation. Key person and focus group consultations at section of the society are arranged at the stage of project preparation to ensure peoples' participation in the planning

phase of this project and to treat public consultation and participation as a continuous two-way process. Aiming at promotion of public understanding and fruitful solutions of developmental problems such as local needs and problem and prospects of resettlement, various sections of DPs and other stakeholders are consulted through focus group discussions and individual interviews.

To keep more transparency in planning and for further active involvement of DPs and other stakeholders, the project information will be disseminated through disclosure of resettlement planning documents. This report with the Entitlement Matrix after accepted by the EA and National Highway Infrastructural Development Corporation Limited would be available for disclosure on both EA's and State Government website.

9.1.4 Legal and Policy Framework

The legal framework and principles adopted for addressing resettlement issues in the Project have been guided by the proposed legislation and policies of the Government of Manipur, Government of India guidelines. Prior to the preparation of the Resettlement Plan, a detailed analysis of the proposed national and state policies is undertaken and an entitlement matrix has been prepared for the entire program. This RP will be prepared based on the review and analysis of all applicable legal and policy frameworks of the state policy requirements.

The objectives of the Resettlement Framework as per the policies are as follows: -

- To minimize displacement and to identify non-displacing or least-displacing alternatives.
- To plan the resettlement and rehabilitation of Project Affected Families, (PAFs) including special needs of Tribal and vulnerable sections.
- To provide better standard of living to DPs; and
- To facilitate harmonious relationship between the Requiring Body and DPs through mutual cooperation.
- The involuntary resettlement would be avoided wherever possible or minimized as much as possible by exploring project and design alternatives.
- The Project or all sub-projects under the program will be screened to identify past, present, and future involuntary resettlement impacts and risks.
- The scope of resettlement planning will be determined through a survey and/or census of displaced persons, including a gender analysis, specifically related to resettlement impacts and risks.
- Meaningful consultations with affected persons, host communities, and concerned non-government organizations will be carried out and all displaced persons will be informed of their entitlements and resettlement options participation in planning, implementation, and monitoring and reporting of resettlement programs will be ensured.

- Particular attention will be paid to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and Indigenous Peoples, and those without legal title to land, and ensure their participation in consultations.
- An effective grievance redress mechanism will be established to receive and facilitate resolution of the displaced persons' concerns. The social and cultural institutions of displaced persons and their host population will be supported through proper planning. Where involuntary resettlement impacts and risks are highly complex and sensitive, compensation and resettlement decisions should be preceded by a social preparation phase.
- Physically and economically displaced persons will be provided with needed assistance, including (i) if there is relocation, secured tenure to relocation land, better housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities, and extension of project benefits to host communities; (ii) Transportation support and development assistance, such as land development, credit facilities, training, or employment opportunities; and (iii) civic infrastructure and community services, as required.
- The standards of living of the displaced poor and other vulnerable groups, including women, will be improved to at least national minimum standards. In rural areas legal and affordable access to land and resources will be provided, and in urban areas appropriate income sources and legal and affordable access to adequate housing will be provided to the displaced poor.
- If land acquisition is through negotiated settlement, procedures will be developed in a transparent, consistent, and equitable manner to ensure that those people who enter into negotiated settlements will maintain the same or better income and livelihood status. If, however, the negotiated settlement fails, the normal procedure of land acquisition will be followed.
- Displaced persons without titles to land or any recognizable legal rights to land will be ensured that they are eligible for resettlement assistance and compensation for loss of non-land assets.
- A resettlement plan will be prepared elaborating on displaced persons' entitlements, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule.
- The draft resettlement plan, including documentation of the consultation process will be disclosed in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected persons and other stakeholders. The final resettlement plan and its updates will also be disclosed to displaced persons and other stakeholders.

- Involuntary resettlement will be conceived and executed as part of a development project or program. Full costs of resettlement will be included in the presentation of project's costs and benefits. For a project with significant involuntary resettlement impacts, consider implementing the involuntary resettlement component of the project as a stand-alone operation.
- All compensation will be paid and other resettlement entitlements will be provided before physical or economic displacement. The resettlement plan will be implemented under close supervision throughout project implementation.
- Resettlement outcomes, their impacts on the standards of living of displaced persons will be monitored; it will be accessed whether the objectives of the resettlement plan have been achieved by taking into account the baseline conditions and the results of resettlement monitoring. Monitoring reports will be disclosed to DPs.
- Land acquisition for the project would be done as per State's guidelines and the RFCTLARR Act, 2013. To meet the replacement cost of land payment of compensation in revised rate.
- The uneconomic residual land remaining after land acquisition will be acquired as per the provisions of Land Acquisition Act. The owner of such land/property will have the right to seek acquisition of his entire contiguous holding/ property provided the residual land is less than the average land holding of the district.
- People moving in the project area after the cut-off date will not be entitled to any assistance. In case of land acquisition, the date of publication of preliminary notification for acquisition under RFCTLARR Act, 2013 will be treated as the cut-off date. For non-titleholders the date of project census survey or a similar designated date declared by the executing agency will be considered as cut-off date.
- All common property resources (CPR) lost due to the project will be replaced or compensated by the project.

The project will recognize two types of displaced persons like (i) persons with formal traditional rights to land lost in its entirety or in part and (ii) persons who lost the land they occupy in its entirety or in part who have no formal legal rights to such land, but who have claims to such lands that are recognized or recognizable under national laws. The involuntary resettlement requirements apply to all types of displaced persons.

9.1.5 Entitlements, Assistance and Benefits

The project will have two types of Affected persons i.e., (i) persons with formal legal rights to land lost in its entirety or in part and (ii) persons who lost the land they occupy in its entirety or in part who have no formal legal rights to such land, but who have claims to such lands that are recognized or recognizable under national laws. The involuntary resettlement requirements apply to both types of affected persons.

Compensation eligibility is limited by a cut-off date as set for this project on the day of the ending of the census survey for non-title holders. APs who settle in the affected areas after the cut-off date will not be eligible for compensation. They, however, will be given sufficient advance notice, requested to vacate premises and dismantle affected structures prior to project implementation. Their dismantled structures materials will not be confiscated and they will not pay any fine or suffer any sanction. For Title holders, the day of the publication of the gazette notification under Section 3(a) of National Highway Act, 1956 or any other act as applicable.

Compensation for the lost assets to all affected persons will be paid on the basis of replacement cost. Resettlement assistance for lost income and livelihoods will be provided to title holders. Special resettlement and rehabilitation measures will be made available to the "Vulnerable Group" comprises of APs living below poverty line (BPL), SC, ST, women headed households, the elderly and the disabled. The detail of the assistance and entitlements has been discussed in the following chapters.

9.1.6 Institutional Arrangements

For implementation of RP there will be a set of institutions involve at various levels and stages of the project. The Executing Agency (EA) for the Project is NHIDCL under which the Road Construction Department, Government of Manipur. They have already set up a Project Implementing Unit (PMU) headed by a Project Director (PD) with Technical Manager and Deputy Managers (DGM) assisted by other staffs. This office will be functional for the whole Project duration. The EA, headed by PD will have overall responsibility for implementation of the project and will also be responsible for the overall coordination among NHIDCL and PMU. For resettlement activities, PIU will do the overall coordination, planning, implementation, and financing. Project Monitoring Unit (PMU) will be established at project level for the implementation of sub-projects. An experienced and well-qualified NGO in this field will be engaged to assist the PMUs in the implementation of the RP.

9.2 PROJECT DESCRIPTION

9.2.1 General

NHIDCL has decided to take up the development of Ukhrul-Toloi-Tadubi section of NH-102A into two lane with hard shoulder configuration in the State of Manipur on EPC Mode. The project road lies in Ukhrul district of Manipur state. The project road is located in mountainous Terrain. The entire road passes through major village / localities namely Hundung & Hunphun on NH-102A in the State of Manipur.

9.2.2 The Profile of the District of Ukhrul

Ukhrul District was first marked out as a Sub-Division in 1919 by the then British-India. Later it was upgraded to a District in the year 1969 by the Govt. of India. The District now has 7(seven) Sub-Divisions which are co-terminus with the 8(eight) Development Blocks. The area of the district was 1,754 Sq.Km. according to the CSI Publication 1976. Later Tengnoupal District, now called Chandel was carved out from this district on 15th July, 1983 and the area of the Manipur East District was sliced down to 4,544 Sq.Km and the title of the district was changed into Ukhrul District in 1983.

Ukhrul District (currently including Kamjong District) is bounded by Myanmar in the East, Kamjong District in the South, Kangpokpi Districts in the West and Senapati district in the North. The terrain of the district is hilly with varying heights of 913m to 3114m (MSL). The district HQ Ukhrul is linked with Imphal, the state capital by a NH 150 about 84 Km. By ordinary passenger bus it takes about 3 hours.

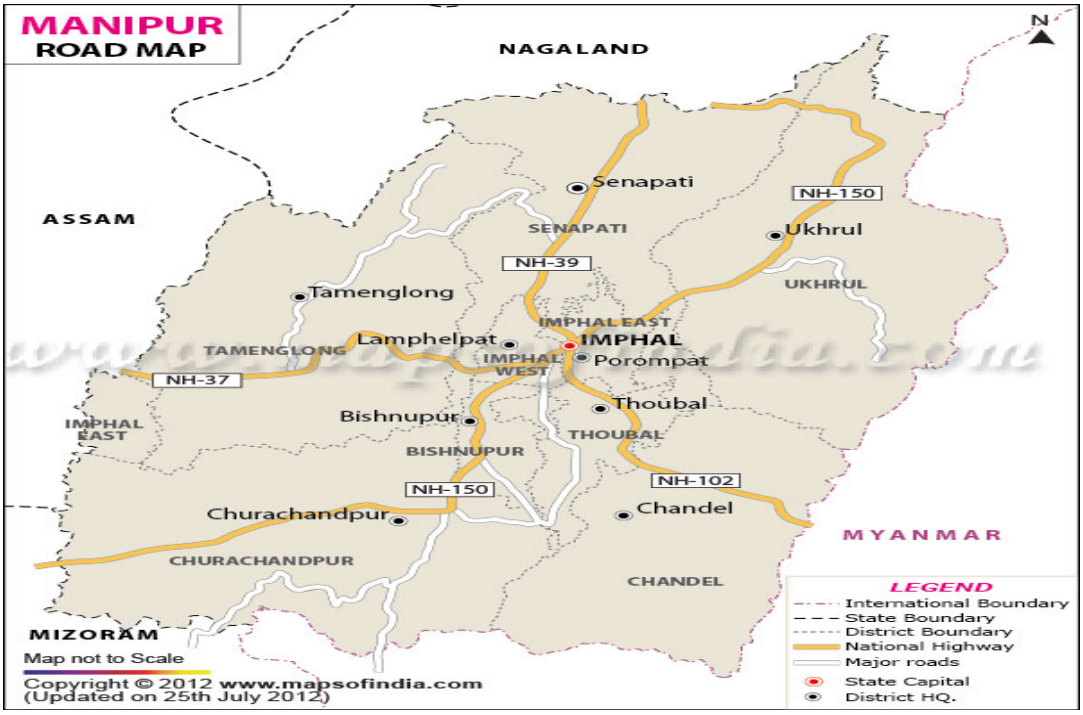
Some of the vital statistics of Ukhrul District are presented in **Table 9.2.1**

Table 9.2.1: Statistic of Ukhrul District

Description	2011
Actual Population	2.37 Lacks
Male	1.22 Lacs
Female	1.15 Lacs
Population Growth	30.70%
Density/km2	40
Proportion to Manipur Population	7.9
Sex Ratio (Per 1000)	943
Child Sex Ratio (0-6 Age)	923
Average Literacy	81.35%
Male Literacy	85.52%
Female Literacy	76.95%
Child Proportion (0-6 Age)	13.27%
Boys Proportion (0-6 Age)	13.40%
Girls Proportion (0-6 Age)	13.13%

9.2.3 The Profile of the State of Manipur

Manipur is a state in north eastern India, with the city of Imphal as its capital. It covers an area of 22,347 square kilometres. The state is bounded in the north by Manipur, in the south by Mizoram, Assam lies in the west and nation of Myanmar is bordering in the east. Manipur has a recorded history of kingship since 33 A.D. with the coronation of Pakhangba followed by a series of kings ruling over the kingdom of Manipur. The independence and sovereignty of Manipur remained uninterrupted until the Burmese invaded and occupied it for seven years in the first quarter of the 19th century (1819-25). In 1891 British Govt. brought it under its rule, and later on it is merged in the Indian Union as part "C" State on 15 October, 1949. This is replaced by a Territorial Council of 30 elected and 2 nominated members. In 1963, a Legislative Assembly of 30 elected and 3 nominated members is established under the Union Territories Act, 1962. Manipur attained full-fledged statehood on 21 January, 1972. With this, a Legislative Assembly consisting of 60 elected members is established.



Physio graphically, Manipur is characterised in two distinct physical regions – an outlying area of rugged hills and narrow valleys, and the inner area of flat plain, associated with residual mounds and undulating plains. These two regions are also conspicuous with respective distinct various flora and fauna. The Loktak lake is an important feature of the central plain. The hills cover about 9/10th of the total area of the State. Manipur Valley is about 790 metres above the sea level. The hill ranges are higher on the north and gradually diminish in height as they reach the southern part of Manipur. The valley itself slopes down towards the south. The highest peak is Mt. Iso of 2,994 m altitude near Mao.

Manipur state has four major river basins: the Barak River Basin (Barak Valley) in the west, the Manipur River Basin in central Manipur, the Yu River Basin in the east, and a portion of

the Lanye River Basin in the north. The total water resources of Barak and Manipur river basins are about 1.8487 Mham. The Barak River, the largest of Manipur, originates in the Manipur Hills and is joined by a number of tributaries, all originating from surrounding hills. Rivers in the valley area are in mature stage and deposit their sediments in Loktak. The rivers in the hills cause land erosion and in rainy season turn into turbulent form.

According to 2011 census Manipur has a total population of 2,721,756 and ranked 22nd among Indian states. Its density of population is 115 persons per square kilo-meter. Population communities of Manipur comprise Meitei, Pangal, Naga, Kuki and Mizo.[11] The Meitei, who live primarily in the state's valley region, form the primary ethnic group (60% of the total population). They occupy about 10% of the total land area. The Muslims (the Meitei-Pangal) also live in the valley. The Kuki, Naga, Mizo and several other smaller tribal communities make up about 40% of the population but occupy the remaining 90% of the total area of Manipur.

9.2.4 Impact and Benefits

The road project is associated with some adverse impacts as well as some benefits. The major impacts of the road project include loss of agricultural land due to acquisition of land all along the project corridor and in Bypasses and Realignment. But it should be kept in mind that the project road strategically connects with NH-202 which from between Imphal to Jessami . Boost in agricultural and industrial development can be viewed as boosting economic growth and poverty reduction which will bring substantial social and economic development in the region. The social benefits arising due to the project will be triggered off due to improved accessibility to various services such as easy access to markets, health facilities, schools, workplace etc which in turn increases the income of the locals, and ultimately elevating their standard of living. The possible direct and indirect positive impacts of the project are listed below.

i. Road network will not only link the village communities to better national markets, but also open up wider work opportunities in distant places. People can shuttle to distant worksites and engage in construction, mining, factories, business as well as domestic works.

ii. The immediate benefits of road construction and improvement will come in the form of direct employment opportunities for the roadside communities and specially those who are engaged as wage labourers, petty contractors and suppliers of raw materials.

iii. Effective drainage system to ensure that there will be no pooling of water

iv. Safety measures for Highway signs, Pavement marking, Traffic signals, Truck lay byes, Bus stops and Bus bays

v. Rectification of geometric deficiencies (both Horizontal & Vertical).

vi. Provision of Pedestrian passes.

vii. Provision of ROBs to fly over the traffic and minimize the traffic congestion, if required.

viii. Provision of ROBs over railway crossings, if required.

ix. Slope protection.

x. Provision of crash barrier at Bridge approaches.

xi. Improvement of all Major and Minor Intersections.

xii. Facilities for public amenities such as Restrooms, Telephone booths, Toilets, shops and Trauma Centres.

Other benefits: -

xiii. It will give a major fillip to the quest for all weather connectivity.

xiv. It will reduce travel time between towns and cities by 50% to 60%.

xv. It will enhance the spirit of enterprise.

xvi. Help the locals to ply their trade.

xvii. Provide direct employment in road construction and allied activities.

xviii. Lower accident and provide quick accessibility to services like hospital, market, office etc.

xix. Will help in growth of tourism activities immensely.

9.2.5 Minimizing Resettlement

Adequate attention has been given during the feasibility and detailed project design phases of the project preparation to minimize the adverse impacts on land acquisition and resettlement impacts. However, technical and engineering constraints were one of the major concerns during exploration of various alternative alignments. With the available options, best engineering solution have been adopted to avoid large scale land acquisition and resettlement impacts. Following are the general criteria adopted for the selection of the alignment:

- ❖ It should serve as uninterrupted traffic for proposed Tourist centres.
- ❖ It should provide linkage to other roads in the region.
- ❖ It should take in to account the future traffic growth and management.
- ❖ It should be coordinated with local and national development plans.
- ❖ It should minimize environment impact along the corridor.
- ❖ It should take in to consideration the opinions of local people in selection of alignment.

The specific measures adopted for minimizing the resettlement impacts for the sub Project is as follows:

- ❖ Exploration of several alternate alignments in consultation with engineering team, concerned government departments and local community
- ❖ Following proposed local roads as much as possible to minimize the land acquisition in the bypass alignments
- ❖ Avoiding major settlements and urban areas to minimize the large-scale physical displacement

- Avoiding productive agricultural land to minimize the adverse economic displacement
- Diverting the alignment towards the available unused government land to minimize impact on private property

9.2.6 Scope and Objective of Resettlement Plan (RP)

The aim of this Resettlement Plan (RP) is to mitigate all such unavoidable negative impacts caused due to the project and resettle the affected persons and restore their livelihoods. This Full Resettlement Plan has been prepared on the basis of project census survey findings and consultation with various stakeholders. The plan complies with RCD, GoM policy for involuntary resettlement. The issues identified and addressed in this document are as follows:

- Type and extent of loss of land/ non-land assets, loss of livelihood, loss of common property resources and social infrastructure
- Impacts on indigenous people, vulnerable groups like poor, women and other disadvantaged sections of society
- Public consultation and people's participation in the project
- Proposed legal and administrative framework and formulation of resettlement policy for the project
- Preparation of entitlement matrix, formulation of relocation strategy and restoration of businesses/income
- R&R cost estimate including provision for fund and Institutional framework for the implementation of the plan, including grievance redress mechanism and monitoring & reporting

9.2.7 Primary Responsibility for Land Acquisition & Resettlement

NHIDCL is the nodal agency for implementation of the proposed project. Therefore, the prime responsibility for land acquisition lies with the NHIDCL. However, such land acquisition is normally done through the State level District Administration and the compensation amount is deposited with the District Administration by the acquiring body for disbursement. Similarly, the resettlement of the affected population will be implemented by the Road Construction Department, Government of Manipur like it is being done in other projects. NHIDCL will hire the services of some experienced NGO to implement the RAP on its behalf. However, NHIDCL does conduct its own internal monitoring of RAP implementation through PMU. An independent External Monitor would be engaged to review and monitor the implementation process and time frame of the resettlement and rehabilitation of the APs. The External Monitor may submit a biannual report on the progress of the implementation of the Resettlement action plan to through NHIDCL.

9.3 METHODOLOGY FOR IMPACT ASSESSMENT

This Chapter presents an analysis of the project impacts based on census survey data. The purpose of the analysis is to (a) develop profiles of APs and communities affected by the project. (b) Identify the nature and types of losses. The following sections briefly describe the methods used to ascertain various types of impacts.

9.3.1 The Census Survey

The census survey will be carried out by a team of trained enumerators. The objectives of the census survey is to generate an inventory of social impacts on the people affected by the project, their structures affected, social profile of the project affected people, their poverty, their views about the project and also their views on various options of rehabilitation and resettlement. A questionnaire will be used to collect detailed information on affected households/business for a full understanding of impacts in order to develop mitigation measures and resettlement plan for the APs. A structured census questionnaire will be used to collect detailed information on affected households/ properties for a full understanding of impacts in order to develop mitigation measures and resettlement plan for the APs. The census survey includes the following: -

- ❖ Inventory of the affected assets
- ❖ Categorization and measurements of potential loss
- ❖ Physical measurements of the affected assets/structures
- ❖ Identification of trees and crops
- ❖ Household characteristics, including social, economic and demographic profile
- ❖ Identification of non-titleholders
- ❖ Assessment of potential economic impact

The census survey will cover 100% structures affected within the proposed ROW including titleholders and non-titleholders. The additional information about the titleholder's land will be collected on completion of landholders' data collection from revenue department which is in the progress. The results of census survey presented in the report will also be updated further after completion of landholders' data collection.

9.3.2 Land Acquisition Planning

The alignment is finalized as per the detailed engineering design. Initially, the numbers of affected villages are identified as per the alignment. All the village maps are collected from the local revenue offices. The village maps will be digitized by the consultant. Following the digitization of village maps, the engineering design of the alignment was superimposed in the digitized cadastral map in order to identify the number of land parcels and their demarcation including the quantification. The superimposition of alignment on the village map provided all the plot numbers. A Land Acquisition Plan (LAP) has been prepared accordingly.

9.3.3 Inventory of Assets

Following finalization of the road alignment and identification of the land parcels, cross-sections design and land acquisition requirements, census of all affected persons (APs) will be carried in the sub-project. The objective of the project census survey was to identify the persons who would be affected by the project and to make an inventory of their assets that would be lost to the project, which would be the basis of calculation of compensation. The survey team is trained by the resettlement specialist and the survey was closely monitored on a regular basis. Additionally, socio-economic data was also collected as part of the Social Impact Assessment (SIA) study. The census survey includes the following.

9.3.4 Survey of Affected Structures

Different types of structures will be affected by the road improvements. In order to assess market/ replacement value for the affected structures, the survey considered the types of construction, material used for roof, walls and floor; levels/ stories of structures, and land area of each structure.

9.3.5 Public Consultation

To ensure peoples' participation in the planning phase and aiming at promotion of public understanding and fruitful solutions of developmental problems such as local needs of road users and problem and prospects of resettlement, various sections of affected persons and other stakeholders were consulted through focus group discussions, individual interviews and formal and informal consultations. The vulnerable sections of APs and women were also included in this consultation process.

9.4 SOCIO ECONOMIC PROFILE OF THE PROJECT AREA

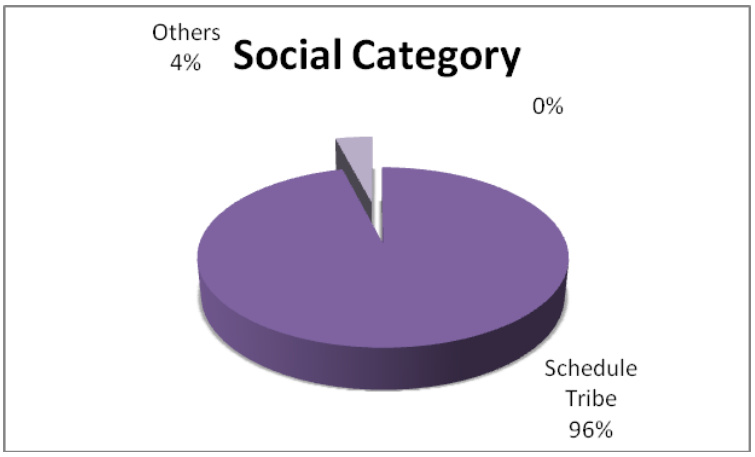
9.4.1 Socio-economic Profile of Project Area

To understand the socio-economic profile of project area, the socio-economic information of DPs was collected through the Socio-Economic Survey (SES) and Census survey. The total number of Displaced Household (DH) is 83 and the total number of Displaced Population (DP) living within this 83 household is 332 persons. The gross findings of the survey are presented in the following sections.

9.4.2 Social Categories of the DPs

The social stratification of the project area shows the dominance of Schedule Tribe (ST) population with 196% households. The second stratum of the social grouping in the area is General and other just less than 4% households. The detail of social grouping in the project area is presented in the ***(Figure 3.1).***

Figure 9.4.1: Social Categories of DPs along the Project Road

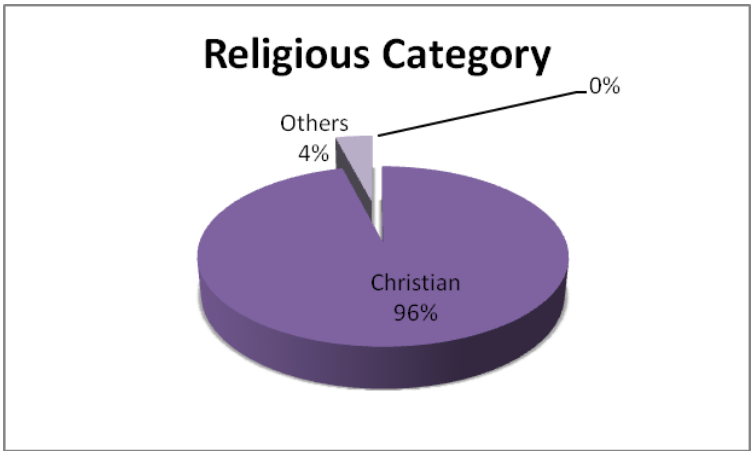


Source: Census Survey, April, 2018

9.4.3 Religious Categories of the Displaced Households

The project area is dominated by Christian community as they form 96% of the total Displaced Households **(DH).** Hindus are 4% of the total affected population. In addition, there are some animistic believers' households in the Project Impact Area (PIA) being affected by the Project.

Figure 9.4.2: Religious Categories of DPs along the Project Road

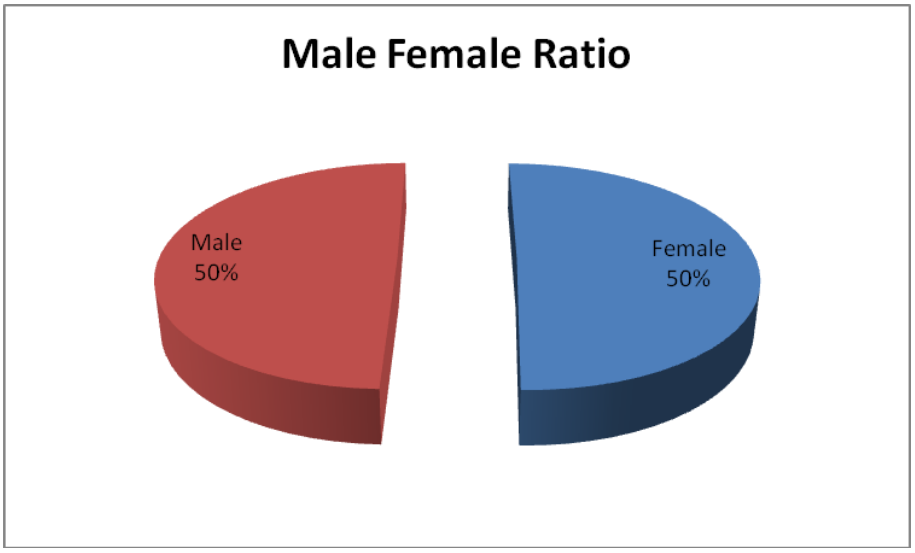


Source: Census Survey, April2018

9.4.4 Number of Displaced Persons (DPs)

There are altogether 332 DPs concerning to titled and non-titled categories, that are being affected by the project. It includes 50.4% females and 49.6% males. The number of DPs is substantially significant in the project area mainly because presence of joint family system and a large number of shareholders of landed as well as non-landed properties.

Figure 9.4.3: Male Female Ratio of DPs along the Project Road

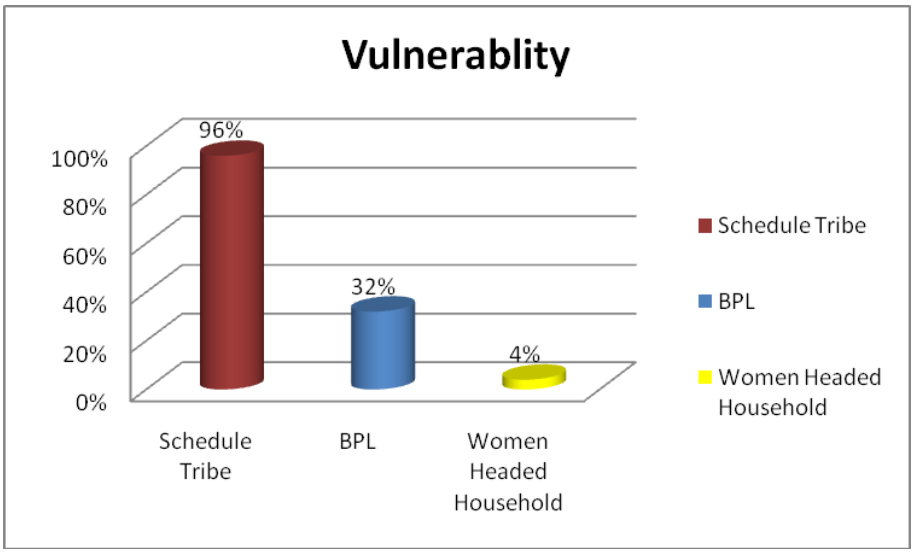


9.4.5 Vulnerable Households being affected in the project

In the project area there are 96% households falling in the vulnerable category being Schedule Tribe. About 32% falls in the below poverty line (BPL) category. The State Government of Manipur has identified them and distributed BPL cards to such families. In this project among

other vulnerable group there are 4% households headed by women but no households are headed by physically handicapped people who are also ST household.

Figure 9.4.4: Vulnerability of DPs along the Project Road



9.4.6 Annual Income Level of the Affected Households

The number of BPL population, is further strengthen from the data analyzed on the basis of monthly income of the households, which reflects that there are 52% households, which are having an average monthly income of less than Rs. 30000/. Again, as discussed earlier 32% household have BPL Card. About 24 % DPs are having income in the range of Rs. 30000-50000, while 16% are earning in the range of Rs. 50000-100000. It has been observed that about 8% households are annually earning more than Rs. 100000/-. The detail is depicted below: -

Table 9.4.1: Annual Income Level of the Affected Households

Sl. No.	Annual Income Categories in (Rs)	% Age
1	Up to 10000	4%
2	>10000 and <20000	12%
3	>20000 and <30000	36%
4	>30000 and <50000	24%
5	>50000 and <100000	16%
6	<100000	8%
	Total	**100%**

Source: Census Survey, April 2018

9.4.7 Occupation by DPs

The occupational status of head of the households i.e. the primary occupation by the households reveals that 24% households are depending on business and this includes the business they are carrying out in the road side and allied activities they are involve with. About 52% households are having agriculture as their primary source of income and only 8% are daily wage earners engaged in both agricultural sector and non-agricultural sector. The details of occupations by the DPs are presented in the ***(Table 4.2).***

Table 9.4.2: Occupational Status of DPs

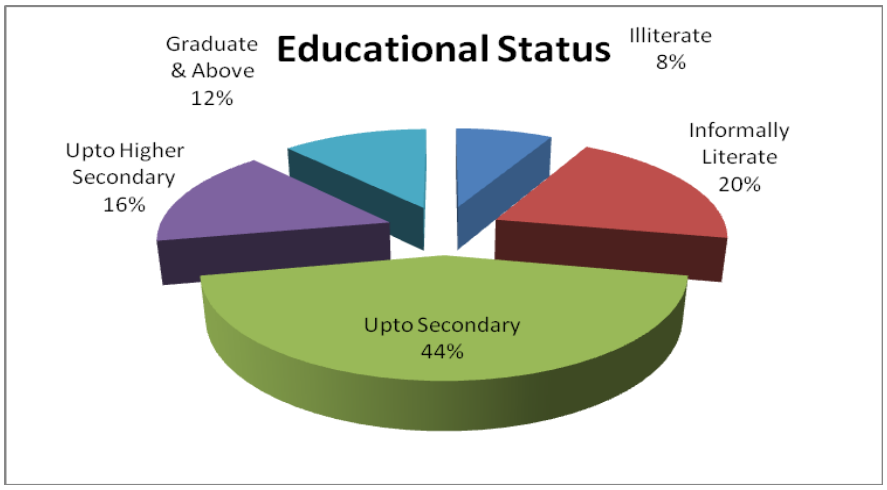
Sl. No.	Occupational Status of APs	% Age
1	Service	12%
2	Business/ Allied activities	24%
3	Agriculture	52%
4	Wage earner	8%
5	Professional	4%
	Total	**100%**

Source: Census Survey, April 2018

9.4.8 Educational Status of DPs

The educational status of head of the households reveals that overall scenario of literacy level is encouraging in the project area as significant percentage of population, i.e., 44%have education upto Secondary level and only 8% are still illiterate. There are 20% of the population who are informally literate. Another 16% has attained the education up to Higher Secondary level. About12% DPs are graduates degree or master and above, which are presented in the ***(Figure 9.4.5).***

Figure 9.4.5: Educational Status of DPs



Source: Census Survey, April 2018

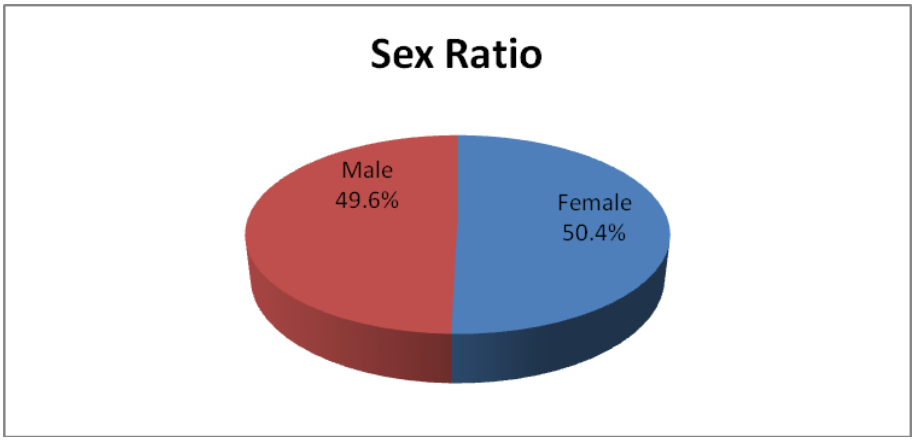
9.4.9 Impact on Indigenous People

The Scheduled Tribes (STs) in the project area is considered to be IP. The presence of ST population in the affected area as displaced person is about 96%. The census survey finding shows that the ST community is the mainstream community in the project influence area.

9.4.10 Gender Impact and Mitigation Measures

The gender composition of DPs shows that the female accounts for 50.4% and male accounts for 49.6%, thus it is slightly bias towards the female population. The gender equality is visible in higher sex ratio among DPs i.e. 1014 against state level statistic having 976 as per census data of India, 2011. The sample size is of only among the affected population. The census survey revealed that 4% of the DH is women headed households will be affected by the project.

Figure 9.4.6: Gender Ratio in study area



The working women and girl students face lot of problem for travel, due to non-availability of good road and transport network. Especially in rainy season, the problem increases manifold which sometimes compels the girl students abstains from classes.

Only primary health centres (PHCs) are located at some villages and the quality of treatment and medical facilities are less than satisfactory. In emergency they have to reach hospitals at district headquarters only.

The women feel that their mobility will increase as market & relatives' places will be easily accessible for them as better road condition will induce more transport vehicles to operate. More shops, markets will open within the village approach area and as a result they will get quality leisure time at their disposal.

Women from poor families will get job opportunity during construction work as casual labour or at office. Besides, women can operate individual / family enterprise by opening small tea stalls, shops/eateries to provide meals to the construction labourers. This will enhance their family income as well as their entrepreneurial skill which may be useful in future.

Women labourers feel that improved road network will provide them with better job opportunity as they will be able to travel further and even can commute from home. Moreover, travel by public transport system, like Govt. bus service, will become cheaper and money saved on transport can be better utilized for household needs.

The girl students will be able to attain higher education at colleges, since journey time and cost will be greatly reduced and the girls can commute from home all by themselves free of hazard.

Women will not be affected negatively due to the program. Any negative impacts of the project on female-headed households will be taken up on a case-to-case basis and assistance to these households will be treated on a priority basis. During disbursement of compensation and provision of assistance, priority will be given to female-headed households. Additionally, women headed households are considered as vulnerable and provision for additional assistance (lump sum amount @ Rs.50,000/- per affected households) has been made in the entitlement of the RP. Provision for equal wage and health safety facilities during the construction will be ensured by the EA. Therefore, the sub project activities will not have any negative impact on women

9.5 GENDER IMPACT AND MITIGATIVE MEASURES

9.5.1 Introduction

The social economical survey and census survey to the project sites identified some critical social issues related to gender impacts associated with project impacts. Typically, vulnerability is relatively higher among this group. Dislocation and loss of livelihood caused by road widening and development may further aggravate their disadvantaged situation, unless special attention is paid to them. This chapter particularly examines the issues from social safeguard considerations to develop specific mitigation measure.

9.5.2 Women's Participation in the Project

The gender composition of APs shows that the male accounts for 49.6% and female accounts for 50.4%. The census survey revealed that 1% women headed households will be affected by the sub project.

The Gender Development Index (GDI) value for India is very low and the socio-economic profile of the project area shows much lower socio-economic standing for women. They are largely involved in domestic work and have very low economic participation rate (i.e. productive or gainful employment). In the project, women are affected in a variety of ways. For example, they face hardship and stress and continue to suffer during the transition period until the time the project -affected households are able to regain their lost income and livelihood. Often, the duration of this process is lengthened due to delays in payment of compensation, rehabilitation assistance and implementing the R&R., reconstructing the livelihood systems. The longer the transition period, more are the miseries for women. The census identified 1% women headed households. The vulnerability of women headed households has been addressed in the RAP with social attention and gender specific attention. During project implementation, project affected women will receive preferential treatment for the civil work in the project. Each field team of the

RAP implementation agencies/partner agencies shall include at least one-woman investigator/facilitator. The PIU will ensure that the women are consulted and invited to participate in group-based activities to gain access and control over the resource as a part of the RAP. The monitoring and evaluation team(s) shall include woman. Further, during RAP implementation, NGO's will make sure that women are actually taking part in issuance of identity cards, opening accounts in the bank, receiving compensation amounts by cheque in their names. This will further widen the perspective of participation by the women in the project implementation. The implementing agencies will provide training for upgrading women's skill for alternative livelihoods and income restoration.

9.6 PUBLIC CONSULTATION

Public Consultations or community participation is an integral part and process of any projects which involves resettlement or rehabilitation issues. It helps to incorporate valuable indigenous suggestions and perceptions of development. In the process, stakeholders get the opportunity to address issues, which are resolved after making appropriate changes in design and alternative finalization. The stakeholders become aware of the development schemes and at the same time influence and share to control over these initiatives, decisions and resources. Community consultations also help to avoid opposition to the project, which is otherwise likely to occur. The Table briefly depicts the plan and implementation of Public Consultation and Disclosure of the Project.

Table 9.6.1: Public Consultation and Disclosure Implementation and Plan

Activity	Task	Timing (Date/ Period)	No of People	Agencies	Feedback/ Issues/ Concerns Raised	Remarks
Stakeholder Identification	Mapping of the project area					
Project information Dissemination	Distribution of information leaflets to affected persons (APs)					
Consultative Meetings with APs during Scoping Phase	Discuss potential impacts of the project					
Public Notification	Publish list of affected lands/sites in a local newspaper; Establish eligibility cut-off date					
Socio-Economic Survey	Collect socioeconomic information on DP's perception on the project					
Consultative Meetings on Resettlement Mitigation Measures	Discuss entitlements, compensation rates, grievance redress mechanisms					
Publicize the resettlement plan (RP)	Distribute Leaflets or Booklets in local language					
Full Disclosure of the RP to APs	Distribute RP in local language to APs					
Web Disclosure of the RP	RP posted on RCD, GoM and/or EA's website					
Consultative Meetings during DMS	Face to face meetings with APs					
Disclosure after Detailed Measurement Survey (DMS)	Disclose updated RP to APs					
Web Disclosure of the Updated RP	Updated RP posted on RCD, GoM and/or EA website					

Source: Census Survey on August 2017

The overall objectives of the consultation program in preparing RAP were to disseminate project information and to incorporate public and DP's views in Resettlement and Environmental Action Plans, which are guided by specific objectives like:

- Awareness amongst stakeholders by disclosing the updated R.P. according to GOI's involuntary resettlement policy.
- Improvement in project design minimising potential conflicts and delays in implementation.
- Facilitate development of appropriate and acceptable entitlement options.
- Increase project sustainability.
- Reduce problems of institutional co-ordination.
- Make the R&R process transparent and reduce leakage.
- Increase re-settler commitment, ensure effectiveness and sustainability of the income restoration strategies, and improve coping mechanisms.
- Creating sense of belongingness among the stakeholders.

9.6.1 Identification of the stakeholders

The stakeholders are all the people getting affected by the project or are responsible for the project, whether directly or indirectly. The community participation programmes in social assessment ensured that information is disseminated to all the APs and other stakeholders in appropriate ways. The information dissemination has taken place in vernacular, detailing about the main project features and the entitlement framework. Due consideration has also been given to address the views of the vulnerable groups.

Certain issues conditioned the participation of the stakeholders, as follows:

- Who might be affected (positively or negatively) by the proposed development?
- Who are voiceless for whom special efforts may have to be made?
- Who are representatives of those likely to be affected?
- Who is responsible for what is intended?
- Who can make what is intended more effective through their participation or less effective by their non-participation or outright opposition?
- Who can contribute financial and technical resources?
- Whose behaviour has to change for the effort to succeed?
- Both primary and secondary stakeholders were identified, based on the above criteria. They were invited to take part in the consultation series, and were solicited to participate in planning and implementation of the R&R programme.

Primary stakeholders included those affected negatively or positively by the project, like the APS, project beneficiaries and project implementing agencies. Secondary stakeholders included other individuals and groups, with an interest in the project, viz., the State Govt. of Manipur, the highway users etc.

9.6.2 Discloser of Project Information

The sharing of information is essential for sustainable development. It stimulates public debate on and broadens understanding of development issues, and enhances transparency and accountability in the development process. It also strengthens public support to improve the lives of people, facilitates collaboration among the many parties involved in development, and improves the quality of projects and programs. It is now accepted everywhere that the expanded access to information by the public will enhance the dialogue on development, and make an important contribution to efforts to reduce poverty and promote sustainable development. In this development project the discloser of project information (during the feasibility stage) to the public in general and to the people who are likely to be impacted negatively in particular have been done by way of consultation process. During the consultation session it was observed that the local people are aware of this project through local newspaper, published from time to time.

9.6.3 Consultations for Determining Principle

The consultation process is not only targeted at project information dissemination to the people but another important aspect covered is determining of principle for formulating an entitlement frame work and eligibility policy for the project. The consultation process throws light of the people's expectations, aspirations etc. from the project as well as their expectations in terms of compensation and assistance from the project in case of adverse impacts.

9.6.4 Participants at different levels

The extent or the likely level of adverse impacts was one of the major criteria in deciding locations for public consultation sessions. The consultation programme has been tiered and conducted at several levels, such as:

- ❖ Heads of the households, likely to be impacted
- ❖ Members of the households, likely to be impacted
- ❖ Clusters of APS
- ❖ Villagers
- ❖ Village Councils
- ❖ Local voluntary organisations and CBOs/NGOs
- ❖ Government agencies and departments

9.6.5 Levels of Consultation

The enactment of the participation and consultations with the stakeholders has been done at different levels throughout the project preparation stage. The Public Consultation was carried out at various stages of project preparation: Social Screening stage and Feasibility stage.

9.6.6 Consultation during Project Preparation

The Census/Survey Team carried out preliminary consultations through Focus Group Discussions (FGDS) and meetings with the APs as well as the general public in the project area. FGDs were conducted primarily in settlements with problems of traffic congestion, dense informal/squatter settlement, close junctions and road intersections, and concentration of APs. During the survey, intensive discussion and consultation meetings were conducted with large number of APs in nearly every affected village wherein policy related issues; displacements and other related issues were discussed. Suggestions and comments by APs were incorporated in the project road design as well as the policy measures for resettlement management. Public discussions were conducted at important points, where people could assemble in large numbers. Village Council members were contacted to inform the people. The Team also had informal meetings with village head, Village Council and other district level government officials, leaders of local level organization /association, trucker's association, and village women groups.

Illustration of Public Consultation meetings at our project corridor are tagged below:

All the Local people and all the officials promised that they would extend their co-operation in our Project work.

9.6.7 Plan for further Consultation in the Project

The effectiveness of the R&R program is directly related to the degree of continuing involvement of those affected by the Project. Several additional rounds of consultations with APs will form part of the further stages of project preparation and implementation. A local NGO will be entrusted with the task of conducting these consultations during RP implementation, which will involve agreements on compensation, assistance options, and entitlement package and income restoration measures suggested for the sub-project. The consultation will continue throughout the project implementation. The following set of activities will be undertaken for effective implementation of the Plan:

In case of any change in engineering alignment planning the APs and other stakeholders will be consulted in selection of road alignment for minimization of resettlement impacts, development of mitigation measures etc.

Together with the NGO, the Project Monitoring Unit (PMU) will conduct information dissemination sessions in the project area and solicit the help of the local community/ leaders and encourage the participation of the DP's in Plan implementation.

During the implementation of RP, NGO will organize public meetings, and will appraise the communities about the progress in the implementation of project works, including awareness regarding road construction.

Consultation and focus group discussions will be conducted with the vulnerable groups like women, SC, ST, and OBC's to ensure that the vulnerable groups understand the process and their needs are specifically taken into consideration.

To make reasonable representation of women in the project planning and implementation they will be specifically involved in consultation.

9.6.8 Information Disclosure

To keep more transparency in planning and for further active involvement of APs and other stakeholders the project information will be disseminated through disclosure of resettlement planning documents. The EA will submit the following documents to NHIDCL for disclosure on GoM's website:

- The final resettlement plan endorsed by the EA after the census of Affected persons has been completed;
- A new resettlement plan or an updated resettlement plan, and a corrective action plan prepared during project implementation, if any; and
- The resettlement monitoring reports.

The EA will provide relevant resettlement information, including information from the above-mentioned documents in a timely manner, in an accessible place and in a form and language(s) understandable to affected persons and other stakeholders. A resettlement information leaflet containing information on compensation, entitlement and resettlement management adopted for the project will be made available in local language and distributed to APs.

9.7 OBJECTIVES AND POLICY FRAME WORK

This Resettlement Plan (RP) has been prepared in accordance with RTFCLARR Act, 2013, Manipur State Act and Rules as amended and National Highway Safeguard Policies. Policies are designed to protect the rights of the affected persons and communities. The primary objectives of the RP are to mitigate the adverse impacts of the project and to assist the affected persons (APs) in resettlement and restoration of their income and livelihoods.

The legal framework and principles adopted for addressing resettlement issues in the project have been guided by the proposed legislation and policies of the GOI & the Government of Manipur. Prior to the preparation of the Resettlement Plan, a detailed analysis of the proposed national and state policies was undertaken and an entitlement matrix has been prepared for the entire program. The section below provides details of the various national and state level legislations studied and their applicability within this framework. This RP is prepared based on the review and analysis of all applicable legal and policy frameworks of the country and Manipur State. A summary of applicable acts and policies is presented in the following paragraphs and the detailed policy review and comparison is provided in the entitlement matrix.

9.7.1 Objectives of the Policy

The objectives of the Policy are as follows: -

- ❖ To minimize displacement and to identify non-displacing or least-displacing alternatives;
- ❖ To plan the resettlement and rehabilitation of Project Affected Families, (PAFs) including special needs of Tribal and vulnerable sections;
- ❖ To provide better standard of living to APs; and
- ❖ To facilitate harmonious relationship between the Requiring Body and APs through mutual cooperation.

9.7.2 The National Highways Act

For LA, the Act defines the various APs of the process as follows: (i) section 3A - power to acquire land; (ii) 3B - power to enter for surveys; (iii) 3C - hearing of objections; (iv) 3D - declaration of acquisition; (v) 3E - power to take possession; (vi) 3F - power to enter into the land where land has vested in the central government; (vii) 3G - determination of amount payable as compensation; and (viii) 3F - deposit and payment of amount. The Act requires that the processes must be completed within a year from 3A to 3D. The acquisition process is faster due to central government co-ordination and provision for arbitration or power of civil court for trying any LA-related dispute. Although NHAI Act significantly reduces the time frame for acquisition, the rules and principles of compensation are derived from the LA Act of 1194 amended from time to time. The Act covers only legal title holders and provides for: (i) market value of the land; (ii) a solarium of 30% on the market value for compulsory acquisition; (iii) additional amount for trees, crops, houses or other immovable properties; (iv) damage due to

severing of land, residence, place of business; (v) compensation to sharecroppers for loss of earning; and (vi) an interest of 12% on the market value from the date of notification to award.

The LA Act does not address many of the social and economic issues associated with displacement and resettlement of 'illegal" or non-titled informal settlers/squatters. However, in many donor-funded or DFBOT (Design Finance Built Operate Transfer) projects, EA assisted affected and/or Affected persons even without any legal title. The impacts of the present project are also on the roadside SBEs/households - people who are "non-titled" informal dwellers and encroachers.

9.7.3 Right to Fair Price Compensation of Land Acquisition Resettlement and Rehabilitation Act, 2013.

The Government of India (GOI) in December 2013 had enacted RTFCLARR Act, 2013 from 1st January 2014. It recognizes the following essential features:

- That Affected Households (DHs) not only lose their lands, other assets and livelihoods, they also experience adverse psychological social/cultural consequences.
- The need to minimize large-scale displacement and where displacement and where inevitable, resettlement and rehabilitation has to be handled with care. This is especially necessary for tribal, small and marginal farmers and women.
- That cash compensation alone is often inadequate to replace agricultural land, homesteads and other resources. Landless labor, forest dwellers, tenants, artisans are not eligible for cash compensation. The need to provide relief especially to the rural poor (with no assets) and marginal farmers, SCs/STs and women; the revised draft of NPRR include poor (BPL) and deprived groups, vulnerable, ex-gratia of Rs 20,000/- for linear acquisition, per family.
- The importance of dialogue between DFs and the administration; responsible for resettlement for smoother implementation of projects R&R.

Affected agricultural labourer who has been working for a period of minimum three years and who used to earn his livelihood by working on the land which is now under acquisition and who has become jobless because of the acquisition, shall be entitled for onetime payment of two hundred days wages as fixed by the govt. under minimum wages act and shall also be entitled for National/State level job card under National Rural Employment Guarantee Program.

The policy specifies that the entire cost for Resettlement and Rehabilitation, in addition to the cost of acquisition of land shall be borne by the respective requisitioning authorities. The Requisitioning Authority shall deposit an amount equivalent to 0.5 percent of the estimated cost of land under acquisition for the project to the Collector-cum- Administrator, Resettlement and Rehabilitation through a bank draft subject to maximum of Rs. 2 lacs (Two lacs) only. This amount shall be over and above the amount paid for establishment expenditure under LAA. This additional amount shall be paid for outsourcing the work of survey for Resettlement,

Monitoring, Stationeries, POL and other incidentals like vehicle, Computer, Computer Operator, Amins, Drafts man, Chainman etc.

9.7.4 MoRTH's Policy of Social Considerations

The MoRTH Guidelines for Confirmation of Environmental and Social Considerations refer not only to the natural environment, but also to social issues such as involuntary resettlement and respect for the human rights of indigenous peoples.

The objective of the Guidelines is to encourage project proponents seeking funding from MoRTH to implement appropriate environmental and social considerations in accordance with the Guidelines. In doing so, it endeavours to ensure transparency, predictability and accountability in its confirmation of environmental and social considerations.

One of the basic principles of Guidelines regarding confirmation of environmental and social considerations is that the responsibility for environmental and social considerations for the project shall be that of the project proponent. NHAI confirms environmental and social considerations by undertaking screening, environmental review, and monitoring and follow ups.

Environmental and social considerations required for funded projects cover underlying principles, examination of measures, scope of impact to be examined, compliance with laws, standards and plans, social acceptability and social impacts, involuntary resettlement, indigenous peoples and monitoring.

The following are summary of requirements under the Guidelines.

Social acceptability and social impacts projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality in which the project is planned. For projects with a potentially large environment impact, sufficient consultations with stakeholders, such as local residents, must be conducted via disclosure of information from an early stage where alternative proposals for the project plans may be examined. The outcome of such consultations must be incorporated into the contents of the project plan; and

Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, the poor and ethnic minorities who are susceptible to environmental and social impact and who may have little access to the decision-making process within society.

9.8 ENTITLEMENTS, ASSISTANCE AND BENEFITS

9.8.1 Definition of APs and Eligibility

The project will have three types of Affected persons i.e., (i) persons with formal legal rights to land lost in its entirety or in part; (ii) persons who lost the land they occupy in its entirety or in part who have no formal legal rights to such land, but who have claims to such lands that are recognized or recognizable under national laws; and (iii) persons who lost the land they occupy in its entirety or in part who have neither formal legal rights nor recognized or recognizable claims to such land. The involuntary resettlement requirements apply to all three types of

affected persons. APs entitled for compensation, assistance and rehabilitation provisions under the sub project are:

- ❖ All APs losing land either covered by formal legal title, recognizable title, or without legal status;
- ❖ Tenants and sharecroppers whether registered or not;
- ❖ Owners of buildings, crops, plants, or other objects attached to the land; and
- ❖ APs losing business, income, and salaries

Compensation eligibility is limited by a cut-off date as set for this project on the day of the beginning of the census survey or as decided by the EA. APs who settle in the affected areas after the cut-off date will not be eligible for compensation. They, however, will be given sufficient advance notice, requested to vacate premises and dismantle affected structures prior to project implementation. Their dismantled structures materials will not be confiscated and they will not pay any fine or suffer any sanction.

9.8.2 Entitlements

The entitlement provisions various categories of APs in terms loss of land house and income as per census survey are detailed below:

Agricultural land impacts will be compensated at replacement cost. Cash compensation at replacement cost will be determined according to the State Highways Act. If the residual plot(s) is (are) not viable, i.e., the DP becomes a marginal farmer, three options are to be given to the DP, subject to his acceptance which are (i) The DP remains on the plot, and the compensation and assistance paid to the tune of required amount of land to be acquired, (ii) Compensation and assistance are to be provided for the entire plot including residual part, if the owner of such land wishes that his residual plot should also be acquired by the EA, the EA will acquire the residual plot and pay the compensation for it and (iii) If the DP is from vulnerable group, compensation for the entire land by means of land for land will be provided if DP wishes so, provided that land of equal productive value is available. All fees, stamp duties, taxes and other charges, as applicable under the relevant laws, incurred in the relocation and rehabilitation process, are to be borne by the EA.

Loss of homestead /Commercial land will be compensated at replacement cost. Cash compensation at replacement cost will be determined according to the State Highways Act. All fees, stamp duties, taxes and other charges, as applicable under the relevant laws, incurred in the relocation and rehabilitation process, are to be borne by the EA.

Loss of Structures Residential/Commercial/Other will be compensated at replacement value with other assistance. The details on the determination of compensation will be as (i) Compensation of structure will be paid at the replacement cost to be calculated as per latest prevailing basic schedules of rates (BSR) without depreciation, (ii) Shifting assistance of Rs. 10,000/-, (iii) Right to salvage material from demolished structure and frontage etc, and (iv)

Rental assistance as per the prevalent rate in the form of grant to cover maximum three-month rentals.

Loss of rental accommodation by the tenants will be compensated as rental assistance and shifting assistance. The details assistance will be as per (i) Rental assistance for both residential & commercial tenants as per the prevalent rate in the form of grant to cover maximum three month rentals, (ii) Additional structures erected by tenants will also be compensated and deducted from owner's compensation amount, (iii) Shifting assistance based on type of house and household assets, (iv) Any advance deposited by the tenants will be refunded from owners total compensation package to the tenant on submission of documentary evidences and (v) Right to salvage material from demolished structure and frontage etc. erected by tenants

Loss of structure by non-title holder (This is beyond the scope of this project) will be also compensated as per applicable guidelines. The squatters will be compensated for structure and also get shifting assistance, whereas, the vulnerable encroachers only, who are having structure within the proposed ROW will get compensation for affected properties. The detail assistance will be as per (i) compensation for both residential & commercial squatter as per the prevalent rate in the form of grant to cover maximum three-month rentals, (ii) Shifting assistance will be Rs. 10,000/-, (iii) Right to salvage material from demolished structure and frontage etc. erected by squatters. This is not applicable for this project.

(Non-titleholders are not entitled for any assistance for compensation as per the State Highway Authority)

Loss of Trees will be compensated to Land holders, Share- croppers and Lease holders based on the market value to be computed with assistance of horticulture department. This can further be detailed in specific ways such as (i) Advance notice to APs to harvest fruits and remove trees, (ii) b) For fruit bearing trees compensation at average fruit production for next 15 years to be computed at current market value and (iii) For timber trees compensation at market cost based on kind of trees

Loss of Crops will be compensated to Land holders, Share- croppers and Lease holders based on the market value to be computed with assistance of agricultural department. The detailed compensation methods are (i) Advance notice to APs to harvest crops and (ii) In case of standing crops, cash compensation at current market cost to be calculated of mature crops based on average production.

Loss of Livelihood due to Loss of primary source of income will be compensated through rehabilitation assistances. There are various categories of entitled persons under this category which are (i) Titleholders losing income through business, (ii) Titleholders losing income through agriculture, (iii) Non-titleholders namely squatters and vulnerable encroachers losing primary source of income, (iv) Wage earning employees indirectly affected due to displacement of commercial structure, (Non-titleholders are not entitled for any assistance for compensation as per the State Highway Authority) (v) Agricultural labourer/share-cropper and (vi) Licensed mobile vendors and kiosk operators. Details of entitlements for the above categories are described below:

Title holders losing their business establishment due to displacement will be provided rehabilitation assistance through a lump sum Transportation allowance of Rs. 9,000/-

Titleholders losing income through agriculture will be provided with the rehabilitation assistance which are (i) Training Assistance will be provided for income generating vocational training and skill up gradation options as per APs choice at the rate of Rs. 5,000 per affected household to those households losing their primary source of income and (ii) Employment opportunity for APs in the road construction work, if available and if so desired by them. This is not applicable for this project.

Non-titleholders namely squatters and vulnerable encroachers losing primary source of income will be provided with rehabilitation assistances through (i) Training would be provided for up-gradation of skills @ Rs. 5,000/ - per family to the APs, (ii) Employment opportunity for APs in the road construction work, if available and/if so desired by them, Or (iii) National/State level job card under National Rural Employment Guarantee Program. **This is beyond the scope of this project.**

Wage earning employees indirectly affected due to displacement of commercial structure will be assisted through rehabilitation assistance which are; (i) persons indirectly affected due to the employer having being Affected, on case-by-case, based on local wage rates for three months, (ii) Employment opportunity for APs in the road construction work, if available and if so desired by them, Or (iii) National/State level job card under National Rural Employment Guarantee Program.

Rehabilitation assistance for Agricultural labourer/share-cropper will be paid as per the details such as (i) Assistance is to be paid as per the prevailing local wage rates for 100 days., (ii) b) Employment opportunity for APs in the road construction work, if available and if so desired by them, Or (iii) National/State level job card under National Rural Employment Guarantee Program.

Licensed mobile vendors and kiosk operators will be provided with the rehabilitation assistance which are (i) Mobile vendors are not eligible for compensation or assistance (ii) Those mobile vendors in possession of a permit from local authorities to operate in the affected area will be treated as kiosks operators, (iii) Kiosk operators and vendors licensed to operate from affected locations will be entitled to a one-time lump sum assistance of Rs. 5,000/-. This is not applicable for this project.

Loss of community infrastructure/common property resources will be compensated either by cash compensation at replacement cost or reconstruction of the community structure in consultation with the affected community.

Additional Assistance to vulnerable groups (Vulnerable households including BPL, SC, ST, WHH, disabled and elderly) will be paid with Special Assistance which will be one-time lump sum assistance of Rs. 20,000/ to vulnerable households. This will be paid above and over the other assistance(s) as per this entitlement matrix. This is not applicable for this project.

Other Unanticipated Impacts (Temporary impact during construction like disruption of normal traffic, damage to adjacent parcel of land / assets due to movement of heavy machinery and plant site) will be compensated to either individual or community in the form of (i) The contractor shall bear the cost of any impact on structure or land due to movement of machinery during construction or establishment of construction plant and (ii) All temporary use of lands outside proposed RoW to be through written approval of the landowner and contractor. Location of Construction camps shall be set up by contractors in consultation with NHIDCL

Any unanticipated impacts (if any) due to the project will be documented and mitigated based on the spirit of the principle agreed upon in this entitlement matrix.

9.8.3 Entitlement Matrix

Compensation for the lost assets to all affected persons will be paid on the basis of replacement cost. Resettlement assistance for lost income and livelihoods will be provided to title holders. Special resettlement and rehabilitation measures will be made available to the "Vulnerable Group" comprises of APs living below poverty line (BPL), SC, ST, women headed households, the elderly and the disabled. An Entitlement Matrix has been formulated, which recognizes and lists various types of losses resulting out of the project and specific compensation and resettlement packages.

Table 9.8.1: Entitlement Matrix

Sl.	Impact Category	Entitlements		Implementation Guidelines
PART I.TITLE HOLDERS-Compensation for Loss of Private Property				
1	Loss of Land (agricultural, homestead, commercial or otherwise)	1.1	Compensation for land at Replacement Cost or Land for land, where feasible	Land will be acquired by the competent authority in accordance with the provisions of RFCTLARR Act, 2013. Replacement cost for Land will be, higher of (i) market value as per Indian Stamp Act, 1899 for the registration of sale deed or agreements to sell, in the area where land is situated; or(ii)average sale price for similar type of land, situated in the nearest village or nearest vicinity area, ascertained from the highest 50% of sale deeds of the preceding 3years; or (iii) consented amount paid for PPPs or private companies. Plus 100%solatium and 12%interest from date of notification to award. The multiplier factor adopted by GoM for land in rural area, based on the distance from urban area to the affected area, will be applied. In case of severance of land, house, manufactory or other building, As per Section 94(1), the whole land and /or structure shall be acquired, if the owner so desires.
2	Loss of Structure (house, shop, building or immovable property or assets attached to the land)	2.1	Compensation at replacement cost	The market value of structures and other immovable properties will be determined by PWD on the basis of relevant PWD Schedule of rates (SR)M as on date without depreciation. Plus 100% solatium For partly affected structures, the DP will have the option of –claiming compensation for the entire structure, if the remaining portion is unviable.
PART II. REHABILITATION AND RESETTLEMENT- Both Land Owners and Families Whose Livelihood is Primarily Dependent on Land Acquired				

3	Loss of land	3.1	Employment to at least one member per affected family in the project or arrange for a job in such other project as may be required after providing suitable training and skill development in the required field and at a rate not lower than the minimum wages provided for in any other law for the time being in force. Or One-time payment of Rs.5,00,000/- for each affected household. Or Annuity policy that shall pay Rs, 2000/- per month for 20 years with appropriate indexation to CPIAL	
		3.2	Monthly subsistence allowance of Rs, 3000/-per month for a period of one year to affected households who require to relocate due to the project	
		3.3	Transportation assistance of Rs, 50,000/- for affected households who require to relocate due to the project	
		3.4	One-time assistance of Rs, 25,000/- to all those who loss a cattle shed	
		3.5	One-time Resettlement Allowance of Rs, 50,000/- for affected house \hold who have to relocate	
		3.6	Additional onetime assistance of Rs, 50,000/-to scheduled caste and scheduled tribe families who are displaced from scheduled areas and who require to relocate due to the project	

4	Loss of Residence	4.1	An alternative house for those who have to relocate, as per IAY specification in rural areas and constructed house/flat of minimum 50sq.m. in urban areas or cash in lieu of house if opted (the cash in lieu of house will be Rs, 70,000/-in the line with Gol IAY standards in rural areas and Rs, 1,50,000 in case of urban areas) , for those who do not have any homestead land and who have been residing in the affected areas continuously for a minimum period of 3years	Stamp Duty and registration charges will be borne by the project in case of new houses or sites.
		4.2	Employment to at least one number per affected family in the project or arrange for a job in such other project as may be required after providing suitable training and skill development in the required field and at a rate not lower than the minimum wages provided for any other law for the time being in force. Or One Time payment of Rs, 5,00,000/- for each affected household Or Annuity policy that shall pay Rs, 2000/- per month or 20 years with appropriate indexation to CPIAL	
		4.3	Monthly subsistence allowance of Rs, 3000/- per month for a period of one year to affected households who require to locate due to the project	
		4.4	Transportation assistance of Rs, 50,000/- for affected households who require to relocate due to the project	
		4.5	One-time assistance of Rs, 25,000/- to all those who lose a cattle shed	
		4.6	One-time assistance of Rs, 25,000/- for each affected family of an artisan or self-employed and who has to relocate	

		4.7	One-time Resettlement Allowance of Rs, 50,000/-for affected household who have to relocate	
		4.8	Additional onetime assistance of Rs, 50,000/-to scheduled caste and scheduled tribe families who are displaced from scheduled areas and who require to relocate due to the project	
		4.9	Right to salvage affected materials.	
5	Loss of shop /trade /commercial structure	5.1	Employment to at least one number per affected family in the project or arrange for a job in such other project as may be required after providing suitable training and skill development in the required field and at a rate not lower than the minimum wages provided for in any other law for the Or Onetime Payment of Rs,5,00,000/- for each affected household Or Annuity policy that shall pay Rs, 2000/-per month for 20 years with appropriate indexation to CPIAL	
		5.2	Monthly subsistence allowance of 3000/- per month for a period of one year to affected household who require to relocate due to the project	
		5.3	Transportation assistance of Rs, 50,000/-for affected household who require to relocate due to the project	
		5.4	One-time assistance of Rs, 25,000/- for each affected family of an artisan or self employed or small trader and who has to relocate	
		5.5	One-time Resettlement Allowance of Rs, 50,000/-for affected household who have to relocate	

		5.6	Additional onetime assistance of 50,000/-to scheduled caste and scheduled tribe families who are displaced from scheduled areas and who require to relocate due- to the project	
		5.7	Right to salvage affected materials	
PART III.IMPACT TO VULNERABLE HOUSEHOLD				
8	Vulnerable Household	8.1	Training for skill development. This assistance includes cost of training and financial assistance for travel/conveyance and food.	One adult member of the affected household, whose livelihood is affected, will be entitled for skill development. The PIU with support from the NGO will identify the number of eligible vulnerable displaced persons during joint verification and updating of the RP and will conduct training need assessment in consultations with the DPs so as to develop appropriate training programmes suitable to the DPs skill and the region. Suitable trainers or local resources will be identified by PMU and NGO in consultation with local training institutes.
		8.2	One-time assistance of Rs,25,000/- to DHs who have to relocate	
PART IV. IMPACT DURING CIVIL WORKS				
9	Impact to structure / assets/tree/crops	9.1	The contractor is liable to pay damages to assets/tree/crops in privet/public land, caused due to civil works	The PIU will ensure compliance
10	Use of private land	10.1	The contractor should obtain prior written consent from the landowner and pay mutually agreed rental for use of private land for storage of material or movement of vehicles and machinery or diversion of traffic during civil works	
PART V. COMMION PROPERTY RESOURCES				
11	impact to common property resources such as places of worship, community buildings, schools, etc	11.1	Relocation or restoration, if feasible, or cash compensation at replacement cost.	

12	Utilities such as water supply, electricity, tc	12.1	Will be relocated and services restored prior to commencement of civil works	The PIU will ensure that utilities are relocated prior to commencement of civil works in that stretch of the road corridor in accordance with the civil works schedule
PART VI. UNFORSEEN IMPACT				
Unforeseen Impacts encountered during implementation will be addressed in accordance with the principles of RFCTLARR2013/ Safeguard policy Guidelines of Multilateral Institutions				

9.9 INSTITUTIONS FOR PLANNING & IMPLEMENTATION OF RP

9.9.1 Introduction

Institutions for planning & implementation of RP vary substantially in terms of their respective roles & capacity. Timely establishment & involvement of appropriate R&R institutions would significantly facilitate achievement of objectives of the R&R program. The main R&R institution would include:

EA

PMU

Local Administration

Line departments

NGO

DLC/GRC

Training Institutions

M&E Agency

9.9.2 The Process

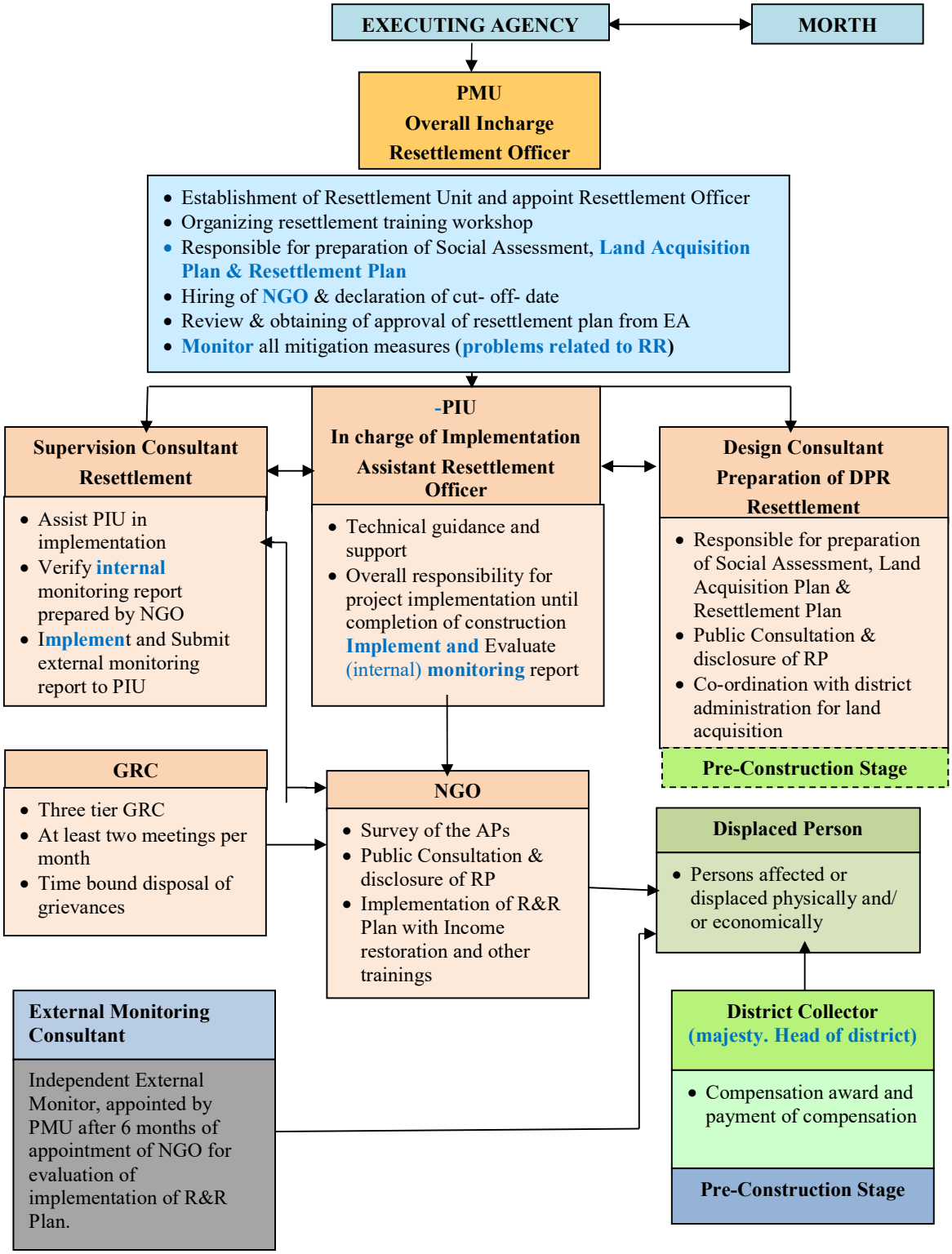
EA will initiate the following activities to commence and implement the RP:

- Establish PIU and field offices.
- Select NGO with proven track records for the smooth implementation of R&R activities as stated.
- Orientation and awareness seminars for Project Implementation Unit (PIU).
- Appointment of external monitoring and evaluation consultants.

Effective RP implementation will require institutional relationships & responsibilities, rapid organizational development & collaborative efforts by EA, State Govt. & partnering NGO. The ESDU will establish operational links within EA (for e.g. finance for release of money on approval of micro plan) & with other agencies of govt. involved in project induced settlement. It will provide means & mechanism for coordinating the delivery of the compensation & assistance entitled to those who will suffer loss. On behalf of EA, ESDU will assume the responsibility for representing the social impact & resettlement component of the project. The ESDU will also be responsible for disseminating the information to the public & providing additional opportunities for public comment.

The ESDU at the apex level will have overall responsibility for policy guidance, coordination, and contingency planning, monitoring and overall reporting during RP implementation.

Figure 9.9.1: Institutional arrangement for RAP



9.9.3 Roles and Responsibilities

The role and responsibilities of the various offices in R&R implementation are presented below:

9.9.4 At Corporate Level

The Project Director: -

- In-charge of overall project activities.
- Participate in the State Level Committees to facilitate land acquisition, pre-construction activities and implementation of R&R activities.

EA: -

- Co-ordinate the implementation of R&R activities with corporate and field staff.
- Appoint NGO for R&R implementation and M&E consultants for monitoring and evaluation.
- Plan and conduct training programs for staff capacity building as well as capacity of field level NGOs and partner agencies.
- Review the micro plans prepared by the NGO.
- Review monthly progress report.
- Monitor the progress on R&R and land acquisition.
- Advice PIU/NGO/M&E Agency on policy related issues during implementation.
- Ensure early release of money to PIUs for R&R activities.

9.9.5 Project Monitoring Unit (PMU)

This unit will coordinate the process for land acquisition. Relocation and rehabilitation, distribution of project provided assistance and APs access to government programs. NGO would be selected who would be working in close association with the Project Implementation Unit.

9.9.6 RP Implementation Field Offices and Tasks

The PD-PIU will be responsible to carry out the following tasks concerning resettlement of the project:

- Overall responsibility of Implementation of R&R activities of RP.
- Responsible for land acquisition and R&R activities in the field.
- Ensure availability of budget for R&R activities.
- Liaison with District Administration for support for land acquisition and implementation of R&R.
- Participate in the district level committees.

9.9.7 District Resettlement and Rehabilitation Officer (DRRO)

- ❖ Co-ordinate with District Administration and NGO for land acquisition and R&R.
- ❖ Translation of R&R policy in local language.
- ❖ Prepare pamphlets of the policy.
- ❖ Printing of the policy and identity cards for the APs.
- ❖ Ensure development of resettlement sites, wherever required.
- ❖ Participate in the allotment of residential, commercial and agricultural plots.
- ❖ Liaison with District Administration for dovetailing government's income generating and developmental programs for the APs.
- ❖ Ensure the inclusion of those APs who may have not been covered during the census survey; facilitate the opening of joint accounts in local banks to transfer assistance for R&R for APs and organize disbursement of cheques for assistance in the affected area in public.
- ❖ Monitor physical and financial progress on land acquisition and R&R activities.
- ❖ Participate in regular meetings.
- ❖ Organize Bi-monthly meetings with the NGO to review the progress on R&R.
- ❖ Review micro plan & monthly reports submitted by NGO.

9.9.8 NGO will be principally responsible for the day-to-day implementation work

- ❖ Survey and verification of the APs.
- ❖ Verification of land records followed by verification on the spot related to identified plots and owners.
- ❖ Develop rapport with the APs.
- ❖ Verify and Photograph of each DP for ID cards.
- ❖ Assist to issue identity cards to the APs.
- ❖ Co-ordinate with the DRO to implement R&R activities.
- ❖ Conduct market feasibility study.
- ❖ Valuation of properties/assets for finalization of replacement value.
- ❖ Participate with the DRO to undertake public information campaign at the commencement of the projects.
- ❖ Distribute the pamphlets of R&R policy to the APs.
- ❖ Assist the APs in receiving the compensation.

- Facilitate the process of arranging loans for APs.
- Facilitate the opening of joint accounts.
- Generate awareness about the alternate economic livelihood and enable the APs to make informed choice.
- Prepare micro-plans for R&R.
- Enable the APs to identify the alternate sites for agriculture, residential and commercial plots.
- Participate in the consultation on allotment of shops and residential plots.
- Ensure the APs have received their entitlements.
- Ensure the preparation of rehabilitation sites.
- Participate in the meetings organized by the PMU.
- Submit monthly progress reports.
- Identify training needs and institutions for the APs for income generating activities.
- Participate in the disbursement of cheques for the assistance at public places.
- Coordinate the training programs of the APs for income generating activities.
- Coordinate the meeting of District Level Committees.
- Accompany DP to GRC.
- Awareness campaigns for highway related diseases.
- Ensure the DP judiciously uses compensation and R&R assistance.

9.9.9 Coordination with Other Agencies and Organizations

R&R Cell will establish networking relationships with line departments and other Govt. & non-Govt. organizations. The Revenue Department has an influencing role in land acquisition proceedings, and initiation of resettlement process. Unless the compensation process is prompt and efficient, implementation process will get delayed. R&R Cell will coordinate with the Project Land Acquisition Officer to expedite the land acquisition process.

Income restoration will be sole responsibility of the Project Authority.

Restoration of community assets such as hand pumps, bore wells will require help from PHED. EA will extensively work on developing lateral linkages for mobilization of resources to benefit the APs and to achieve the desired results expected from implementation of RP.

The Revenue Department is responsible for providing land records, acquiring land and other properties and handing them over to the proper authorities. The District Rural Development Agency (DRDA) will extend the IRDP and other developmental schemes to include the APs. The representative of these departments/agencies will be in contact with the R&R Cell, which will facilitate the integration of the various agencies, involved in the R&R process.

9.9.10 NGO Participation

This will be required by the PIU, R&R Cell. A good rapport with the affected community will facilitate a satisfactory R&R of the DPs and minimize disturbance particularly physical and economic. To overcome this deficiency, experienced and well-qualified NGO in this field will be engaged to assist the EA in the implementation of the RP. NGO hired for RP implementation will also be responsible for HIV/AIDS, trafficking of women and children, child labour, etc. The NGO should have experience of addressing such social issues.

The NGO, in this sense, will have to ensure that due entitlements flow to the DPs in the most effective and transparent manner. The success of the NGO inputs will largely depend on their liaison with the DPs and other concerned government agencies. Other involved agencies are expected to collaborate with Project, based on instructions from the EA, in accordance with the policy framework and the RP. These arrangements have to be made during the first month of Project implementation in order to set up the various committees and implementation mechanisms required for the project.

9.9.11 Role of NGO

The role of NGO would be of a facilitator. The NGO will work as a link between the PIU - R&R Cell and the affected community. They will educate the DPs on the need to implement the Project, on aspects relating to LA and R&R measures and ensure proper utilization of various compensations extended to the DPs under the R&R entitlement package. After the approval of the micro plans, the NGO will issue identity cards to the entitled persons.

9.9.12 Selection of NGO

It is extremely important for the success of the RP to select NGO that are capable, genuine and committed to the tasks assigned. Key quality criteria include:

- ❖ Experience in direct implementation of programs in local, similar and/or neighbouring districts.
- ❖ Availability of trained staff capable of including DPs into their programs.
- ❖ Competence, transparency and accountability based on neutral evaluations, internal reports, and audited accounts.
- ❖ Integrity to represent vulnerable groups against abuses; experience in representing vulnerable groups, demonstrable mandate to represent local groups.

In addition to above, taking into consideration the risks of HIV/AIDS during the project period and road safety and anti trafficking issues, specialized NGOs will be invited to undertake activities related to their core competencies. The focus will be more on prevention as well as referral services on curative aspects. The major activities of such NGO will include awareness generation, information dissemination and mobilization of communities to act on the issues towards safer behaviour.

The NGO chosen will have to agree to the terms and conditions under the RP. Hence, the selection of a committed NGO is very crucial for implementation of the Project. The selection process and TORs will be reviewed by the ESDU.

The NGO will be involved through mutually agreed terms and conditions with specific responsibilities and in-built accountability. A contract will be signed with the NGO indicating the tasks to be performed and the amount to be paid for their services. The payment to the NGO will be linked to performance of the tasks assigned and the time period. Their payment will be arranged as per contract agreement. The NGO will submit a monthly progress report to the project level PIU-R&R Cell, which in turn will send the summarized version of their reports with comments to the EA HQ. The monitoring and evaluation component of the RRP will include the performance of the contracted NGO. The NGO services will be required for 36 months for which provision has been made in the budget.

9.9.13 NGO Staffing and Personnel

The NGO shall have offices at one district for implementation for duration of 36 months. The NGO, therefore, shall have adequate support staff for carrying out the R&R activities. One Key Professional (Social) for the district and also one Key Professional (Technical) for the district will be required. Overall supervision will be under a Team Leader assigned specifically for this project.

❖ **Team Leader**

The Team Leader should be post-graduate, preferably in social sciences, and should have experience of implementing R&R activities for linear projects. She/he should have at least 5 years experience in implementation of R&R and rural development works. She/he should have held responsible position in the previous assignments should possess participatory management skills and should have good knowledge of the region and the local language.

❖ **Key Professionals (Technical – Authorised Valuer)**

Should be at least a Degree holder in civil engineering. She/he should have at least 10 years experience in fieldwork. She/he should have participated in at least one project involving R&R activities, should have participatory knowledge of land measurement, and should be conversant with land/structure valuation methods. Knowledge of local language is a necessary qualification.

❖ **Key Professional (Social)**

Should be at least a graduate in social sciences. She/he should have at least 5 years of working experience of which at least 2 years in R&R or rural development projects. Should have sound understanding of the land acquisition process, experience in developing, implementing vocational training and participatory management. Knowledge of local language is a necessary qualification.

❖ **Key Professional (HIV/AIDS)**

Since HIV/AIDS will be one of the major implementation concerns, the team will have professional with expertise to work on issues of HIV/AIDS with an objective to generate awareness on the issue and work towards its prevention. Professional with at least 3-5 years of experience on HIV/AIDS awareness and communication techniques will be qualified to fill up the position.

❖ **Technical Support Professionals**

Should be graduate or equivalent in social sciences. Knowledge of local language and experience of working in the region is desired.
Additionally, the following conditions shall apply to the team proposed by the NGO:

- That the proposal should accompany a personnel deployment schedule, clearly indicating whether the deployment is home-office based or in the field.
- That the NGO must propose at least one woman as part of the key personnel. The person-month deployment of the woman key personnel shall constitute at least 33% of the assignment.
- That the women key persons, if selected for the contract, may be replaced during the period of contract, only with women key persons of equivalent qualifications and experience.

That the NGO will depute a 'technical support' team to work at the site, which will consist of women members. Junior support personnel and / or administrative staff will not be considered as 'technical support' professionals, as far as this condition is concerned.

9.10 CONCLUSION

NHIDCL has decided to take up the Development of the road Ukhrul-Toloi-Tadubi Road Pkg-1 (Ukhrul Bypass) with two lane hard shoulder configuration in the state of Manipur

The project road lies in Ukhrul district of Manipur State. The project road is located in mountainous Terrain. The entire road passes through major village / localities namely Hundung & Hunphun on NH-102A in the State of Manipur. As per road inventory the total length of the project road comes out as 6.571 km.

The public consultation on the focus groups and the stakeholders give the opportunity to address issues, which were already resolved after making appropriate changes in design and alternative finalisation. The stakeholders become aware of the development schemes and at the same time influence and share to control over these initiatives, decisions and resources. Community consultations also help to avoid opposition to the project, which is otherwise likely to occur.

Decisions regarding providence of the resettlement and rehabilitation entitlement would be done as per the guidelines of Manipur State Act and Rules and RFCTLARR Rules, 2014 as amended in accordance with the policy of MoRTH. The APs may go to the Grievance Redressed Cell and to the Arbitrator as per the provision laid in the Guidelines. It may be noted that the redress to the grievances of the APs may be done with consideration.

The PIU should look into the income restoration of the Affected Families with the objective that the families are '**as well off as before'.**

Proposed section of Ukhrul-Toloi-Tadubi Road Pkg-1 (Ukhrul Bypass) gives an immense scope of development of the region in regards of easy accessibility in the state of Manipur and as well as in the neighbour state also. Other than the development of the industrial sector there would be easy accessibility of the agricultural surplus of the region and the finished industrial products from the rest the country as well as for International Trade. The socio-economic status of the region is been changing drastically with inflow venture and human capital. The changing climate of the socio – economic and political scenario of the state of Manipur with the working culture of the people with a huge supply of local skilled labour and unskilled labours would increase the scope of developments by manifolds. Infrastructural investment such as the Highway would remove the bottle neckness of development and help in taking a huge positive leap of sustainable socio- economic growth of the region.

CHAPTER – 10
COST ESTIMATES

10.1 General

Cost estimates is an important component of the study as it provides vital input to economic & financial evaluation and insights for proper planning of project execution. Over and above construction costs, provision has been made for social and environmental mitigation measures. Cost estimates are based on the detailed engineering designs and detailed drawings presented in drawing volume.

10.2 Quantification

The construction items covered in cost estimates includes twelve different heads as:

- ✓ Site Clearance and Dismantling
- ✓ Earth work, Sub grade & Erosion Control
- ✓ Sub-Base & Base Courses
- ✓ Bituminous Courses
- ✓ Traffic signs, Road marking & other road appurtenances
- ✓ Junction Improvements (Major & Minor)
- ✓ Bus bay & Passenger Shelter
- ✓ Drainage and Protective Works
- ✓ Bridges & Culverts

10.3 Unit Rates

Rate Analysis of each item of work has been carried out as per Manipur Schedule of Rates, 2022 for National Highways works published by Public Works Department, Govt. of Manipur. The standard Data Book for Analysis of Rates revised in 2019 by MoRTH has essentially been taken as the basis for the publication for this schedule. The rates for materials and labour have been collected from the market and the other sources and rationalized for the entire state.

Leads for major construction materials, considered for the rate analysis, are given in Table 10.1 below:

Table 10.1: Leads for Various Materials

Sl. No.	Name of Material	Name of Source	Distance from Source to Start/ End Point of Project Road (Km)	Distance on Project Road (Km) (Half of Project Road)	Total Lead (Km)
1	Sand (Fine)	Local	15	3.4	18.4
2	Filling Material	On Site	-	-	-
3	Stone Metal	On Site	-	-	-
4	Stone Boulder	On Site	-	-	-
5	Stone Chips, Aggregate	On Site	-	-	-
6	Coarse Sand	Local	15	3.4	18.4
7	Cement	On Site	-	-	-
8	Steel	On Site	-	-	-
9	Bitumen	On Site	-	-	-
10	Bitumen Emulsion	On Site	-	-	-
11	Structural Steel	On Site	-	-	-
12	RCC Pipe	On Site	-	-	-

10.4 Project Costing

The cost of the road portion has been worked out based on the cross-sections, plan and profile and other drawings for widening and strengthening of the project road.

It is proposed that the excavated earth available from the cutting and reconstructed road sections would be used for the embankment construction and median/island filling. Adjustments have accordingly been made in the quantification of fill materials.

Locations of pavement reconstruction as identified in the pavement design and suitably quantified for dismantling and new crust composition. Extent of improvements to the cross roads at junctions has been considered up to the limits of proposed right of way. Quantification for road drainage has been in accordance with the recommendations of designs and drawings.

10.5 Bridges & Culverts

The quantification of various items of work has been detailed out from the drawings.

10.6 Road Intersections

Quantification for major intersections along the corridor has been done for each intersection based on the preliminary designs and drawings. Quantification for minor intersections and different kind of improvement option considered for each intersection has been worked out on the typical designs and drawings.

10.7 Bus Bays & Bus Shelters

4 nos. of Bus Bays at 2 locations are provided at the project road. Quantification for construction of pavement at these locations has been done along with road construction and quantification for providing shelters, footpaths, markings etc. have been separately made.

10.8 Truck Lay Bye

No Truck Lay bye is proposed on the project road.

10.9 Safety Barriers

W Metal Beam Crash Barriers have been provided on bridge approaches.

10.10 Traffic Signs, Markings & Other Appurtenances

Road Signs: Traffic signs are important features of traffic control devices and transmit visually vital information to drivers and ensure increased safety and efficiency in free flow of traffic. All these signs shall be of informatory nature. All signs shall be retro-refectories type. Quantification for road signs have been done based on the locations of intersections and other features along the corridor.

Road Markings would be done with thermoplastic paints with reflective bands. It will consist of lane line and edge line. The details of Lane markings are shown Drawings volume.

The other items covered under this sub-head are road furniture like km stones, 5th km stones, Hectometer stones, delineators, and boundary stones. They are to be laid as per IRC specifications over the entire length of the road

Delineators have been proposed depending upon the proposed radii of the horizontal alignment and height of embankment or valley site. The delineator posts have been proposed near all curves of radii less than 1000m, with spacing given as per IRC. The delineators, guard posts/pillars will be painted with alternate black and white paint bands and reflectors will be provided in each post.

10.11 Total Project Cost

Abstract of Cost

Ukhrul-Toloi-Tadubi Road (Pkg-I) 'Ukhrul Bypass' in the State of Manipur by NHIDCL on EPC Mode.

PACKAGE-I (0+000 KM TO 6+799 KM)

GENERAL ABSTRACT OF COST

Length of Road:							**6.571 Km**
DESCRIPTION OF WORKS		**Conventional Method (Flexible Pavement)**		**Non-Conventional Method (WMM and CT Sub Base Pavement)**		**Rigid Pavement**	
		TOTAL COST (IN CR.)	**COST PER KM. LENGTH (IN CR.)**	**TOTAL COST (IN CR.)**	**COST PER KM. LENGTH (IN CR.)**	**TOTAL COST (IN CR.)**	**COST PER KM. LENGTH (IN CR.)**
A.	**ROAD WORKS**						
1	Site Clearance and Dismantling	0.29	0.04	0.29	0.04	0.29	0.04
2	Earth work, Subgrade and Erosion control	32.85	5.00	32.81	4.99	32.53	4.95
3	Sub-Base & Base	6.61	1.01	4.88	0.74	1.22	0.19
4	Bituminous Courses	5.99	0.91	4.43	0.67	12.71	1.93
5	Junction Improvement (Major & Minor)	0.50	0.08	0.50	0.08	0.50	0.08
6	Traffic signs, Road marking & other road appurtenances	3.39	0.52	3.39	0.52	3.39	0.52
7	Bus bay & Passenger Shelter	0.26	0.04	0.26	0.04	0.26	0.04
8	**Drainage and Protective Works**						
a.	Longitudinal Drains (V Drain)	1.58	0.24	1.58	0.24	1.58	0.24
b.	Retaining wall (RR)	2.15	0.33	2.15	0.33	2.15	0.33
c.	Breast wall	4.47	0.68	4.47	0.68	4.47	0.68
b.	Gabion Structure	14.09	2.14	14.09	2.14	14.09	2.14
c.	Soil Stabilization with Coir Mat	0.98	0.15	0.98	0.15	0.98	0.15
d.	Soil Stabilization with Bamboo Plantation	1.52	0.23	1.52	0.23	1.52	0.23
B.	**BRIDGES & CULVERTS**						
9	Culverts	8.31	1.26	8.31	1.26	8.31	1.26
10	Minor Bridges	13.60	2.07	13.60	2.07	13.60	2.07
11	Major Bridges	13.80	2.10	13.80	2.10	13.80	2.10
C.	**COST OF CIVIL WORKS IN LAKHS (AS PER SOR 2022)**	**110.39**	**16.80**	**107.07**	**16.29**	**111.41**	**16.96**
	GST @ 18% of 'C'	19.87		19.27		20.05	
D.	**Construction cost + GST**	**130.27**	**19.82**	**126.34**	**19.23**	**131.47**	**20.01**

GENERAL ABSTRACT OF COST

Length of Road:							**6.571 Km**
DESCRIPTION OF WORKS		**Conventional Method (Flexible Pavement)**		**Non-Conventional Method (WMM and CT Sub Base Pavement)**		**Rigid Pavement**	
		TOTAL COST (IN CR.)	**COST PER KM. LENGTH (IN CR.)**	**TOTAL COST (IN CR.)**	**COST PER KM. LENGTH (IN CR.)**	**TOTAL COST (IN CR.)**	**COST PER KM. LENGTH (IN CR.)**
	Contingencies @ 1.0% On of 'C'	1.10		1.07		1.11	
	Agency Charges 3% on of 'C'	3.31		3.21		3.34	
	Supervision Charges 3% on of 'C'	3.31		3.21		3.34	
	Price Escalation@ 2.50% (for 24 months) on of 'C' for one year	5.52		5.35		5.57	
	Maintenance @ 2.5% on ''C'	2.76		2.68		2.79	
E.	**Total Provision for Contingencies and Centages**	**16.01**	**2.44**	**15.53**	**2.36**	**16.15**	**2.46**
(i)	LA and Standing Properties Cost	51.73		51.73		51.73	
(ii)	Forest, Environmental & Wildlife Clearance Budget	7.92		7.92		7.92	
(iii)	Electric Utility Shifting	0.07		0.07		0.07	
(iv)	PHED Utility Shifting	0.20		0.20		0.20	
F.	**Total Preconstruction Cost**	**59.92**	**9.12**	**59.92**	**9.12**	**59.92**	**9.12**
G.	**Total Project Cost**	**206.19**	**31.38**	**201.79**	**30.71**	**207.54**	**31.58**

CHAPTER-11
ROAD SAFETY AUDIT

11.1 Introduction

Road Safety Audit (RSA) is a formal procedure for assessing accident potential and safety performance in the provision of new road schemes and schemes for the improvement and maintenance of existing roads.

However, its systematic application can also ensure that a growing awareness about good road safety principles is achieved throughout in highway planning, design, construction and maintenance organization. The essential elements of the definition are that it is:

a) A formal process and not an informal check,
b) Carried out by persons who are independent of the design and construction, IRC: SP: 88-2010
c) Carried out by persons with appropriate expertise, experience and training, and
d) Restricted to road safety issues.

Road, engineers will apply quality assurance techniques by established procedures and regularly check the details of their own work. This regular checking includes checking safety aspects. This type of assessment, however, is not 'road safety auditing' because it is not done with a 'fresh pair of eyes' and it probably is not applying road safety engineering skills and experience required for the task. Road safety audit, on the other hand, is a 'step-by-step' process, performed at all stages. An independent road safety audit of the design is sought, to permit independent road safety engineering advice to be input, for the benefit of the future road users. Presently, it has become practice of involving safety engineers during the life of project, liaising informally with professionals of all disciplines at all stages, from feasibility/concept stage to completion. In turn, quality assurance can be applied to the providers of road safety audit services.

Road safety is now recognized as a major socio-economic concern in India. Increasing traffic volumes, the rapid growth in two and three wheeled traffic, higher speeds due to construction improvement / rehabilitation of roads has increased safety problem. A Road Safety Audit (RSA) is the safety performance examination of a road section through experienced road safety expert. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. The road safety audit investigates general safety conditions, focuses on specific concerns or users. This also includes pedestrian safety as well as safety of transport use.

11.2 Road Safety Audit & Quality Assurance

Road safety audit is an important aspect of Quality Assurance (QA), applied to the implementation of a road project. It is a management process in which the provider of goods or services assures the customer or client of the quality of those goods or services, without the customer or client having to check each time.

Quality assurance is done by the implementation, in the organization, of a set of procedures designed to ensure that agreed standards are met. Quality assurance procedures for the design and implementation of new road or traffic projects are to input road safety engineering expertise into

the design. Often the client and the customer are the same person or organization. In case of roads, the client for whom the road is designed and built is usually the highway authority, whereas the customer is the road user. A road safety audit is undertaken for the highway authority to ensure that the customer is afforded a level of protection from unsafe design and construction.

'Getting it right the first time' is the underlying theme of quality assurance. Road safety audits seek to ensure the road operates 'right the first time' once it opens and that the road users make fewer mistakes. Quality assurance is a continuous process. So far as the safe design of roads is concerned, quality assurance starts with a safety culture in an organization. While designing a road, engineers will apply quality assurance techniques by established procedures and regularly check the details of their own work. This regular checking includes checking safety aspects. This type of assessment, however, is not 'road safety auditing' because it is not done with a 'fresh pair of eyes' and it probably is not applying road safety engineering skills and experience required for the task. Road safety audit, on the other hand, is a 'step-by-step' process, performed at all stages. An independent road safety audit of the design is sought, to permit independent road safety engineering advice to be input, for the benefit of the future road users. Presently, it has become practice of involving safety engineers during the life of project, liaising informally with professionals of all disciplines at all stages, from feasibility/concept stage to completion. In turn, quality assurance can be applied to the providers of road safety audit services.

11.3 Objective of Road Safety Audit

Road safety audit must assess projects on the basis of road user knowledge, attributes and skills, day/night and wet and dry road conditions. Safety audit is only a study of safety aspects and an auditor may indicate road safety problems inherent in designs that conform to our road standards. This is due to the fact that our road standards are an expression of a socio-economic balance between road safety, accessibility, environment and economy.

The goal of road safety audit is to ensure that all new road projects – and major operating and maintenance activities on existing roads-are assessed from the standpoint of road safety, so that any parameters of the project that are unsuitable from the standpoint of road safety are Corrected in time. The benefits of conducting road safety audit are that:

- The likelihood of accidents on the road network can be reduced,
- The severity of accidents can be reduced,
- Road safety is given greater prominence in the minds of road designers and traffic engineers,
- The need for costly remedial work is reduced, and
- The total cost of a project to the community, including accidents, disruption and trauma, is minimized.

The cost of road safety audit and the consequent cost of changing a design are significantly less than the cost of remedial treatments after works are constructed. It is easier to change the lines/alignment or so on a plan than to move concrete structures. With less remedial work included in a highway authority's work program, budgets can be kept down or the same money can be utilized more effectively.

11.4 Road Safety Audit: What Is Done & Not Done

Road Safety Audit Is:

a) Minimizing the likelihood of crashes occurring through safety-conscious planning and design;
b) Ensuring that, if a crash occurs, then the likelihood of the injury is minimized (such as provision of anti-skid surfacing and crash barriers);
c) Ensuring that safety related design criteria (e.g. critical sight distances) have been met;
d) Managing risks, such that the risk of major safety problems occurring is less than the risk of minor problems occurring;
e) Reducing the whole-life cycle costs of a design (unsatisfactory designs are expensive to correct after they are built);
f) Minimizing the risk of crashes on the adjacent road network (particularly at intersections) as well as on the new road scheme;
g) Enhancing the importance and relevance of road safety engineering in highway design work and to enhance consideration for the safety of all categories of road users in all new and existing schemes.

Road Safety Audit Is Not:

a) A way of assessing or rating a project as good or poor;
b) A means of ranking or justifying one project against others in a works program;
c) A way of rating one option against another;
d) An accident investigation;
e) A redesign of a project;
f) Something to be applied only to high cost projects or only to projects involving safety problems;
g) The Name you use to describe informal checks, inspections or consultations;
h) An opportunity to raise subjective concerns.

11.5 Safety Auditors

To be effective, the safety audit needs to be carried out by specialists, who are independent of the design process. In this way auditors will be taking a fresh look at the project without the distraction of having been involved in their design. Road safety audit involves one set of professionals checking the work of other professionals. Crucial factor is that auditors should be independent and impartial. Road safety auditor must not question the justification for a project but must bring to light its consequences on road safety and endeavor to ensure that the project as presented in the brief is as safe as possible. Auditors need to be objective in their assessments, yet sensitive to the fact that no one likes criticism. Designers and clients need to consider audit recommendations objectively as brought out from the audit outcome.

Expertise and experience in road safety engineering are the essential ingredients in any road safety audit team. This should be linked to an understanding of:

- Traffic engineering and traffic management, and
- Road design and road construction techniques

A person who understands road user behavior and human perception is also likely to be able to develop road safety audit skills. This understanding is in fact a desirable skill because of the

interactive nature of road user behavior with the road environment. An audit team leader must not only have knowledge and skills in road safety engineering, but also should have received training and participated in a number of audits. It is expected that the safety auditors will apply due diligence in identifying the deficiencies and evolving audit recommendations which should be supported with reasons.

The Authority, which engage safety auditors should ensure that the team leader has:

• Adequate road safety engineering experience for the stage of the audit,

• Successfully completed a recognized audit training course,

• At least five years' experience in a relevant road design, road construction or traffic engineering field, and

• Undertaken at least three road safety audits including design stage, etc.

It is not practical or necessary to have a multi-member team conducting an audit. An audit of a low budget project, a road safety audit by more than two persons may not be justified. For large projects, three persons are needed whereas for small projects two persons will be required.

11.6 Organizations Involved in Road Safety Audit

Road Safety Audit Road Safety Audit is based on the principle of an independent review. Road safety audit process reveals that three parties will be involved in this process-Client, Designer and Auditor. For the Public Private Partnership projects (PPP) the client would be both the Govt, and the Concessionaire with their respective obligations as provided in the Concession Agreement. One fundamental idea is that disagreements between the designer and the auditor are resolved not by the designer but by the client. So, it is an interaction between different parties, whose roles are predefined at specific stages. In India, for large and small projects client may be National Highways Authority of India (NHAI)/Ministry of Road Transport and Highways(MoRTH)/NHIDCL/concerned Public Works Departments (PWD). Designer may be one consultant and Auditor may be another consultant/Govt. institution approved by the Authority. Main functions of the key players in road safety audit are shown in Table 11.1.

11.6.1 Role of Designer

Designer is responsible for planning/designing the project. Designer bears the responsibility for ensuring that a road safety audit is conducted and that the necessary measures are agreed on the basis of the auditor's recommendations and/or the client's decisions. The designer is also responsible for ensuring that the audit input information is unambiguously defined and that all circumstances are described in an easily understandable manner. For existing roads, it is the responsibility of operating organization of the relevant highway authority which requests the auditor to prepare accident analysis of the project and which arranges for the road operator to be notified about the results of the audit. The project manager, or design engineer should be responsible for initiating the safety audit process for each scheme and for responding to the audit. The role of the designer is thus to:

- Attend commencement and completion meetings.
- Bring out the action proposed in response to the audit report and its recommendations and to document these proposed actions.

- Implement the decisions given by the client on the proposed action by amending the original design
- Feed the experience back into the designer's organization and to avoid similar design problems recurring.

Table 11.1 Main Functions of the Key Players in Road Safety Audit

Key Player	Main Functions
Project Owner (Govt. and/or Concessionaire)	• Expresses a commitment to road safety • Provides funding and resources • Considers safety audits and reviews as an essential quality control requirement • Commissions audits and reviews at appropriate times • Selects road safety audit team • Facilitates the response to the recommendations of audits and reviews and arranges implementation of recommendations that are accepted • Attends commencement and completion meetings
Design Team	• Attends commencement and completion meetings • Provides relevant information to safety team • Acts upon and documents response to recommendations of audit
Safety Audit Team	• Identifies safety issues in the proposed design • Makes constructive recommendations to enhance safety • Documents safety issues and recommendations • Holds commencement and completion meetings with the client and design team

11.6.2 Role of Client

Client is one who allots the project to the designer and owns the project. As the party responsible for the basic conditions of the project, it is the task of the client to decide in cases where the designer and auditor disagree. Disagreements are presented to the client who conveys its decision to the designer and the auditor. Road operator assumes this responsibility in case of existing roads. The client should be responsible for ensuring that clear terms of reference are laid down to cover the whole range and scope of audit and for commissioning audits at appropriate stages. The role of the client is thus to:

- Select an appropriate auditor,
- Provide all the relevant and necessary documents, and
- Hold a commencement meeting with the auditor and the client.

11.6.3 Role of Auditor

Auditor's responsibility is to carefully review the presented project material in its entirety, in the light of best road safety expertise and from the viewpoints of all relevant road users. Auditor also indicates all circumstances that cause misgivings concerning road safety. Persons designated as Road Safety Auditors work with, and have experience of, road accident analyses and road accident

reduction. Auditors must be familiar with road planning, design and construction work and must undertake to keep their expertise up-to-date.

Auditors should comply with the terms of reference. They should comment only on the safety implications of schemes and provide constructive recommendations as to how any potential difficulties can be resolved. The role of the auditor is thus to:

- Review all the documents and audit the drawings and designs,
- Inspect the site (including during night time),
- Repeat these two steps,
- Prepare a report,
- Hold a completion meeting with the designer or client or both,
- Participate in the meeting organized by the client sequel to designers' reactions in the Auditor's Report.

11.7 Ways of Organizing a Road Safety Audit

There are many ways of organizing a road safety audit. However, the two essential attributes of road safety auditor are that the person should be skilled and independent. Practically, two options are there for conducting a road safety audit:

- Audit by specialist auditors,
- Audit by those within the original design team or by other road designers.

In case of audit by specialist auditors, team needs to be a separate entity from the normal road design functions of an organization and team members should not, except for the purpose of an audit, be involved with the design of the project. There needs to be a clear understanding, prior to commencement of an audit, about how the audit findings and recommendations will be dealt with. Someone has to consider the safety recommendations and resolve the inevitable trade-offs i.e., project cost, road capacity, likelihood of severity of accidents, etc. In every case where an audit recommendation is rejected, the reasons must be stated and documented. Other ways of dealing with audit recommendations can include:

- A requirement that each recommendation must be formally considered by the client with a view to its acceptance in a normal course and the work cannot proceed to the next stage until formal written approval has been issued by the client based on the recommendations of the audit team.
- The audit recommendations are considered by the designers, or by the project manager. This has the risk that the safety concerns may be rationalized away, in the atmosphere of keeping the project moving with minimal changes.

Instead of using specialist auditors, another designer or design team could undertake the audit. This approach may be applicable in organizations, which have sufficient road design work to have two or more separate design teams. This separation provides a level of independence. But this arrangement does not provide for the one essential ingredient in any road safety audit experience in road safety engineering. Using auditors from within the same organization also has its limitations. It may be considered that the original designer can audit his or her own designs, on the basis that this is better than nothing. However, this option does not meet requirement of independence. Experience shows that no matter how concerned a designer or design team is about road safety, it is almost inevitable that they will be too close to the issues in the design to apply the

'fresh pair of eyes' needed to inquire into design policies, approaches or details. A more effective way to organize a road safety audit is to engage specialist auditor(s) who is(are) independent and possess requisite road safety engineering skills and experience. The independence of the RSA Team is vital to ensure that the design team does not influence the recommendations of the Safety Audit and, therefore, compromise safety at the expense of other issues. This, however, does not mean that there should not be any interaction between the Design Team and the Safety Auditors. A meeting between Safety Auditors at the start and at the end of the audit process would be useful and Safety Auditors could be asked to provide advice on safety issues during the design. However, the independence of the Audit Team is critical and should not be compromised.

11.8 Stages of Road Safety Audit (RSA)

As per the scope of works RSA needs to be performed in the following stages:

- During Feasibility Study Stage (planning stage)
- On completion of Preliminary Design Stage
- On completion of Detailed Design Stage

This report is related to safety audit report at feasibility study stage (planning stage). The audit team reviewed proposed design from road safety perspective and checked the following aspects. RSA related to construction stage and monitoring existing road stage is not discussed here.

11.9 Aspects to be Checked

Broadly following items have been checked or reviewed during the feasibility study stage based on site data, existing road and proposed designs.

- 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.
- Width options considered for various sections.
- Departures from standards, if any and accordingly actions taken.
- Provisions of pedestrians, cyclists and intermediate transport.
- Safety implications of the schemes beyond its physical limits, i.e., how the scheme fits into its environs and road hierarchy

Road Safety Audit is a formal procedure that uses extensive safety engineering knowledge to identify safety deficiencies in road sections. A broad experience in road, traffic and safety engineering needs to be acquired to ensure that a Road Safety Auditor has the knowledge and ability to refer back to the basic principles in road safety, and propose appropriate mitigation measures. Following points are generally adequately clarified during a road safety audit.

- Confusion or ambiguity due to design layout for road users that could lead to potential road traffic accidents.
- Insufficient information for road users.
- Improper visibility or an obstruction to road view s of road users.
- Hazards in layout create or obstacles to road users that could contribute to an increased risk of injuries.

In the above cases safety of the scheme may be compromised and remedial measures may be required to remove this potential or actual deficiency. Road users need to perceive and process vast amounts of sensory and visual information to negotiate a road layout. On the other hand, role of designer is to provide a safe road environment that should:

- provide adequate information for road users of the layout and conditions ahead;
- provide adequate warning of hazards or unusual layouts ahead;
- provide positive control of road users passage through conflict points or unusual sections;
- provide a road performance that can nullify road user's errors or inappropriate behavior;
- provides clear, concise and phased release of road user information;
- provides a consistent standard of road design and traffic control;
- Provides adequate warning of hazards.

Desirable minimum Design Standards should be used wherever possible and advance information and warning should be used to inform road users of the layout ahead. However, driver overload must be avoided as it may cause road users to focus too much on the unimportant data and shed vital information. Conflicting information, an overabundance of road signs or a lack of delineation can cause overload. Therefore a "safer" road environment can be defined as a layout that:

It is important that a road improvement caters for all road users. Often the needs of the motorist are incorporated within a scheme whilst the needs of the vulnerable user are ignored. The vulnerable road users that need to be considered are: pedestrians – the old, young and those with mobility or sight impairment; cyclists – children, commuters and leisure users; and motorcyclists.

Each vulnerable road user has different needs from the road network. In the habitation environment the pedestrian is likely to be the principal user and designs must incorporate safe crossing locations, adequate visibility to and from the crossings and appropriate lighting. In addition to the needs of vulnerable road users, particular attention should be paid to the needs of trucks, buses or other specialist vehicles.

Safe road design varies from the urban to the rural road network; and a number of external factors can create a situation in which a safe road in one location becomes unsafe due to external factors. These factors can include traffic volumes, population density, noise, or road user familiarity. The function of a road should be clear to all road users, and a well-planned and defined road hierarchy can assist in providing a safe road network. The design speed can also be an important factor in influencing the safety of a road and should be appropriate to the location, local road users and level of private access control.

One important aspect to the safety of junctions is that layout as well as control method need to be simple and clear, with defined priorities for all road users. The assumption that 'straight on' traffic has priority is widely accepted and it needs to be remembered that alterations to this, despite reinforcement with signs and lines can still be confusing if visual clues such as fences, kerbing or lighting remain unchanged. It is important to attempt to make any minor approach perpendicular to the main road. Y-junctions with acute angles should be avoided. These angled junctions pose problem for road users, including restriction of forward and side visibility. Similarly, it is advisable to avoid intersections on the inside of bends as foliage often encroaches into sight lines after several years. Roundabouts used as a form of junction control have their own rules and design requirements. One of the primary requirements in good roundabout design is that the radius is tighter on the entry than the exit. This ensures a slow entry and lower circulating speed. Visibility is

a key requirement for all junction types, all road users need to see and be seen by others. Care should be taken with fixing street furniture and vegetation within visibility splays. Vulnerable road users often experience difficulties during crossing at junctions. It is important that their needs are provided for and that safe crossing places are implemented where required.

The relationship between cross-sectional elements (carriageway, shoulders, etc.) and safety is affected by the type and volume of traffic, and also by the surrounding environment. Lane widths can be critical in affecting safety, where they are too narrow vehicles may collide on horizontal curves, and there may also be inadequate space for two wheeled vehicles. Where lane widths are too wide the alignment may encourage excess speed. On high speed links there is a safety benefit to be gained by the provision of a Hard shoulder and central reserve gaps should be of adequate width, depending on the size of vehicles turning. Vehicles parked on the carriageway affect the road environment, layout and consequently safety. Safety problems experienced with parked vehicles are:

- Parked vehicles causing physical obstructions which are sideswiped or run into
- Parked vehicles causing sudden braking or nose-to-tail shunts
- Parked vehicles which deflect oncoming vehicles into adjacent vehicle paths
- Parked vehicles blocking visibility for any road user
- Parked vehicles between which pedestrians emerge

To reduce the risk of parked vehicles contributing to an accident it is important that designs should minimize parking in main traffic lanes. Trees and foliage can greatly enhance the environmental impact of the street scene. However, left un-maintained, they can also restrict visibility considerably. In addition to this, saplings grow into large trees, which can provide an unforgiving road hazard in the event of a road traffic accident.

With the above discussions and study / analysis of the project road sections safety issues that have been conceived are presented below in Table 11.2

TABLE 11.2: Road Safety Issues

Content	Items	Observation with respect to Safety		Remarks
		Existing Situation	Proposed Situation	
A1. General	Departure from Standards	The horizontal alignment of the existing road has many sub-standard and sharp curves including reverse S-curves. There is also deficiency in transition length as per MoRTH standards.	Proposed alignment has been designed based on the design speed adopted for mountainous terrain as per standard specified in IRC: SP 73-2018 and Hill Road Manual (IRC: SP 48-1998) Horizontal curves including the sharp/blind curves as well as zigzag ones has been improved to achieve required design speed and super elevation reversal for riding safety and comfort in conformation to MoRTH standards. (Refer Plan Drawing No. CET/2016/3640/NH-102A/DPR/PP & Horizontal Alignment Report Drawing No. CET/2016/3640/NH-102A/DPR/HAR)	Considering mountainous/Steep terrain in general design speed has been adopted as • Ruling = 50 kmph • Limiting = 40 Kmph
	Cross sectional Variation	The existing carriageway width is 5m, with formation width varies from 3.5 m -7.50 m	(1) Rural Area a)Carriageway Width = 7.0 m b)Hard Shoulder Width = 2 x 1.5 m c)Earthen Shoulder Width on Valley side = 1.0 m d)Roadway Width= 11.0 m (2) Rural Area a) Carriageway Width = 7.0 m b) Hard Shoulder Width = 2 x 1.5 m c)Earthen Shoulder Width = 1 x 1.0 m c)Roadway Width= 12.0 m (2) Rural Area with Retaining Wall & Breast Wall a)Carriageway Width = 7.0 m b)Hard Shoulder Width = 2 x 1.5 m c)Roadway Width= 10.0 m (for Cross-sectional Parameters, refer TCS Drawing No. CET/2016/3640/NH-102A/DPR/TCS)	Extra widening has been provided on the curves having radius less or equal to 300m.

Content	Items	Observation with respect to Safety		Remarks
		Existing Situation	Proposed Situation	
	Drainage	Existing drainage condition is poor with improper camber and longitudinal gradient of carriageway and shoulder.	Efficient drainage system is provided along the project road including structure and outfall facility. For quick disposal of precipitations, carriageway and shoulder have the requisite camber and longitudinal gradient. The water from road and adjacent areas to be intercepted and carried through roadside drains to natural outfall. In case of Semi-Built-up area, Triangular shaped drain is provided on hill side for a length of 6371 m for effective surface drainage. (for Cross-sectional Parameters, refer TCS Drawing No. CET/2016/3640/NH-102A/DPR/TCS)	

Content	Items	Observation with respect to Safety		Remarks
		Existing Situation	Proposed Situation	
	Climatic Conditions	Generally, Temperature varies from 5°C to 35°C. The average annual rainfall is 1856 mm.		HFL has been considered to fix road top level at bridge location.
	Landscaping	Landscaping on the existing road is not proper due to irregular spacing of trees & absence of proper protection work in hill and valley side.	Proper Road side Plantation is being provided. Protection work shall be given on Hill and Valley side. The details are given below: • Length of RR Masonry Retaining Wall = 662 m • Length of Breast Wall = 1300 m • Length of Gabion Structure = 3787 m Application of Bamboo Plantation has been conducted on slopes of and the area comes out as 54917 sq. m.	Trees and vegetations on the site should be properly trimmed and removed if required so that these should not interfere with the overhead services, clear view of signs and efficiency of roadway lighting. A regular program of pruning of the offending trees shall be under-taken as a part of the maintenance operation. Trees shall be selected based on the soil, temperature, rainfall, water level and should be deep rooted to avoid any damage to the pavement crust.
	Service Apparatus	Existing utilities like Electric poles, Transformer, High Tension Line, and Telephone Pole etc. are found along the existing road.	Existing utilities affected due to widening of road shall be relocated at proposed utility corridor within the proposed ROW.	It will be safe during maintenance

Content	Items	Observation with respect to Safety		Remarks
		Existing Situation	Proposed Situation	
	Lay-byes	No Bus Bay and truck lay-byes have been observed along the project road.	Bus bays (4 nos. at 2 locations) are proposed near built-up location for smooth movement of traffic	

Content	Items	Observation with respect to Safety		Remarks
		Existing Situation	Proposed Situation	
	Footpaths	No footpaths are observed along the existing road.	No Footpaths are considered as there are no such built-up location.	
	Pedestrian Crossings	No pedestrian crossings are observed along the existing road.	Pedestrian crossings are provided at major intersections and other locations like schools, religious structure etc. where substantial conflicts exist between Vehicular and Pedestrian movement	Installation of proper traffic sign/ signal near pedestrian crossings is mandatory. Pedestrian guard rails are also required to guide people
	Access	Existing situation shows maximum access to the private property.	Private access should be minimized directly from the proposed carriageway by providing footpath at built up locations	Private access needs be minimized to maintain the design speed of the corridor as well safe passage to traffic and persons
	Emergency vehicles	Emergency vehicle have not been found along the existing corridor.	It is proposed to provide Emergency vehicles to operate within a certain time frame along the project road.	
	Public Transport	Existing traffic survey shows that 2 axle and 3 axle trucks are plying through the project road and 2-wheeler and car/Jeep/Van are act major public transport compare to bus and minibus along the existing road.	After improvement of road to 2-lane trucks and public transport like bus and minibus etc. will ply on the proposed road along with motorized and non-motorized other vehicles.	Refer Main Report Chapter 7: Traffic Report

Content	Items	Observation with respect to Safety		Remarks
		Existing Situation	Proposed Situation	
	Future Widening	Existing Row= 9-12m	Proposed ROW required for • Rural area = 30 - 55 m Additional land acquisition is required to accommodate future proposal.	
	Staging of Contracts	Length of the existing Road is 9.840 km	Design Length of the proposed road is 6.571 km.	
	Adjacent Development	Existing shoulders are generally in poor condition throughout the road. Footpaths are not found in the built-up stretches. Insufficient traffic signs observed along the project corridor.	Proposed Hard shoulder on both sides of the carriageway can be used for the movement of slow-moving vehicle during emergency as well as parking for stalled vehicle. Installation of traffic sign for road safety purpose is being proposed. Refer TCS drawing No: CET/2016/3640/NH-102A/DPR/TCS	
A2. Local Alignment	Visibility	Visibility is not proper in many places as the existing profile of the road does not follow required sight distances (horizontal as well as vertical).	In general, Intermediate Sight distance is being followed for proposed 2 lane road.	In stretches where intermediate sight distance is not available the profile shall be designed with stopping sight distance and overtaking prohibited traffic sign shall be installed in that location.
	New/Existing Road Interface	Existing road interface are not smooth with improper horizontal and vertical profile.	New/Existing road interface shall be designed with proper geometry and vertical profile as per codal provision so that the vehicle can moved smoothly & safely.	

Content	Items	Observation with respect to Safety		Remarks
		Existing Situation	Proposed Situation	
	Safety Aids on Steep Hills	Existing road alignment shows there is no steep hill section along the project road.	Requirement of Retaining wall, Breast wall, Toe wall, Parapet wall have been considered as protective structures for traffic as the proposed road is passing through mountainous terrain.	

Content	Items	Observation with respect to Safety		Remarks
		Existing Situation	Proposed Situation	
A3. Junction	Minimize potential conflicts	Existing junctions are not properly developed with insufficient turning radius and absence of road signage as well as markings.	1 Major Junctions and 11 minor junctions to be developed with proper turning radius, signage and markings to minimize potential conflict between pedestrians and vehicles	Junctions should be developed with proper traffic sign and markings.
	Layout	Layout of the junctions are not proper	Layout of the proposed junctions are to be made with proper turning radius, acceleration/deceleration lane, island and median etc.	These are designed as per respective IRC guidelines and land acquisition to be kept absolute minimum.
	Visibility	Visibility of the existing junctions are not proper	To improve the visibility of the proposed junction's vertical profile of the road shall be designed with intermediate sight distance. If it is not found it should be taken care that at least stopping sight distance should be available throughout.	Traffic Sign at junctions should informative enough.
A4. Non-Motorized road users' provisions	Adjacent Land Pedestrians Cyclists Non-motorized vehicles	Existing Scenario shows Pedestrians, Cyclists and non-motorized vehicles are plying on the existing road due to damage road shoulder and absence of footpath in built-up areas and causing conflicts with fast moving vehicles which decrease the design speed.	For smooth movement of non-motorized road users, pedestrians and cyclist Hard shoulder has been proposed on both side of the carriageway. Refer TCS Drawing No: CET/2016/3640/NH-102A/DPR/TCS	

Content	Items	Observation with respect to Safety		Remarks
		Existing Situation	Proposed Situation	
A5. Signs and Lighting	Lighting	Insufficient Lighting shall be found in built up areas.	Lighting shall be provided on major junctions, built-up stretches, bus bays locations & Bridge locations.	
	Signs/ Markings	Insufficient signs found on existing road. Markings are not found in the existing road.	Traffic Signs and Road Markings are provided on the proposed road for safe guidance of traffic For typical details of road sign and marking, refer drawing No. CET/2016/3640/NH-102A/DPR/MISC	
A6. Construction and Operation	Build-ability Operational Network Management	Guidelines for safety during construction need to be followed as per IRC: SP-55. Traffic control devices have to be provided as per requirements during construction time. Few of these are: barricading, signs and delineators.		

CHAPTER 12
CONCLUSION AND RECOMMENDATION

12.1 Conclusions & Recommendations

The development of the project road i.e., Ukhrul-Toloi-Tadubi Road Pkg-1 (Ukhrul Bypass) with two lane hard shoulder configuration in the state of Manipur. Total Design Length comes out to be 6.571 km. There are 5 nos. of bridge proposed on the project road. There are 1 nos. of major intersections in the project road and all major junctions are proposed to be improved at grade. Besides major junctions there are 11 nos. of minor Junctions present on the project road which needs to be improved at grade. Bus bays with passenger shelter shall be proposed at 2 locations of the project. Recommendation of Pavement Thickness as per Non-conventional method (CTSB) shall be done on the entire portion of the project stretch.

As per Conventional Method:

Design Chainage (Km)		Length (km)	MSA for 20 years design period	CBR	Type of Pavement	Pavement Thickness over Existing and New/Widening Portion (mm)			
From	To					BC	DBM	WMM	GSB
0.000	6.571	6.571	20	10%	Flexible	40	70	250	200

As per Non-Conventional Method:

Design Chainage (Km)		Length (km)	MSA for 20 years design period	CBR	Type of Pavement	Pavement Thickness over Existing and New/Widening Portion (mm)			
From	To					BC	DBM	WMM	CT Sub-base
0.000	6.571	6.571	20	10%	Flexible	30	50	150	200

As per Rigid Pavement Method:

Design Chainage (Km)		Length (km)	MSA for 20 years design period	CBR	Type of Pavement	Pavement Thickness over Existing and New/Widening Portion (mm)		
From	To					PQC	DLC	GSB
0.000	6.571	6.571	20	10%	Rigid	250	150	150

RR Masonry Retaining Wall of length 662 m, Breast wall of length 1300 m, Gabion wall of length 3787 m shall be considered as protective works on valley and hill side. Application of Bamboo Plantation has been considered on the slope. Provision of Traffic Guidance and Safety (like road

signs, marking, metal beam crash barrier, lighting, landscaping, tree plantation etc.) has been kept for improvement of the project road.

As per Conventional method (Flexible Pavement), the total Civil Construction Cost of the project comes out to be **Rs. 110.39 Cr.** with per km construction cost is **Rs. 16.80 Cr.**

As per Non-conventional method (WMM and CT Sub Base Pavement), the total Civil Construction Cost of the project comes out to be **Rs. 107.07 Cr.** with per km construction cost is **Rs. 16.29 Cr.**

As per Rigid pavement method, the total Civil Construction Cost of the project comes out to be **Rs. 111.41 Cr.** with per km construction cost is **Rs. 16.96 Cr.**

Along with the civil cost, Pre-Construction cost (Land Acquisition and Standing Properties Cost, Forest, Environmental & Wildlife Clearance Budget & Utility Shifting Cost) comes out to be 59.29 Cr.

In viewing of the cost of the project and construction of quality Road, Non-conventional (CTSB) method has been recommended.

Hence, the Nom-Conventional Method has been proposed.