National Highways & Infrastructure Development Corporation Limited

Feasibility Study, Preparation of Detailed Project Report and providing pre-construction services for up gradation of National Highway No. 217 (Paikan-Tura Section) in the state of Assam and Meghalaya

EXECUTIVE SUMMARY
PKG III

M/s Almondz Global Infra-Consultant Limited
In association with
Thoughts Consultants Jaipur Private Limited

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Executive Summary

1 . Introduction

The Ministry of Road Transport & Highways (MORTH), Government of India has taken up various programs of up gradation and development of National Highways. The National Highways of India are owned by the Ministry of Road Transport and Highways. These network of roads are constructed and managed by various Departments like the National Highway Authority of India (NHAI), the National Highways & Infrastructure Development Corporation (NHIDCL), the Public Works Departments (PWDs) of the state Governments etc.

M/s Almondz Global Infra-Consultant Limited in association with Thoughts Consultants Jaipur Private Limited was appointed on 8th March 2019. For Consultancy Services for Feasibility Study, Preparation of Detailed Project Report and providing pre-construction services for up gradation of National Highway No. 217 (Paikan-Tura Section) in the state of Assam and Meghalaya. The Project Highway location map is given in Figure 1-1.

The existing Project Highway alignment is passing through two State Assam and Meghalaya, Three Districts Goalpara, North Garo Hills and West Garo Hills and 56 Revenue Villages. The Project Highway alignment was discussed and Approved by NHIDCL on 27-11-2019 and directed to obtain concurrence of all stake holders of State Govt. For obtaining the concurrence the various Public Consultation meeting were carried out in all three districts for obtaining concurrence of all stakeholders

Goalpara District Assam: The Public Consultation meeting was held in the Office of Deputy Commissioner Goalpara Assam on 06-03-2020, where DC, ADC, SP, DFO, other District level officials, village heads and local people along with NHIDCL official were present in the meeting. The Alignment was approved in Assam the some minor modifications.

West Garo Hills District: The Public Consultation meeting was held in the Office of Deputy Commissioner West Garo Meghalaya on 06-03-2020 where DC, ADC, SP, DFO, other District level officials, village heads and local people along with NHIDCL Official were present in the meeting. The alignment was approved with recommendation to take the realignment in Rongram Town on East side instate of Elevated Road on existing alignment.

North Garo Hills District: The Public Consultation Meeting were held at Bajengdoba playground 09.03.2020, Gokol Playground on 11.03.2020 and in the Office of Deputy Commissioner North Garo Resulbelpara on 11-03-2020. The DC, ADC, SP, DFO, other District level officials, village heads and local people were present in the meeting. Deputy General Manager Tura was present on behalf of NHIDCL. The Propsed alignment was approved with the suggestion of Elevated viaduct at Bajengdoba Bypass.

The outcome of the Public Consultation meeting were presented in Review meeting held on 12-03-2020 at New Delhi HQ. The minor changes suggested in alignment were agreed by Authority and directed to carry out further activities. NHIDCL has also directed to plan to construct the Project Highway road in three packages according to keeping in the View of State / Districts Boundaries. After the discussion the following three packages are formulated.

Table 1-1: Key features of project

Package	State & District	Design Ch.	Design Length (Km)
Package-1	Assam, Goalpara	From Km. 0/000 to Km 20/900	20.900 Km
Package-II	Meghalaya, North Garo Hills	From Km. 20/900 to Km 47/075	26.175 Km
Package-III	Meghalaya, West Garo Hills	From Km. 47/075 to Km 77/055	29.980 Km

The Present Report is dealing with Package-III, which is located in West Garo Hill District of Meghalaya.

Figure 1-1: Location of Project Highway Road

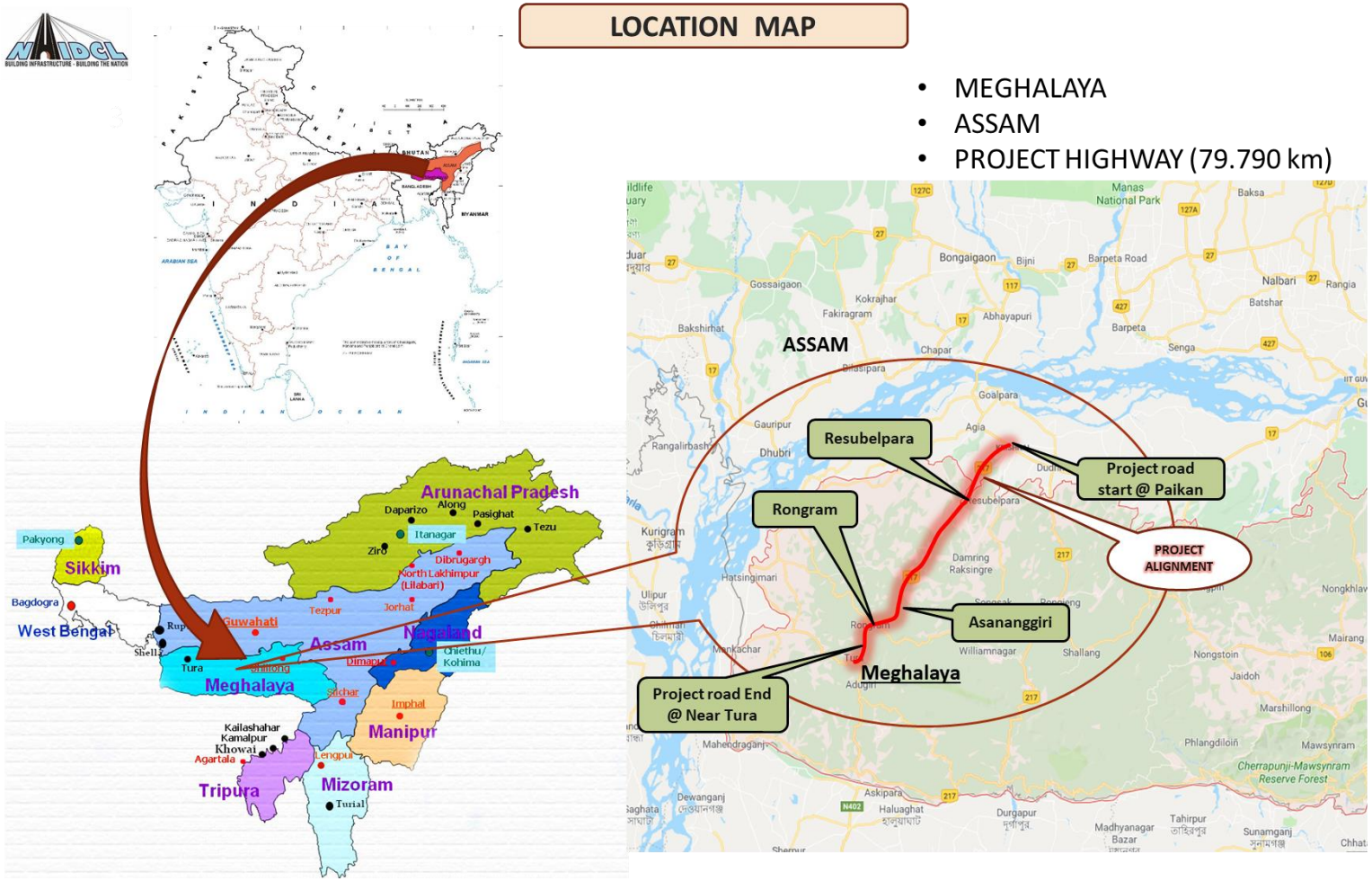
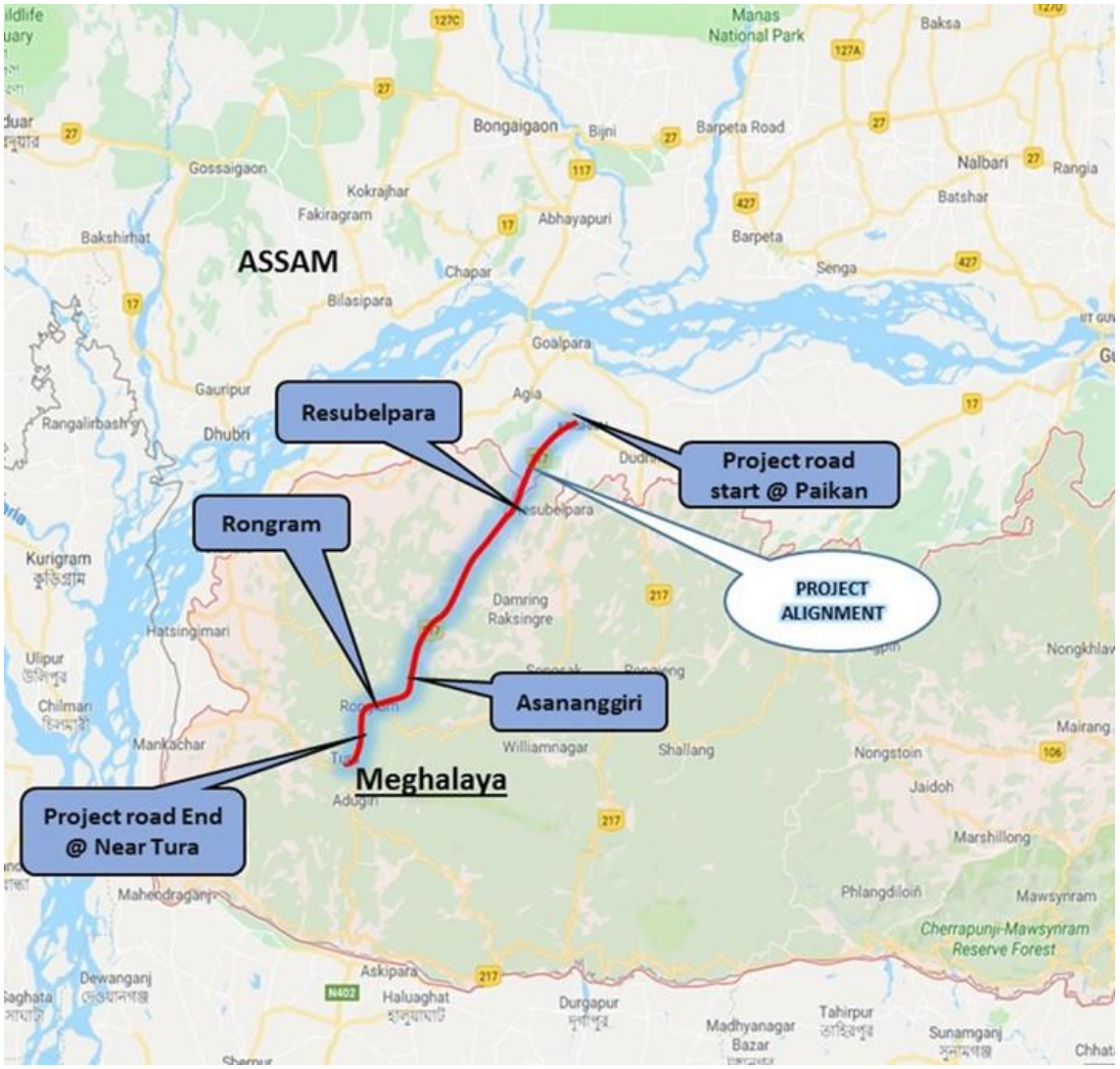


Figure 1-2: Existing Alignment of Project Highway all Packages



2 . Project overview

The Project Highway Package-III is located in West Garo Hills District of Meghalaya State. The existing alignment of Project Highway Starts from Km. 48/625 and end at Km. 79/830 Boarder the North & West Garo Hill District. The Project Highway has 2-lane flexible pavement in entire length.

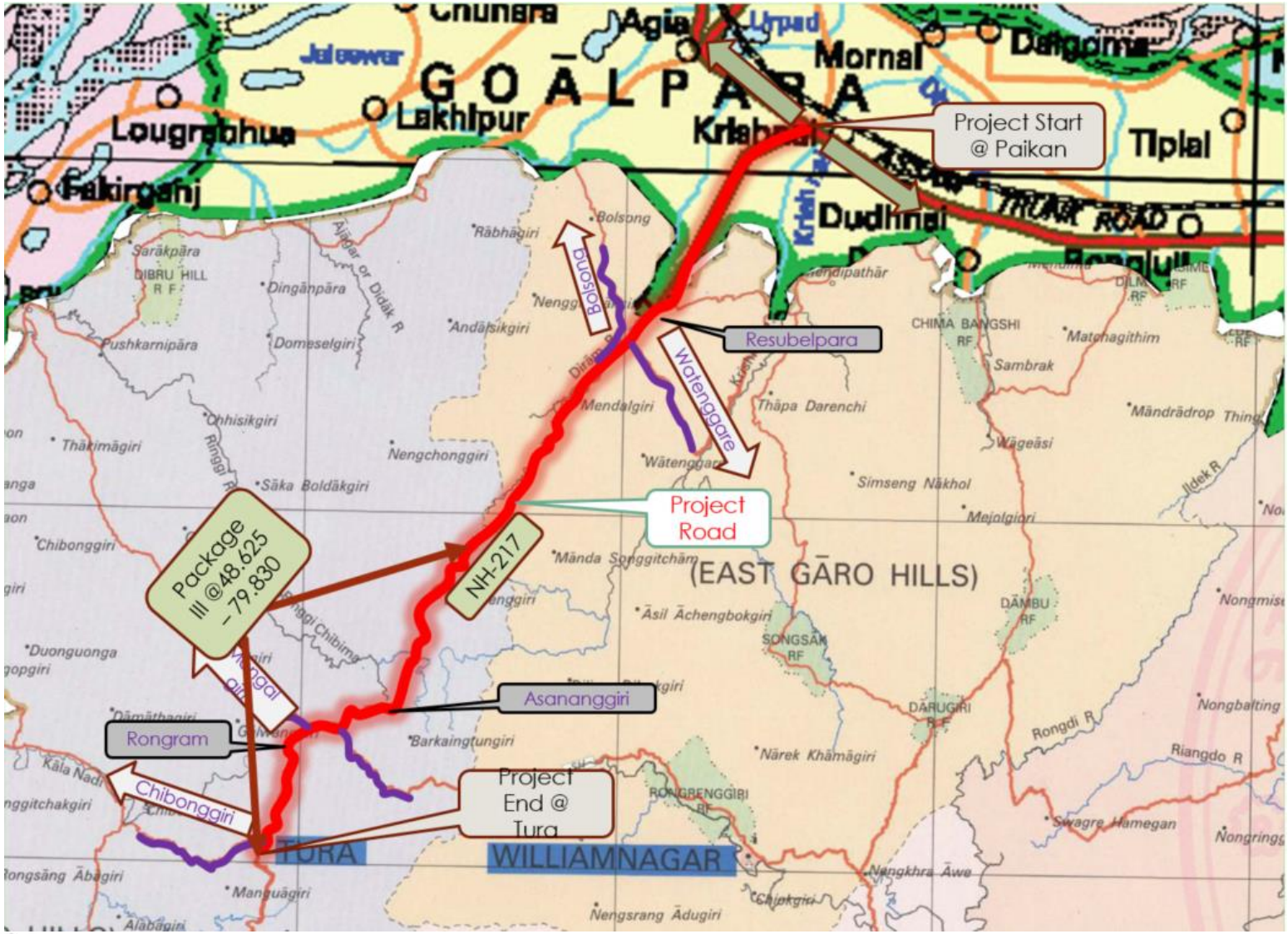
2.1 Key features of project

Table 2-1: Key features of project

Particulars	Existing Details
Terrain	Runs in Mountainous terrain. Land use is predominantly Agricultural, and some built up areas too.
ROW	Varies between 15-22.2 m on site and 2x10.67 m as per Garo Hill Autonomous District Council Nonfiction
Carriageway Configuration	Two lanes of length 29.980 Km
Geometry	Horizontal and Vertical Alignment of Project Road has lot of deficiencies
Pavement Condition	Mostly fair, some part of stretch is damaged.
Bridges Numbers	Major Bridge = 0 Minor Bridge = 14
Culverts Numbers	Pipe Culvert = 106 and Slab Culvert = 21
Side Drains	Exist in built-up stretches 38332 m
Intersections/Junctions	Major =2 Minor Junction =7
Road Facility/Safety Feature	Safety installations are limited to speed breakers
Level Crossing/ROB/RUB	NIL
Breast/Retaining wall	2601 m

2.1 Key plan of existing project stretch

Figure 2-1: Key plan of existing project road



3 . Traffic demands on project road

3.1 Traffic volume surveys

For the purposes of traffic projections and lane design, one individual section of road were considered:

Table 3-1: Classified Volume Count Survey

Sr. No.	Category Of Road	State	Location of Survey
1	NH 217	Meghalaya	Konapara At Ch. 22+630

Traffic volume surveys for the project road were carried out at along the project road in the month of September 2019 to October 2019. The traffic data is projected to year 2021-2022 with growth factor of 5%. Multimodal Logistic Park is proposed at Jogighopha, so traffic will further increase as the diverted traffic will use the project road. 20% of induced traffic for the multimodal logistic park is assumed to be diverted on the project road. The results are as follows:

Table 3-2: Average Annual Daily Traffic

Type of Vehicles	Traffic in Year 2019-20 at Km 22+630 at Konapara	Traffic in Year 2021-2022 @ 5% Traffic Growth	Projected Traffic in Year 2021-2022 at Jogighopa Mulity Model Logistic Park	Induced Traffic in Year 2021-2022 on project Road due to Mulity Model Logistics Park @ 20%	Projected Traffic in Year 2021-2022 on project Road incl. induced traffic
Two-wheeler	937	1033	0	0	1033
Three-wheeler	321	354	0	0	354
Car	1825	2012	0	0	2012
Mini Bus	173	191	0	0	191
Bus	153	169	0	0	169
LCV (<3T)	407	449	461	93	542
LCV (> 3T)	21	23	96	20	43
LCV (> 7.5T)	41	45	0		45
2 Axle	69	76	107	22	98
3 Axle	36	40	0		40
Multi Axle	23	25	163	33	58

Type of Vehicles	Traffic in Year 2019-20 at Km 22+630 at Konapara	Traffic in Year 2021-2022 @ 5% Traffic Growth	Projected Traffic in Year 2021-2022 at Jogighopa Mulity Model Logistic Park	Induced Traffic in Year 2021-2022 on project Road due to Mulity Model Logistics Park @ 20%	Projected Traffic in Year 2021-2022 on project Road incl. induced traffic
Tractor without Trailer	0	0	0	0	0
Tractor with Trailer	0	0	0	0	0
HCM	3	3	0	0	3
Cycle	0	0	0	0	0
Cycle Rickshaw	0	0	0	0	0
Hand Cart	0	0	0	0	0
Animal Cart	0	0	0	0	0
Total Vehicle	4009	4420	827	168	4588
Total PCU	4530	4993	1890	384	5377
Total CVD	346	381	366	75	456

3.2 Axle load survey

Axle load surveys were conducted at NH-217, at one location for Package-III, km 22+360, Konapara using Load Pad to understand the actual load spectrum of commercial vehicles plying on the project road. The results of the load survey, were converted to Vehicle Damage Factor (VDF) using equivalency factors from IRC-37:2018 for the purpose of MSA calculations

Table 3-3: Axle load survey results

Sr. No.	Type of Vehicle	VDF @ 22+630
1	Bus	1.51
2	LCV	1.52
3	2 – Axle Truck	2.53
4	3 – Axle Truck	2.36
5	Multi Axle Truck	2.29
	Weightage VDF	2.05

3.3 Traffic volume forecast

Traffic volume forecast was developed using the Elasticity Model method and converted to Million Standard Axles (MSA) for the purposes of pavement design. Total Projected Traffic Volume for each of the locations of the project corridor are given in below Tables

Table 3-4: Projected traffic load on project road

Sr. No.	Years	Vehicles	PCU's
1	2022	4745	5517
2	2025	5520	6443.5
3	2030	7085	8308.5
4	2035	9078	10677.5
5	2040	11628	13719
6	2045	14882	17602

3.4 Turning movement surveys

Classified direction wise turning movement surveys were conducted at 5 intersections to determine the need for re-design and addition of structure at the intersection

Table 3-5: Turning movement survey results

Sr. No.	Location Details	Type	8 Hour TMC	Peak Hour TMC
			Total No. of Vehicle	Total No. of Vehicle
1	Start 21+960	3 Arm	1642	212

4 . Pavement and corridor surveys

4.1 Pavement condition and distress seen

The overall pavement condition Site has been inspected on visual basis. The pavement condition of road is good on the whole having good riding quality. In general, cracked area is around 15 –20%, patched area is about 5-10% and the average raveled area is 0% to 5%. Pot holes were only observed on the locations where water streams were crossing the road.

Table 4-1: Condition survey of existing pavement

ID	Section	Condition Year	Roughness IRI	Total Cracking Area (%)	Raveled Area (%)	Potholes (no/km)	Edge Break(m²/ km)	Rut Depth (mm)
A-01	From Km 47/075 to 77/055 Km	2019	4.1	16	15	8	12	2

4.2 Pavement composition

The detailed layer composition of the existing pavement was recorded at every pit and the observations have been presented in Annexure 6-6. Generally the existing pavement structure comprise of three layers namely wearing coarse, base course and sub-base course. The wearing course consists of bituminous material that may be termed as Bituminous Top (BT). The base course comprises of mixture of boulder/aggregate. The sub base course mainly comprises of aggregate/sand and murrum. The total thickness of the pavement varies from 310 mm to 370 mm with an average of 340 mm. The summary of the crust thickness is shown in below in Table.

Table 4-2: Composition of existing pavement

Section	Bituminous course (mm)		Granular course (mm)	
From Km 47.075 to Km 77.055	40	350	80	600

4.3 Pavement strength

FWD was carried out to test the strength of the existing pavement, and the characteristic deflection values have been calculated for each homogeneous section of road to enable design of an overlay for the road. The summary of strength of existing pavement

Table 4-3: Strength of existing pavement

Section	Chainage		Distance	Remaining mm
	Start	End	Km	
Section-1	48/625	79/830	31.205	2 MSA

4.4 Sub-grade soil survey

Extensive review of available soil information and testing was done to understand the sub-grade characteristics. Summary of soil investigation surveys is as follows:

Table 4-4: Soil investigation survey results

Attribute	Results	Comments
Sub-grade CBR range (%)	7%- 8%	Low over large lengths of section
Degree of compaction (% of MDD)	95%-97%	Sufficient as per MORTH guidelines
Swelling ratio (%)	5.3 to 36%	Significant variation seen across stretch

Table 4-5: Soil types observed

Soil type	Plasticity index	Comments
Clayey sand (SC)/ CL	2.62 to 2.70	Poorly graded clay sand mixture

5 . Improvement proposals

5.1 Proposed alignment

As per the Discussion with NHIDCL and Outcome of the Public consultation with all stake holders, the widening of existing 2-lane road to 2- lane with paved shoulders has been planned along the existing road alignment only, except for curve improvement and minor realignment in some stretches. The existing road carriageway has been used most of the length.

As per site conditions due to presence of built-up areas speed restrictions need to be adopted. The local and district administration were of the option that deficient curves should only be improved for minimum design speed 40 Kmph, So that Land acquisition can be minimized.

In built-up area the widening has been planned equally on both sides of the existing road alignment so that Minimum land is acquired for road project. The width of median be kept same in non-built-up area same as proposed in built-up area.

5.2 Bypasses proposed

Two Bypass has been proposed at Jingal and rongram village, and one realignment of the Baljek Airport has been proposed.

5.3 Road Geometry

The project road has been re-designed to accommodate the ruling design speed of 40 km/hr in Hill Terrain. The Manual of Standards and Specifications for "Two Laning of Highways with Paved Shoulder published by Indian Roads Congress IRC: SP: 73-2018" or consultation with NHIDCL. Enabling this higher speed will require re-design and re-alignment of the road in certain sections. Initial all the curves were improved for minimum Design Speed of 40 Kmph. During the Public Consolation meeting it was discussed that due to elephant crossing at some locations and presence of built-up areas, speed restrictions need to be adopted. After discussions, the locals and district administration were of the opinion that deficient curves should only be improved for Maximum design speed 40 Kmph only. Locals and district administration insisted to follow relaxed norms if possible so as to have minimum Land acquisition. The villagers insisted that in built-up area the widening must be done equally on both sides of the existing road alignment so that equal land is acquired on both sides of the Alignment and dwellers on both sides of the Alignment are equally affected. The villagers also requested the width of median be kept same in non-built-up area as proposed in built-up area and extra 1.5 m paved shoulders may be reduced, due to the presence of agriculture's fields. Due to these suggestions overall land requirement may be reduced. The Competent Authority has approved the suggestion of Public Consolation meeting. Accordingly final alignment has been modified.

Table 5-1: Lane configuration planned for project road

Section	Chainage		Distance	Lane Configuration	TCS
	Start	End	Km		
Section-1	47/075	77/055	29.980	2-Lane	7 m + 2X1.5 m Paved Shoulders

5.4 Widening scheme

Basis traffic information available, level of service requirements and consultation with NHIDCL, local authorities etc., the following lane configuration is adopted for the project road:

Table 5-2: Typical Cross Section Details

Sr. No.	Particular of TCS	TCS Codes
4	TYPICAL CROSS SECTION -4 New Construction of 2 Lane Road with Paved Shoulders on Both Side	TCS-4
5	TYPICAL CROSS SECTION -5 New Construction of 2 Lane Road with Paved Shoulders on Both Side with High Embankment	TCS-5
6	TYPICAL CROSS SECTION -7 Construction of 2 Lane Road with Hill Cutting on Both Side	TCS-7
	TYPICAL CROSS SECTION -7 TYPE I Construction of 2 Lane Road with Hill Cutting on Both Side with 4.0 m Gabion Wall with Hill Slope Protection Work	TCS-7 (Type I)
	TYPICAL CROSS SECTION -7 TYPE II Construction of 2 Lane Road with High Hill Cutting on Both Side with 6.0 m Gabion Wall with Hill Slope Protection Work	TCS-7 (Type II)
	TYPICAL CROSS SECTION -7 TYPE III Construction of 2 Lane Road with Hill Cutting on Right Side with 6.0 m Gabion Wall with Hill Slope Protection Work	TCS-7 (Type III)
	TYPICAL CROSS SECTION -7 TYPE IV Construction of 2 Lane Road with Hill Cutting on Left Side with 4.0 m Gabion Wall with Hill Slope Protection Work	TCS-7 (Type IV)
7	TYPICAL CROSS SECTION -8 Construction of 4 Lane Road in Built Up Area	TCS-8
8	2-lane Bridge with Footpath	TCS-9A
9	2-lane Structure without Footpath	TCS-9B
10	2-lane existing bridge on one side without footpath and new 2-lane with paved shoulder with footpath keeping in view of 4 lane widening in future	TCS-9C
11	4-lane Bridge	TCS-10
12	TYPICAL CROSS SECTION -11	TCS-11

Sr. No.	Particular of TCS	TCS Codes
	Construction of 2 Lane Road with Reinforced Earth with Gabion Facia Panel	

Basis availability of RoW and land acquisition constraints, a widening scheme has been proposed that makes optimum use of existing ROW and minimizes need for land acquisition in urban areas, a summary of which is given below:

Table 5-3: Chainage TCS Adopted

Chainagewise TCS details				
Sr. No.	Chainage (Km)		Design Length (Km)	TCS Code
	From	To		
(1)	(2)	(3)	(4)	(5)
1	47075	47100	25	MNB
2	47100	47725	625	TCS 4
3	47725	48100	375	TCS 7
4	48100	48175	75	TCS 5
5	48175	48250	75	TCS 7
6	48250	48325	75	TCS 7 type II
7	48325	48575	250	TCS 4
8	48575	48675	100	TCS 5
9	48675	48775	100	TCS 7
10	48775	49925	1150	TCS 4
11	49925	49935	10	MNB
12	49935	49950	15	TCS 4
13	49950	50025	75	TCS 7 type II
14	50025	50250	225	TCS 7
15	50250	50850	600	TCS 7 type II
16	50850	51275	425	TCS 7
17	51275	51350	75	TCS 4

Chainagewise TCS details				
Sr. No.	Chainage (Km)		Design Length (Km)	TCS Code
	From	To		
(1)	(2)	(3)	(4)	(5)
18	51350	51384	34	TCS 5
19	51384	51396	12	MNB
20	51396	51800	404	TCS 5
21	51800	51875	75	TCS 7
22	51875	51894	19	TCS 5
23	51894	51906	12	MNB
24	51906	52025	119	TCS 5
25	52025	52100	75	TCS 7
26	52100	52150	50	TCS 5
27	52150	52225	75	TCS 7
28	52225	52325	100	TCS 5
29	52325	52425	100	TCS 7
30	52425	52475	50	TCS 4
31	52475	52675	200	TCS 7
32	52675	54200	1525	TCS 7 type II
33	54200	54600	400	TCS 7
34	54600	54700	100	TCS 7 type II
35	54700	54775	75	TCS 7
36	54775	54875	100	TCS 4
37	54875	54975	100	TCS 7
38	54975	55025	50	TCS 4
39	55025	56000	975	TCS 7
40	56000	56425	425	TCS 7 type II
41	56425	56525	100	TCS 4
42	56525	56675	150	TCS 7 type IV
43	56675	56925	250	TCS 5

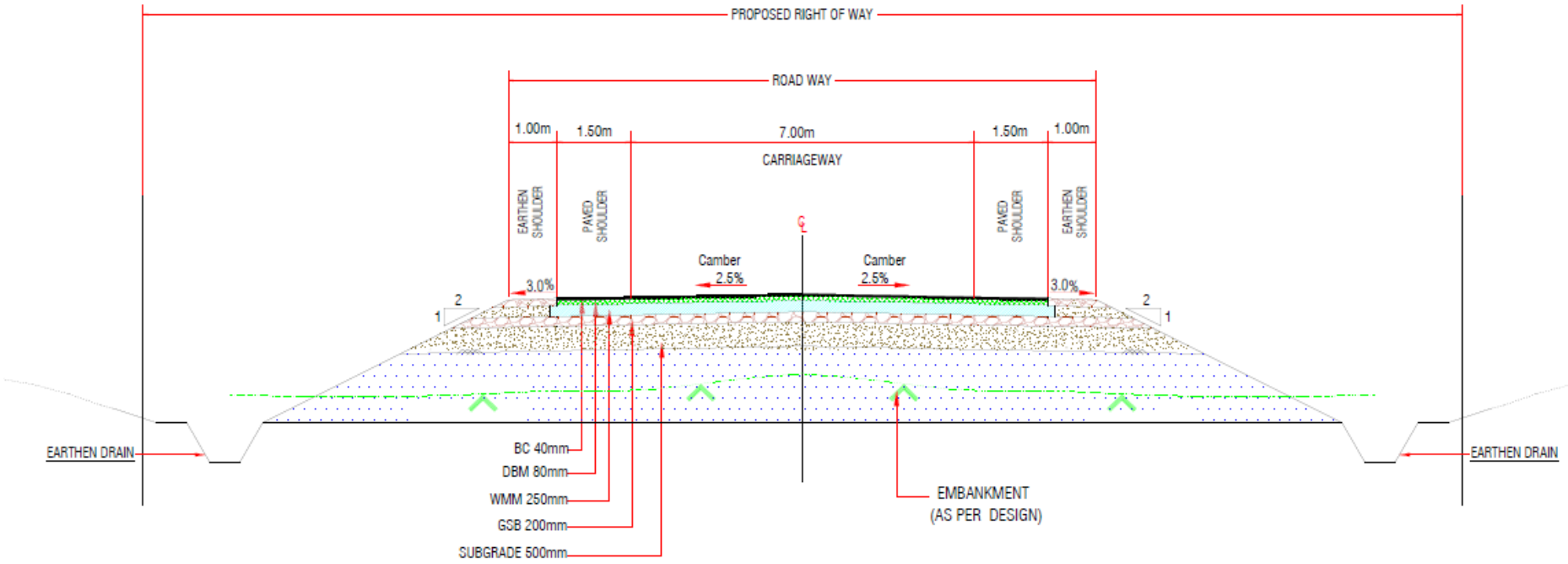
Chainagewise TCS details				
Sr. No.	Chainage (Km)		Design Length (Km)	TCS Code
	From	To		
(1)	(2)	(3)	(4)	(5)
44	56925	57050	125	TCS 7
45	57050	57300	250	TCS 7 type II
46	57300	57425	125	TCS 5
47	57425	57525	100	Elevated Via-Duct
48	57525	57550	25	TCS 5
49	57550	57600	50	TCS 7
50	57600	57725	125	TCS 5
51	57725	58350	625	TCS 7 type II
52	58350	58875	525	TCS 5
53	58875	59029	154	TCS 7
54	59029	59041	12	MNB
55	59041	59950	909	TCS 4
56	59950	60250	300	TCS 5
57	60250	61150	900	TCS 4
58	61150	61325	175	TCS 5
59	61325	61450	125	TCS 7 type III
60	61450	61540	90	TCS 5
61	61540	61590	50	MNB
62	61590	61675	85	TCS 5
63	61675	61800	125	TCS 7 type II
64	61800	62175	375	TCS 4
65	62175	62350	175	TCS 7
66	62350	62825	475	TCS 4
67	62825	63150	325	TCS 7
68	63150	65500	2350	TCS 4
69	65500	65510	10	MNB

Chainagewise TCS details				
Sr. No.	Chainage (Km)		Design Length (Km)	TCS Code
	From	To		
(1)	(2)	(3)	(4)	(5)
70	65510	66675	1165	TCS 4
71	66675	66775	100	TCS 7 type IV
72	66775	66875	100	TCS 7 type I
73	66875	66940	65	TCS 5
74	66940	66960	20	MNB
75	66960	67050	90	TCS 5
76	67050	67275	225	TCS 4
77	67275	67350	75	TCS 5
78	67350	67875	525	TCS 4
79	67875	67908	33	TCS 5
80	67908	67933	25	MNB
81	67933	67950	17	TCS 5
82	67950	68350	400	TCS 7
83	68350	68425	75	TCS 4
84	68425	68500	75	TCS 7
85	68500	68550	50	TCS 7 type I
86	68550	68750	200	TCS 7
87	68750	69000	250	TCS 4
88	69000	69275	275	TCS 7
89	69275	70925	1650	TCS 7 type II
90	70925	71125	200	TCS 7
91	71125	71350	225	TCS 7 type IV
92	71350	71400	50	TCS 5
93	71400	71475	75	TCS 7
94	71475	71525	50	TCS 7 type IV
95	71525	71575	50	TCS 5

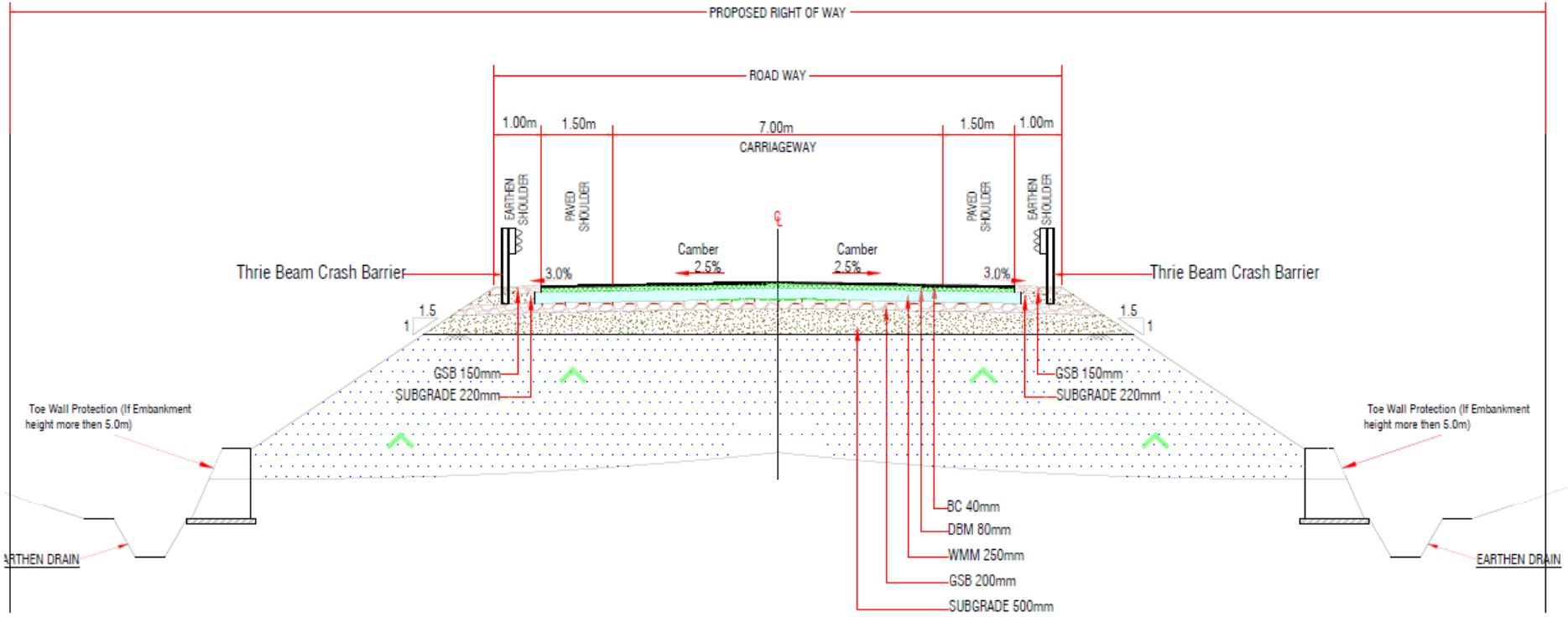
Chainagewise TCS details				
Sr. No.	Chainage (Km)		Design Length (Km)	TCS Code
	From	To		
(1)	(2)	(3)	(4)	(5)
96	71575	71650	75	TCS 7 type IV
97	71650	71700	50	TCS 4
98	71700	71825	125	TCS 7
99	71825	71925	100	TCS 5
100	71925	71992	67	TCS 11
101	71992	72008	16	MNB
102	72008	72225	217	TCS 11
103	72225	72475	250	TCS 5
104	72475	72650	175	TCS 4
105	72650	73410	760	TCS 8
106	73410	73420	10	MNB
107	73420	74060	640	TCS 8
108	74060	74170	110	TCS 4
109	74170	74180	10	MNB
110	74180	74200	20	TCS 4
111	74200	74900	700	TCS 7
112	74900	74975	75	TCS 5
113	74975	75070	95	TCS 4
114	75070	75325	255	TCS 5
115	75325	75525	200	TCS 7
116	75525	75575	50	MNB
117	75575	75710	135	TCS 7 type IV
118	75710	75775	65	TCS 7 type III
119	75775	75960	185	TCS 4
120	75960	76485	525	TCS 8
121	76485	76495	10	MNB

Chainagewise TCS details				
Sr. No.	Chainage (Km)		Design Length (Km)	TCS Code
	From	To		
(1)	(2)	(3)	(4)	(5)
122	76495	77055	560	TCS 8
Total Length			29.980	

Typical Cross Sections Package-III



TYPICAL CROSS SECTION -4



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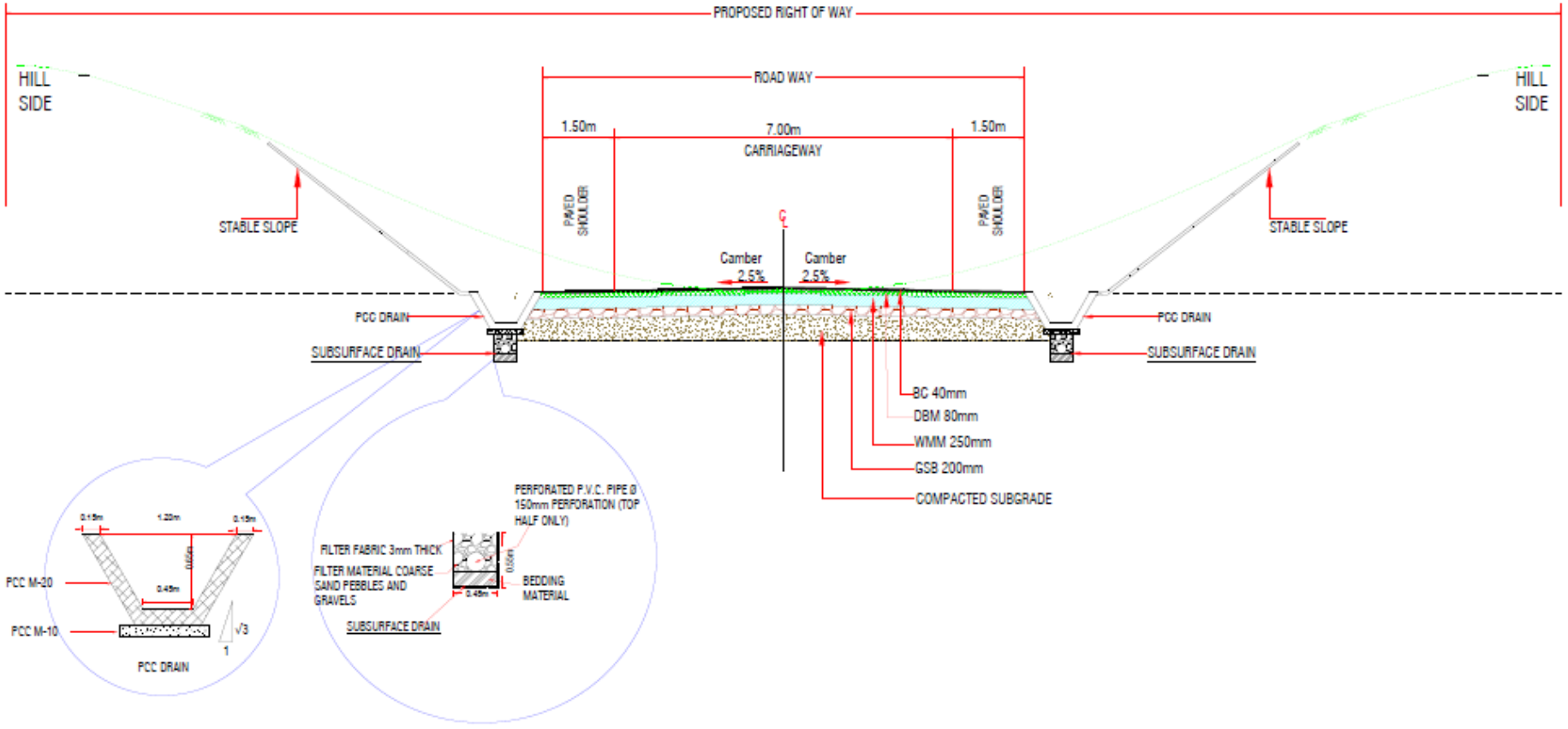
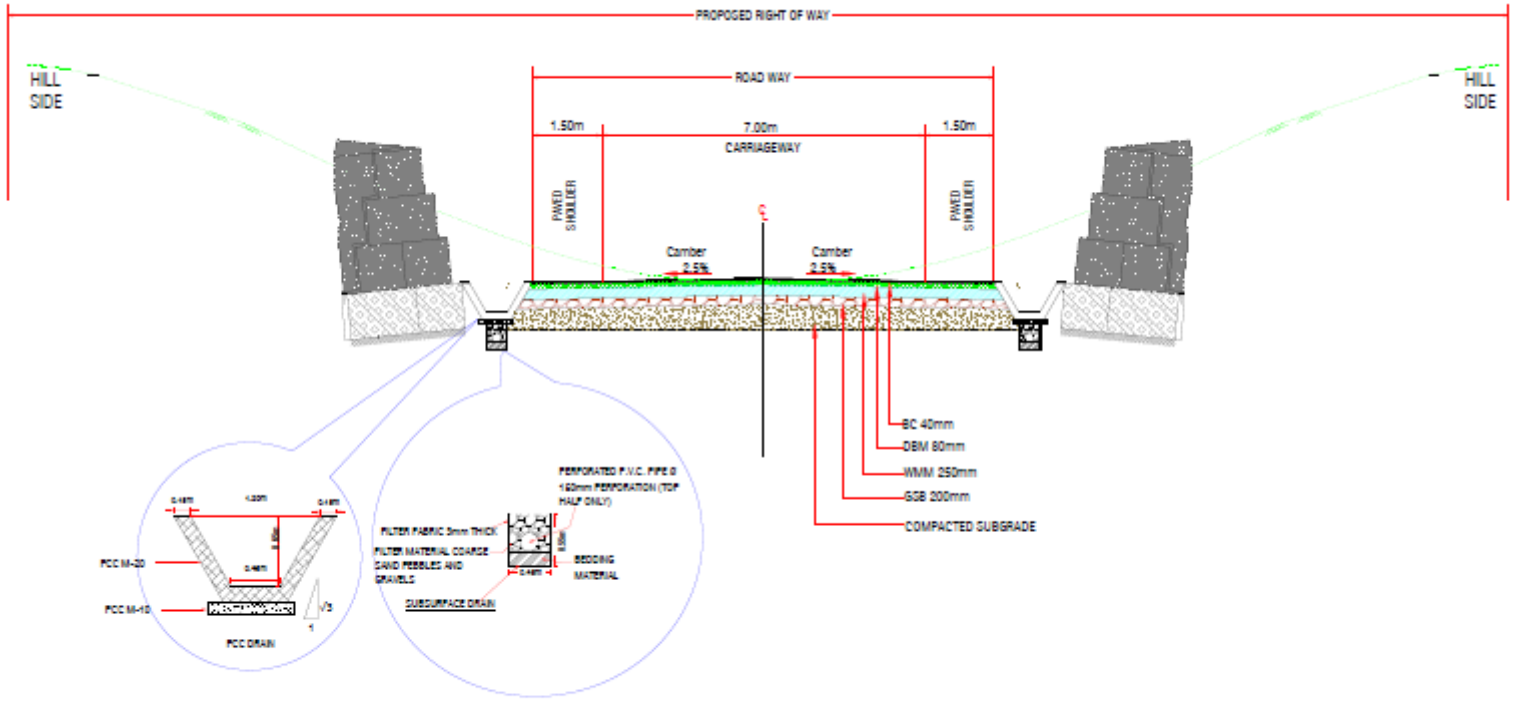
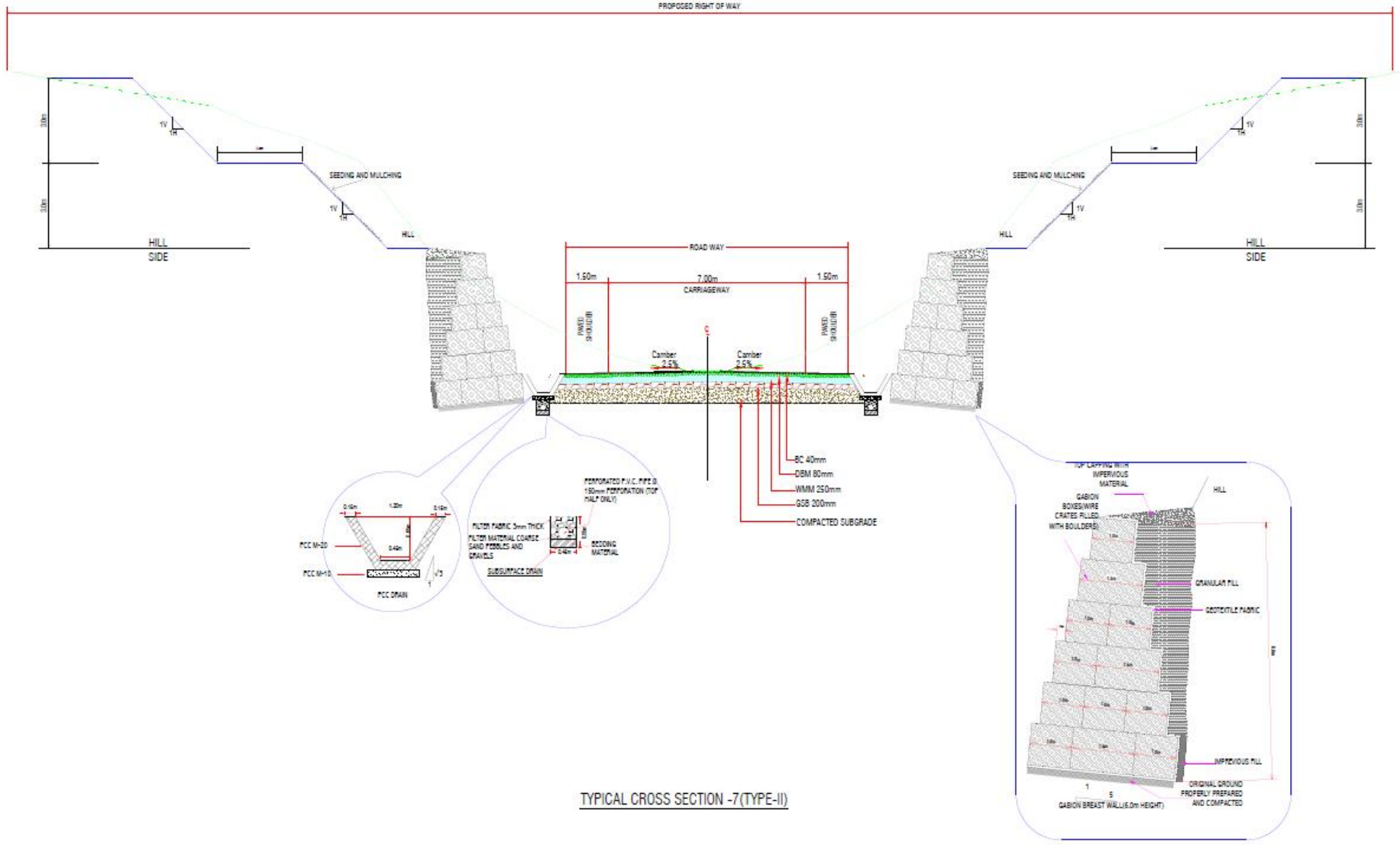


TYPICAL CROSS SECTION -7



TYPICAL CROSS SECTION -7(TYPE-I)



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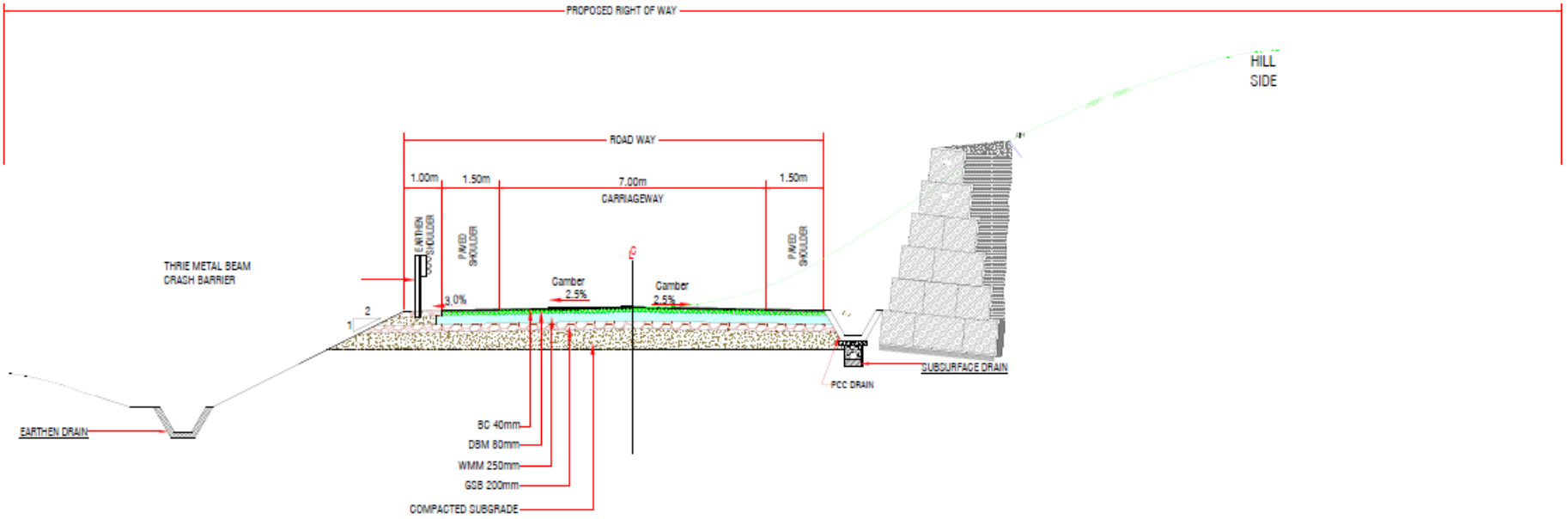

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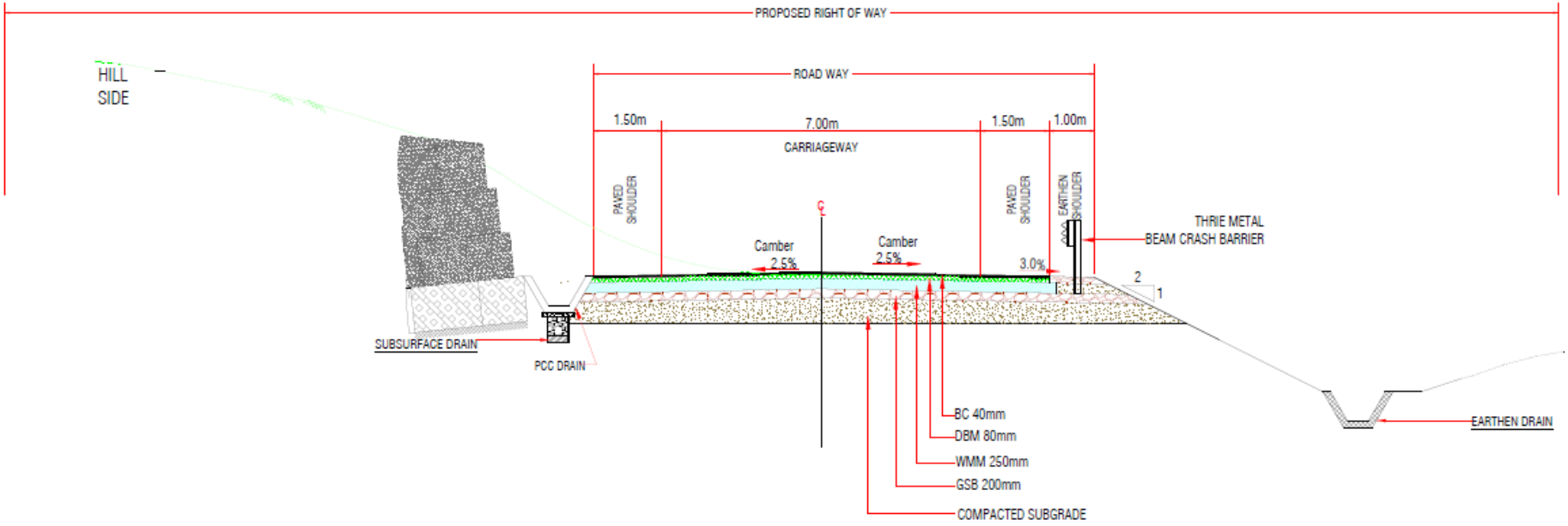
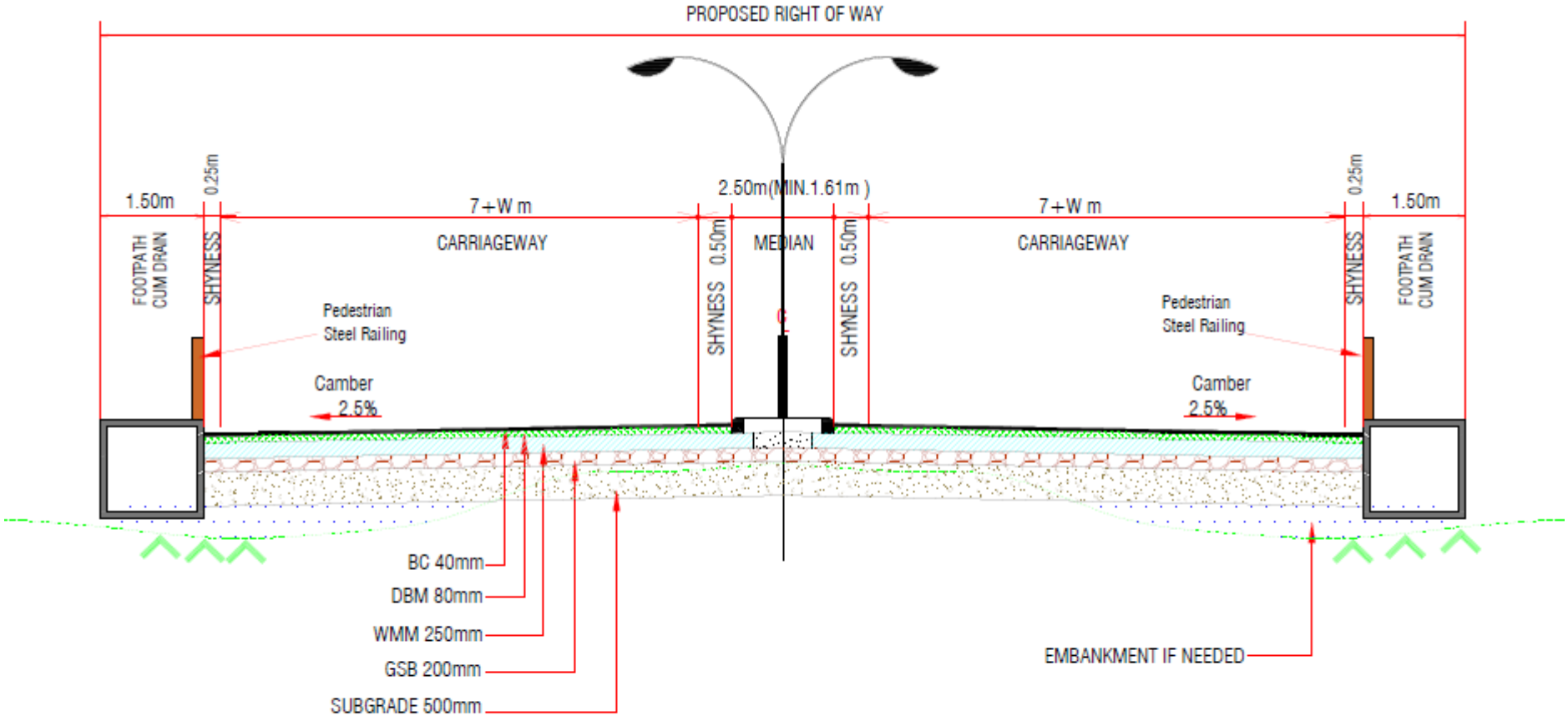
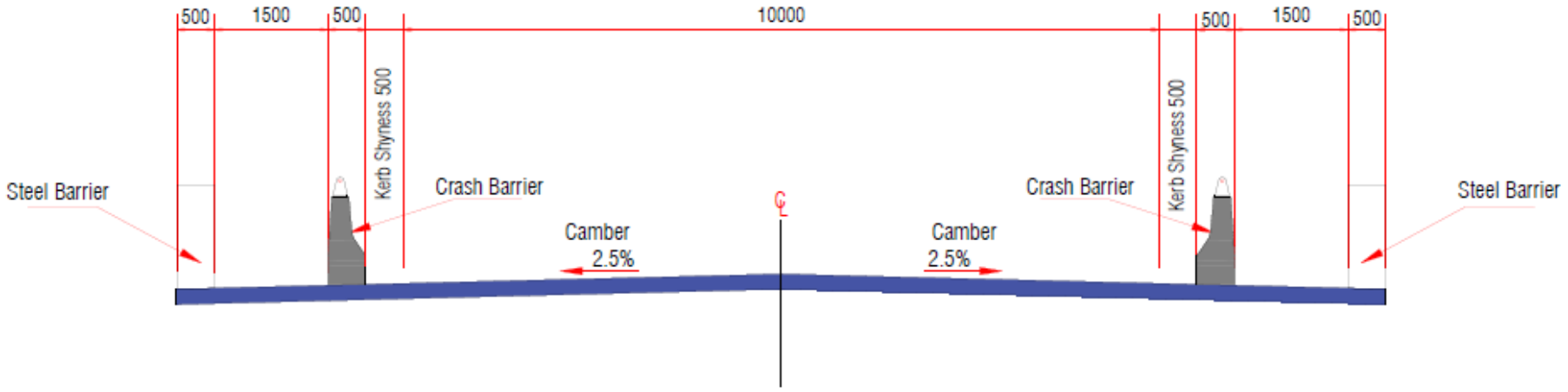


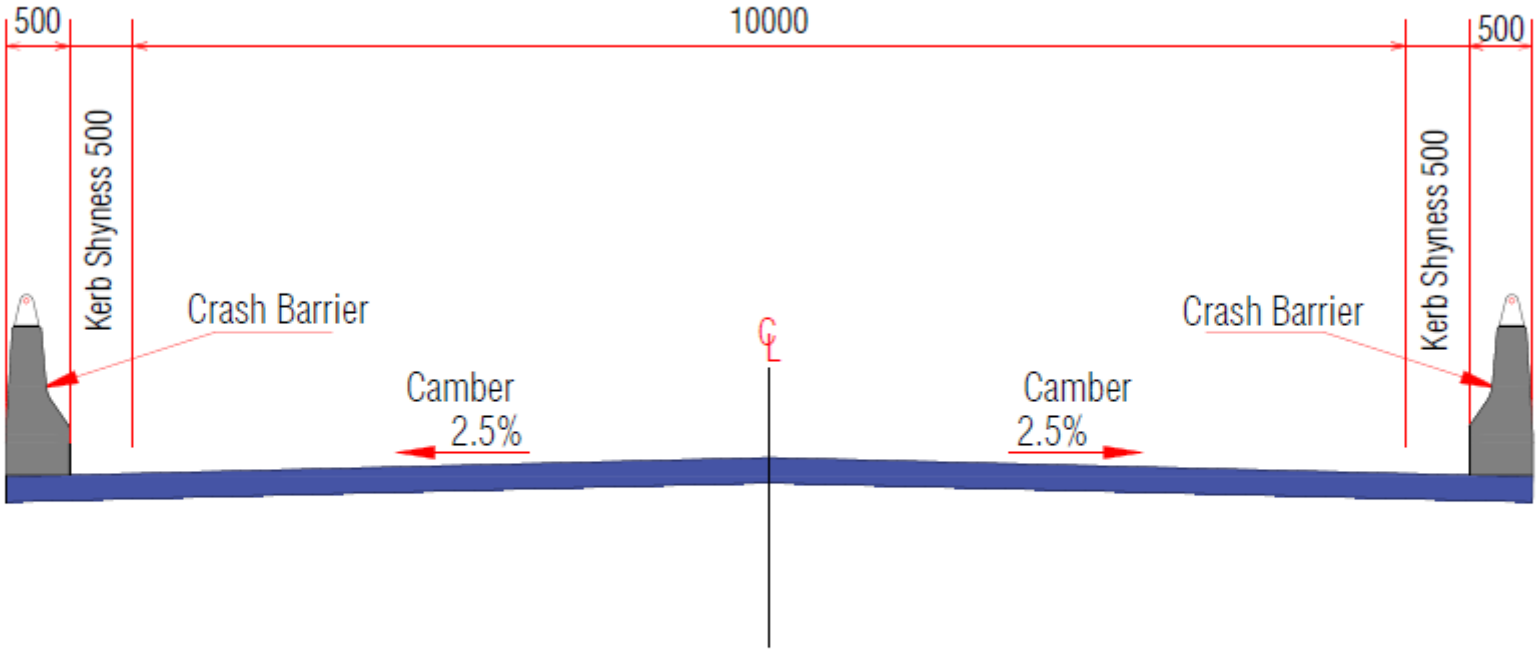
TYPICAL CROSS SECTION -7(TYPE-IV)



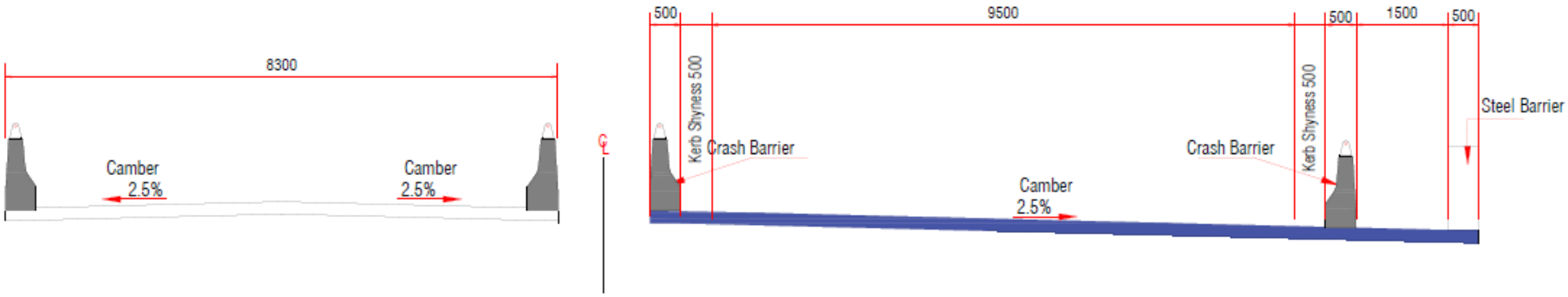
TYPICAL CROSS SECTION -8



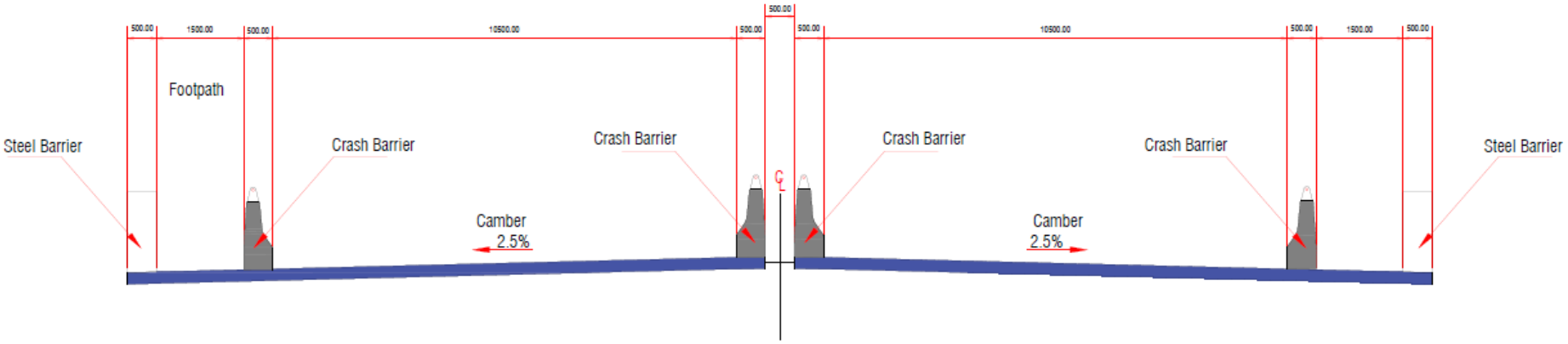
TYPICAL CROSS SECTION 9A
2-Lane Bridge With Footpath on Both Side



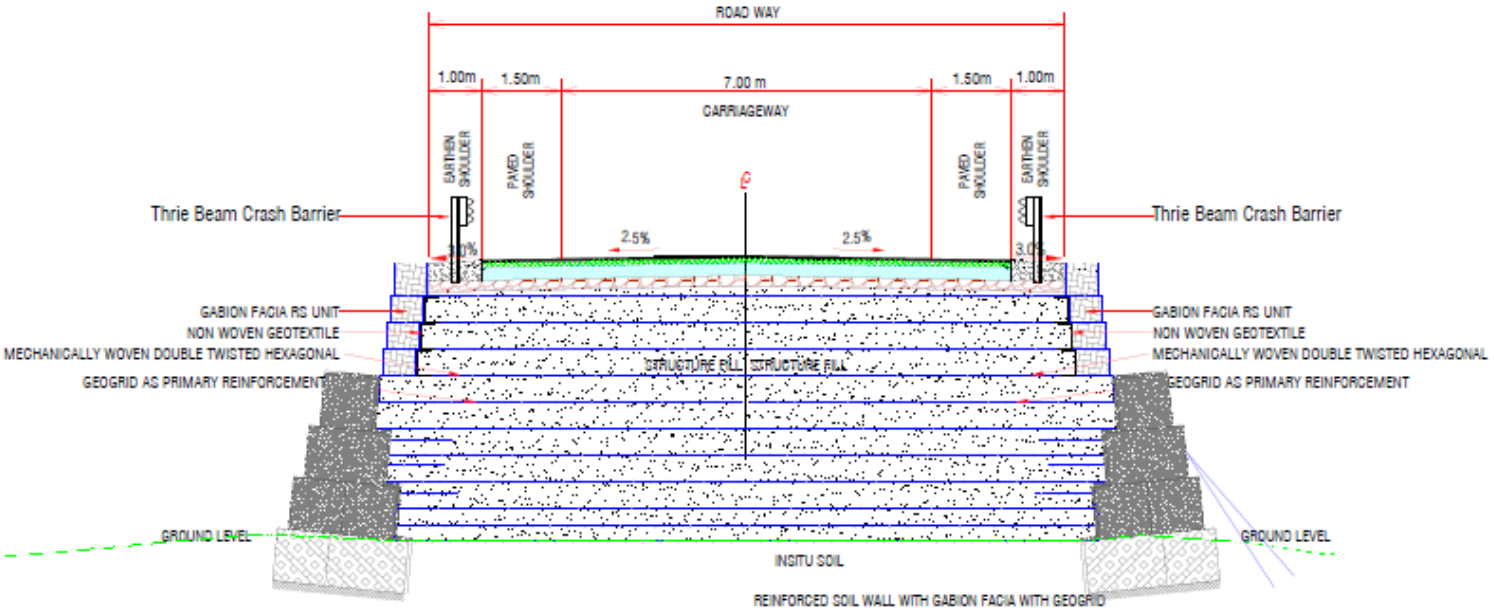
TYPICAL CROSS SECTION 9B



TYPICAL CROSS SECTION - 9C
2 Lane Existing Bridge on one side without footpath and New 2 Lane with Paved Shoulder Bridge with footpath keeping in view of 4 lane widening in future



TYPICAL CROSS SECTION - 10
4 Lane Bridge (2X2 lane) with footpath 2-Lane Highway



TYPICAL CROSS SECTION -11

5.5 Pavement design

5.5.1 Design period, loading and pavement type

Using the projected traffic, VDF values, lane and directional distribution factors, the design traffic loading used for the project is 20 MSA.

Through preliminary design and lifecycle comparisons, the type of pavement was chosen for construction with a design life of 20 years has been considered for design.

5.5.2 Design sub-grade strength

Considering the soil investigations conducted in the project road area, and the availability of suitable soil in the region, the following sub-grade strength has been assumed to vary from 7.0% to 8.0% for various sections of the highway.

5.5.3 Pavement Composition for New Carriageway

The pavement design has been carried out to arrive most economic Pavement for main carriageway and service Road. Three pavement Composition options were considered.

1) Option-1: Conventional Pavement Design Composition
2) Option-2: Cement Treated Sub Base and Base Pavement Design Composition
3) Option-3: Cement Treated Sub Base Pavement Design Composition

The proposed pavement composition for the new sections carriageway basis "The Manual of Standards and Specifications for "Two Laning of Highways with Paved Shoulder published by Indian Roads Congress IRC:SP:73-2018", subgrade strength and design traffic is:

Table 5-4: Proposed pavement composition for Option-1: Conventional Pavement Design

Pavement Layer		Thickness for Main carriage way in mm for 20 MSA
Bituminous	BC	40
	DBM	80
Granular	WMM	250
	GSB	200
Total Thickness		570

Table 5-5: Pavement Composition for Option-2: Cement Treated Sub Base and Base Pavement Design

Pavement Layer		Thickness for Main carriage way in mm for 20 MSA
Bituminous	BC	50

Pavement Layer		Thickness for Main carriage way in mm for 20 MSA
Granular	Granular Crack Relief Layer AIL	100
	CTB	115
	CTSB	200
Total Thickness		465

Table 5-6: Pavement Composition for Option-3: Cement Treated Sub Base Pavement Design

Pavement Layer		Thickness for Main carriage way in mm for 20 MSA
Bituminous	BC	30
	DBM	50
Granular	WMM	150
	CTSB	200
Total Thickness		430

For Elephant crossing locations the interlocking block pavement has been provided as per IRC: SP: 63-2018. The minimum block Thickness 80-100 mm.

5.5.4 Strengthening of existing pavement

The strengthening requirements for the existing pavement have been estimated from the deflection measurements and estimated traffic loadings. The designed overlay proposed is as below:

Table 5-7: Overlay thickness required

Section	Chainage	Distance	Characteristic deflection	Overlay thickness (mm)
NA				

5.6 Design of Structures

Along the project stretch, there are several bridges, culverts, under/overpasses and flyovers. Some of the new bridges have been proposed with a footpath on both side of the traffic direction. Overall width of all new culverts has been proposed to equal to roadway width of the approaches. The outer most face of railing/parapet has been in line with the outer most edge of shoulder. A summary of the total number and proposed additions is given in the table below

Table 5-8: Improvement proposals for Bridges and Culverts

Sr. No.	Particular	Existing Structure	Proposed				Left out	Total Proposed Structures
			Widening	Reconstruction	Retained	New Additional		
1	Major Bridge	Nil	--	--	--	--	--	--
2	Minor Bridge	14	4	5	--	4	5	13
3	Pipe Culverts	106	23	35	--	--	48	58
4	Slab Culverts	21	2	8	--	--	11	10
5	Box Culverts	Nil	--	--	--	40	--	40

5.7 Intersections and Grade Separators

Based on the traffic and turning movement surveys conducted, 40 junctions have been identified for redesign or grade separation, the details of which are given below

Table 5-9: Details of the Junctions improvement plans

Sl. No.	Location of intersection(Design Chainage)	Type of intersection	Other features
(1)	(2)	(3)	(4)
Major Intersections			
1	56.675	Y	Start of Airport Realignment
2	59.100	Y	End of Airport Realignment
3	61.075	Y	Start of Bypass (Jenjal)
4	61.775	X	End of Bypass (Jenjal)
5	66.875	Y	Realignment
6	72.550	Y	MDR
7	75.300	Y	Start of Bypass (Rongram)
8	75.850	Y	End of Bypass (Rongraml)
Minor Intersections			
1	48.075	T	VR
2	48.875	T	VR
3	49.140	Y	VR
4	49.260	Y	VR
5	50.720	T	VR
6	51.745	T	VR
7	53.745	Y	VR
8	55.625	T	VR
9	59.340	T	VR

Sl. No.	Location of intersection(Design Chainage)	Type of intersection	Other features
(1)	(2)	(3)	(4)
10	60.430	T	VR
11	60.820	Y	VR
12	60.970	Y	VR
13	62.620	Y	VR
14	63.375	T	VR
15	64.170	Y	VR
16	64.925	T	VR
17	65.030	T	VR
18	66.625	Y	VR
19	67.775	Y	VR
20	67.890	T	VR
22	69.045	Y	VR
23	69.420	Y	VR
24	73.230	Y	VR
25	73.275	Y	VR
26	73.600	T	VR
27	73.985	T	VR
28	74.190	Y	VR
29	74.500	T	VR
30	76.270	T	VR
31	76.380	Y	VR
32	76.820	T	VR

5.8 Drainage

An effective and efficient drainage system has been proposed for entire project highway including structures and facilities to avoid water logging. The storm water from road and adjacent areas shall be intercepted and carried through road side drains to the nearest natural outfalls. RCC footpath cum Drain and Open side trapezoidal PCC lined cross section drain has been provided as per TCS for the project Highway in order to intercept surface water from the carriageway, shoulders and slopes.

Table 5-10: Location of proposed Line Drains

S. No.	Proposed Type	Remarks	Length (m)
(1)	(2)	(3)	(4)
1	RCC Rectangular drain Cum Foot PATH	TCS - 8	2X2485
2	PCC Trapezoid Lined Drain on Hill Sides	TCS-7 TCS-7 (Type-I) TCS-7 (Type-II)	2X6354 2X150 2X5450

S. No.	Proposed Type	Remarks	Length (m)
(1)	(2)	(3)	(4)
		TCS-7 (Type-III) TCS-7 (Type-IV)	1X190 1X735
3	Longitudinal Subsurface Drain	TCS-7 TCS-7 (Type-I) TCS-7 (Type-II) TCS-7 (Type-III) TCS-7 (Type-IV)	2X6354 2X150 2X5450 1X190 1X735

5.9 Toll plazas

Based on the traffic surveys, O-D surveys and layout of project road, No Toll Plaza shall be provided. Toll plazas are proposed along the project road:

Table 5-11: Location of current and proposed toll plazas

Existing chainage	Design chainage	Location	Existing no of lanes	Proposed no of lanes
NA				

5.10 Slope Protection Works

The side slopes have been provided using suitable slope protection measures; such as Turfing & Vegetation, Stone pitching and Toe wall, drainage chutes, energy dissipation basin at toe of chutes wherever required along the Project Highway conforming to IRC guidelines and standard specifications have been proposed.

a) Toe Wall (PCC 2M)

Sr. No.	Chainage (Km)		Design Length (Km	TCS Code	Remarks
	From	To			
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
1	48100	48175	2X0.075	TCS 5	Both Side
2	48575	48675	2X0.100	TCS 5	Both Side
3	51350	51384	2X0.034	TCS 5	Both Side
4	51396	51800	2X0.404	TCS 5	Both Side
5	51875	51894	2X0.019	TCS 5	Both Side
6	51906	52025	2X0.119	TCS 5	Both Side
7	52100	52150	2X0.050	TCS 5	Both Side
8	52225	52325	2X0.100	TCS 5	Both Side
9	56675	56925	2X0.250	TCS 5	Both Side
10	57300	57425	2X0.125	TCS 5	Both Side
11	57525	57550	2X0.025	TCS 5	Both Side
12	57600	57725	2X0.125	TCS 5	Both Side
13	58350	58875	2X0.525	TCS 5	Both Side

Sr. No.	Chainage (Km)		Design Length (Km	TCS Code	Remarks
	From	To			
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
14	59950	60250	2X0.300	TCS 5	Both Side
15	61150	61325	2X0.175	TCS 5	Both Side
16	61450	61540	2X0.090	TCS 5	Both Side
17	61590	61675	2X0.085	TCS 5	Both Side
18	66875	66940	2X0.065	TCS 5	Both Side
19	66960	67050	2X0.090	TCS 5	Both Side
20	67275	67350	2X0.075	TCS 5	Both Side
21	67875	67908	2X0.033	TCS 5	Both Side
22	67933	67950	2X0.017	TCS 5	Both Side
23	71350	71400	2X0.050	TCS 5	Both Side
24	71525	71575	2X0.050	TCS 5	Both Side
25	71825	71925	2X0.100	TCS 5	Both Side
26	72225	72475	2X0.250	TCS 5	Both Side
27	74900	74975	2X0.075	TCS 5	Both Side
28	75070	75325	2X0.255	TCS 5	Both Side

b) Seeding and Mulching

Sr. No.	Design Ch. (Km)		Length (Km)	TCS
1	48250	48325	75	TCS 7 type II
2	49950	50025	75	TCS 7 type II
3	50250	50850	600	TCS 7 type II
4	52675	54200	1525	TCS 7 type II
5	54600	54700	100	TCS 7 type II
6	56000	56425	425	TCS 7 type II
7	57050	57300	250	TCS 7 type II
8	57725	58350	625	TCS 7 type II
9	61675	61800	125	TCS 7 type II
10	69275	70925	1650	TCS 7 type II

c) Retaining Wall

Sr. No.	Design Ch. (Km)		Length (m)	TCS	Remarks
	From	To			
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
1	48325	48375	50	TCS 4	Dachi Lake
2	71925	71992	67	TCS 11	
4	72008	72225	217	TCS 11	

d) Hill Side Gabion Wall

Sr. No.	Design Ch. (Km)		Length (Km)	TCS	Remarks
	From	To			
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
1	48250	48325	75	TCS 7 type II	Minimum 6 m Height Gabion Wall both side of Hill cutting
2	49950	50025	75	TCS 7 type II	Minimum 6 m Height Gabion Wall both side of Hill cutting
3	50250	50850	600	TCS 7 type II	Minimum 6 m Height Gabion Wall both side of Hill cutting
4	52675	54200	1525	TCS 7 type II	Minimum 6 m Height Gabion Wall both side of Hill cutting
5	54600	54700	100	TCS 7 type II	Minimum 6 m Height Gabion Wall both side of Hill cutting
6	56000	56425	425	TCS 7 type II	Minimum 6 m Height Gabion Wall both side of Hill cutting
7	56525	56675	150	TCS 7 type IV	Minimum 4 m Height Gabion Wall one side of Hill cutting
8	57050	57300	250	TCS 7 type II	Minimum 6 m Height Gabion Wall both side of Hill cutting
9	57725	58350	625	TCS 7 type II	Minimum 6 m Height Gabion Wall both side of Hill cutting
10	61325	61450	125	TCS 7 type III	Minimum 6 m Height Gabion Wall one side of Hill cutting
11	61675	61800	125	TCS 7 type II	Minimum 6 m Height Gabion Wall both side of Hill cutting

Sr. No.	Design Ch. (Km)		Length (Km)	TCS	Remarks
	From	To			
(1)	(2)	(3)	(4)	(5)	(6)
12	66675	66775	100	TCS 7 type IV	Minimum 4 m Height Gabion Wall one side of Hill cutting
13	66775	66875	100	TCS 7 type I	Minimum 4 m Height Gabion Wall both side of Hill cutting
14	68500	68550	50	TCS 7 type I	Minimum 4 m Height Gabion Wall both side of Hill cutting
15	69275	70925	1650	TCS 7 type II	Minimum 6 m Height Gabion Wall both side of Hill cutting
16	71125	71350	225	TCS 7 type IV	Minimum 4 m Height Gabion Wall one side of Hill cutting
17	71475	71525	50	TCS 7 type IV	Minimum 4 m Height Gabion Wall one side of Hill cutting
18	71575	71650	75	TCS 7 type IV	Minimum 4 m Height Gabion Wall one side of Hill cutting
19	75575	75710	135	TCS 7 type IV	Minimum 4 m Height Gabion Wall one side of Hill cutting
20	75710	75775	65	TCS 7 type III	Minimum 6 m Height Gabion Wall one side of Hill cutting
Total Length OF 4 m wall in Km.			=1x0.735+2x0.150=1.770		
Total Length OF 6 m wall in Km.			=1x0.190+2x5.450=11.09		

5.11 Project Facilities

The following Project facilities have been included in the Project.

- Traffic Control Devices and Road Safety Works;

  (a) Road Signs

  (b) Road Marking

  (c) Road Delineator

  (d) Reflective Pavement Markers (Road Studs)

  (e) Roadside & Median Side Safety Barriers

- Pedestrian facilities;
- Land Scoping & Tree Plantation
- Project Facilities

  (a) Road Boundary Stone

  (b) Kilometre & 200 m Stone

  (c) Street Lighting

  (d) Truck lay-byes;

  (e) bus-bays and bus shelters;

  (f) Highway Petro Units

  (g) Emergency Medical Services Cranes;

  (h) Crane Services

  (i) Communication System
- Traffic Diversion during Construction
- Others

  (a) Utilities Ducts

6 . Environmental impact assessment

An environmental impact study was undertaken during the process of creating the detailed project report to understand impact of the project road on the surrounding ecology and environment. The Project Highway Length is approximately 79.0 Km. Hence, the Environmental Clearance (EC) is not required for the Project Highway under Schedule 7(f) as per S.O. 2559 (E), MoEF Notification of 22nd August 2013 (as amendment of 14th September 2006) i.e., Expansion of National Highways greater than 100 km involving additional right of way or land acquisition greater than 40m on the existing alignments and 60m on re-alignment or bypasses. Hence No package out six does not attract Environment Clearance.

The proposed Project does not involve the acquisition of forest land in Package-III in the West Garo Hill District in State of Meghalaya. The DFO has issued NOC for package-II in this regard. However, no loss of rare/threatened/endangered species of flora is envisaged. All impacts are site-specific and can be addressed through proven mitigation measures. Hence, the project is warranting an initial environmental examination (IEE). The EIA & EMP report has been prepared as per MOEF & CC Guidelines

The Project Highway Package-III does not pass any Protected Area Network Hence, Wild Life clearance is not required. In this regard DFO has issued the necessary certificate. However the some elephant movement had been noticed. There two locations has been identified for Elephant crossing. The DFO & Chief Wild life waden (CWLW) has suggested some mitigation measures which has been incorporated in Draft DPR. The typical diagram is enclosed.

The Environmental Mitigation and Management Costs were developed based on the estimation of resources required to implement the mitigation measures proposed and also number of places where intervention is required. Environmental mitigation cost for the proposed project is Rs 1.0 Cr. including road side tree cutting.

7 . Social impact assessment and Land acquisition

7.1 Social impact assessment

The existing 2-lane Road has RoW 15-22.5 m, which is inadequate for the proposed widening. The land width for 2-lane has been proposed 45 m and 36 m in Rural Areas and Built-up.

Sl. No.	Design Chainage		ROW		Total Width of ROW (m)	Remarks
	From	To	LHS (m)	RHS (m)		
(1)	(4)	(5)	(6)	(7)	(8)	(9)
1	47.075	48.180	22.500	22.50	45.00	
2	48.180	48.362	35.000	35.00	70.00	
3	48.362	49.959	30.000	30.00	60.00	
4	49.959	50.181	35.000	35.00	70.00	
5	50.181	50.945	40.000	40.00	80.00	
6	50.945	51.340	35.000	35.00	70.00	
7	51.340	51.485	22.500	22.50	45.00	
8	51.485	52.623	30.000	30.00	60.00	
9	52.623	53.932	45.000	45.00	90.00	
10	53.932	54.840	30.000	30.00	60.00	
11	54.840	56.572	40.000	30.00	70.00	
12	56.572	58.463	30.000	30.00	60.00	
13	58.463	60.000	22.500	22.50	45.00	
14	60.000	61.669	22.500	22.500	45.000	
15	61.669	61.820	35.000	35.000	70.000	
16	61.820	63.043	20.000	35.000	55.000	
17	63.043	63.318	22.500	22.500	45.000	
18	63.318	63.471	20.000	35.000	55.000	
19	63.471	64.040	22.500	22.500	45.000	
20	64.040	64.140	20.000	35.000	55.000	
21	64.140	65.039	22.500	22.500	45.000	
22	65.039	65.489	35.000	20.000	55.000	
23	65.489	66.036	22.500	22.500	45.000	
24	66.036	66.419	35.000	25.000	60.000	
25	66.419	66.622	25.000	35.000	60.000	
26	66.622	66.673	22.500	22.500	45.000	
27	66.673	66.723	35.000	25.000	60.000	
28	66.723	66.870	50.000	40.000	90.000	
29	66.870	66.970	22.500	22.500	45.000	

30	66.970	67.146	35.000	25.000	60.000	
31	67.146	68.035	22.500	22.500	45.000	
32	68.035	68.220	35.000	25.000	60.000	
33	68.220	69.000	22.500	22.500	45.000	
34	69.000	69.294	22.50	22.50	45.000	
35	69.294	71.111	35.00	35.00	70.000	
36	71.111	72.641	22.50	22.50	45.000	
37	72.641	73.440	18.00	18.00	36.000	
38	73.440	75.958	22.50	22.50	45.000	
39	75.958	77.055	18.00	18.00	36.000	

The Project Highway require total 167.53 Ha out of that 56.10 Ha land is available and remaining 111.44 Ha Private land need to be acquired.

Preliminary interactions have been held with locals to understand their issues and concerns and help communicate the project plan and its impact on them. The key concerns of title and non-title holders centered on Compensation of Land and Assists

7.2 Land acquisition requirements

The state and district wise details and status of land acquisition as on the date of publishing of this report is as follows:

Table 7-1: Cost for the Land Acquisition

Sr. No.	Particular	
1	Chainage	From Km 47.075 to Km 77.055
2	Total Land Required for Project in Ha	167.53 Ha
3	Land Available in Ha	56.10
4	Land Need to be acquired in Ha	111.44 Ha (Private Land) +0.00 ha Government including forest
5	Total Compensation (in Cr.) Lum sum	Rs. 250.74 Cr.

A total of Rs. 250.74 crores is expected to be awarded for the acquisition of land required for this project. The land acquisition process is underway with a total of One CALAs appointed.

7.3 Key risks envisaged in land acquisition

No Major risk has been envisaged in the Proposed Project Highway.

8 . Utilities shifting and clearances

Utilities belonging to user agencies have been identified that fall within the project road ROW and will need to be shifted to enable road construction. Shifting proposals have been submitted to the user agencies and initial estimates have been received from the concerned agencies. The process of site inspection, review and revision of the proposals for utilities shifting is in process.

To enable better management of utilities and installation going forward, all utilities are being shifted underground/into a utility corridor/out of the road RoW/ utilities trench is being planned as part of construction>

8.1 Utilities shifting estimates

Table 8-1: Key utilities shifting requirements

Sl No	Utility	Chainage affected	Agency	Shifting required	Estimated cost Cr.	Supervision	Current status
1	Electrical	Most of Project Highway	MePDCL	Yes	Rs. 2.60 (Provisional)	Rs. 34.43 Lakhs (Provisional)	Final estimate has not been submitted
2	Water Supply	At three locations	PHE	Yes	Rs. 2.97	Rs 52.49 Lakhs	Final estimate has been submitted
			Total in Cr.		Rs. 5.57	Rs 86.98 Lakhs	

8.2 Total cost of utilities shifting

The total cost of utilities shifting for all the utilities identified in the road RoW is estimated to be with supervision charges of being paid as supervision charges to the concerned agencies.

9 . Project cost estimates

The cost estimates for the project has been carried out based on detailed design, bill of quantities, and the schedule of rates for NH BSR-2018-19 Garo Hills Meghalaya. The summary of Cost estimate for various options are as follows

Table 9-1: Summary of project cost for Option 1 Conventional Pavement

BILL SUMMARY				
		Based on Meghalaya PWD NH BSR 2018-19		
S.N.	PARTICULAR	Amount (INR)	Amount (INR) without GST	Amount in Cr
1	BILL NO: 1 SITE CLEARANCE AND DISMANTELING	6874033	6137529	0.61
2	BILL NO: 2 - EARTHWORK	1865464015	1665592871	166.56
3	BILL NO: 3 - SUB-BASE AND BASE COURSES			
	a) GSB	347988347	310703881	31.07
	b) WMM	365303945	326164237	32.62
	c) CTSB	0	0	0.00
	d) CTB	0	0	0.00
4	BILL NO: 4 (A) - BITUMINOUS WORKS - FLEXIBLE PAVEMENT			
	a) DBM	338849973	302544619	30.25
	b) BC	185637894	165748119	16.57
	c)Tack Coat	11422222	10198413	1.02
	d) Prime Coat	16116296	14389550	1.44
	BILL NO: 4 (B) - RIGID PAVEMENT	0	0	0.00
5	BILL NO: 5 CULVERTS			
A	Box Culvert (New/Reconstruction)	123173095	109975978	11.00
B	Box Culvert (Widening)	2540403	2268217	0.23
C	Pipe Culvert (New/Reconstruction)	32396759	28925678	2.89
D	Pipe Culvert (Widening)	12220329	10911008	1.09
E	Protection Work for Widening	1757955	1569603	0.16
F	Protection Work for New construction	60112316	53671711	5.37
G	Culvert Repairing	1068529	954044	0.10
6	BILL NO:6 BRIDGES			
A	Elevated Structure			
i)	PSC GIRDER Elevated Structure	151673228	135422525	13.54
ii)	Protection Work	9495482	8478109	0.85

B	MINOR BRIDGES			
i)	SLAB MNB (New/Reconstruction)	110852356	98975318	9.90
ii)	SLAB MNB (Widening)	24687717	22042604	2.20
iii)	Box MNB (New/Reconstruction)	76002565	67859433	6.79
iv)	PSC GIRDER MNB	124739954	111374959	11.14
v)	PSC GIRDER MNB (Widening)	42697529	38122794	3.81
vi)	Protection Work (New/Reconstruction)	87251360	77903000	7.79
vii)	Protection Work (Widening)	23723269	21181490	2.12
viii)	Minor Bridge Repairing	4124725	3682790	0.37
ix)	Box LVUP	17771411	15867331	1.59
x)	Box SVUP	4668940	4168696	0.42
7	BILL NO: 7 DRAINAGE & PROTECTION WORK	980520967	875465149	87.55
8	BILL NO: 8 - TRAFFIC SIGNS, ROAD MARKINGS AND APPURTENANCES	154833766	138244434	13.82
9	BILL NO: 9 - Passenger Shelter	1400000	1250000	0.13
10	BILL NO: 10 - Utility Duct	679836	606996	0.06
11	BILL NO: 11 - Street Lighting	2883806	2574827	0.26
12	Truck Lay bye	19205448.0	17147721	1.71
13	Junction	23547369.0	21024437	2.10
14	Tree Cutting @1000/ tree for 6000 trees		6000000	0.60
15	Muck Dumping		442117	0.04
	Civil Cost As Per SOR 2018-19 Exclusive GST		**4677590188**	467.76
A	**Civil Cost In 2021-22 Considering Inflation Rate 16.36% (WPI FY 2021-22: 139.4, WPI FY 2018-19: 119.8)**		**5442843943**	**544.28**
	Utility Shifting			
B1	**Electrical (Provisional)**		**26032330**	**2.60**
B2	**Water**		**29688918**	**2.97**
B	**Cost of Utility Shifting**		**55721248**	**5.57**
C	**Estimated Civil Cost/ Cost Put to Tender (A+B)**		**5498565191**	**549.86**
	GST @ 12% of A		**653141273**	**65.31**
	GST as per Estimate given by Agency of B1 (Provisional)		**5768945**	**0.58**
	GST as per Estimate given by Agency of B2		**5344005**	**0.53**

	Contingencies @1% Of (C)		54985652	**5.50**
	Agency Charges @3% Of (C)		164956956	**16.50**
	O&M Cost For Last Five Years After Construction @2.5% Of (C)		137464130	**13.75**
	Supervision Charges @ 3% Of (C)		164956956	**16.50**
	Price Escalation @ 5% per year for 1 year on C		274928260	**27.49**
	Add other charges of Utility Shifting		8698203	**0.87**
D	**Total Project Civil Cost**		6968809572	**696.88**
E	Land Acquisition Provisional Cost @ 2.25 Cr/Hect.		2507400000	**250.74**
F	Forest Clearnace & Environment Cost		0	**0.00**
G	Approx Cost of Environment Mitigation		10000000	**1.00**
H	**Total Non Civil Cost (E+F+G)**		2517400000	**251.74**
I	**Total Project Cost (D+H)**		9486209572	**948.62**

Table 9-2: Summary of project cost for Option 2 Cement Treated Sub-Base Pavement

BILL SUMMARY				
		Based on Meghalaya PWD NH BSR 2018-19		
S.N.	**PARTICULAR**	**Amount (INR)**	**Amount (INR) without GST**	**Amount in Cr**
1	BILL NO: 1 SITE CLEARANCE AND DISMANTELING	6874033	6137529	0.61
2	BILL NO: 2 - EARTHWORK	1861282388	1661859275	166.19
3	BILL NO: 3 - SUB-BASE AND BASE COURSES			
	a) GSB	20168636	18007711	1.80
	b) WMM	217548082	194239359	19.42
	c) CTSB	319264593	285057672	28.51
	d) CTB	0	0	0.00
4	BILL NO: 4 (A) - BITUMINOUS WORKS - FLEXIBLE PAVEMENT			
	a) DBM	211781233	189090387	18.91
	b) BC	139228421	124311090	12.43
	c)Tack Coat	11422222	10198413	1.02
	d) Prime Coat	16116296	14389550	1.44

	BILL NO: 4 (B) - RIGID PAVEMENT	0	0	0.00
5	BILL NO: 5 CULVERTS			
A	Box Culvert (New/Reconstruction)	123173095	109975978	11.00
B	Box Culvert (Widening)	2540403	2268217	0.23
C	Pipe Culvert (New/Reconstruction)	32396759	28925678	2.89
D	Pipe Culvert (Widening)	12220329	10911008	1.09
E	Protection Work for Widening	1757955	1569603	0.16
F	Protection Work for New construction	60112316	53671711	5.37
G	Culvert Repairing	1068529	954044	0.10
6	BILL NO:6 BRIDGES			
A	Elevated Structure			
i)	PSC GIRDER Elevated Structure	151673228	135422525	13.54
ii)	Protection Work	9495482	8478109	0.85
B	MINOR BRIDGES			
i)	SLAB MNB (New/Reconstruction)	110852356	98975318	9.90
ii)	SLAB MNB (Widening)	24687717	22042604	2.20
iii)	Box MNB (New/Reconstruction)	76002565	67859433	6.79
iv)	PSC GIRDER MNB	124739954	111374959	11.14
v)	PSC GIRDER MNB (Widening)	42697529	38122794	3.81
vi)	Protection Work (New/Reconstruction)	87251360	77903000	7.79
vii)	Protection Work (Widening)	23723269	21181490	2.12
viii)	Minor Bridge Repairing	4124725	3682790	0.37
ix)	Box LVUP	17771411	15867331	1.59
x)	Box SVUP	4668940	4168696	0.42
7	BILL NO: 7 DRAINAGE & PROTECTION WORK	980520967	875465149	87.55
8	BILL NO: 8 - TRAFFIC SIGNS, ROAD MARKINGS AND APPURTENANCES	154833766	138244434	13.82
9	BILL NO: 9 - Passenger Shelter	1400000	1250000	0.13
10	BILL NO: 10 - Utility Duct	679836	606996	0.06
11	BILL NO: 11 - Street Lighting	2883806	2574827	0.26
12	Truck Lay bye	11701928.0	10448150	1.04
13	Junction	15102470.0	13484348	1.35
14	Tree Cutting @1000/ tree for 6000 trees		6000000	0.60
15	Muck Dumping		442117	0.04
	Civil Cost As Per SOR 2018-19 Exclusive GST		**4365162296**	**436.52**

A	**Civil Cost In 2021-22 Considering Inflation Rate 16.36% (WPI FY 2021-22: 139.4, WPI FY 2018-19: 119.8)**		**5079302848**	**507.93**
	Utility Shifting			
B1	**Electrical (Provisional)**		**26032330**	**2.60**
B2	**Water**		**29688918**	**2.97**
B	**Cost of Utility Shifting**		**55721248**	**5.57**
C	**Estimated Civil Cost/ Cost Put to Tender (A+B)**		**5135024096**	**513.50**
	GST @ 12% of A		**609516342**	**60.95**
	GST as per Estimate given by Agency of B1 (Provisional)		**5768945**	**0.58**
	GST as per Estimate given by Agency of B2		**5344005**	**0.53**
	Contingencies @1% Of (C)		51350241	**5.14**
	Agency Charges @3% Of (C)		154050723	**15.41**
	O&M Cost For Last Five Years After Construction @2.5% Of (C)		128375602	**12.84**
	Supervision Charges @ 3% Of (C)		154050723	**15.41**
	Price Escalation @ 5% per year for 1 year on C		256751205	**25.68**
	Add other charges of Utility Shifting		8698203	**0.87**
D	**Total Project Civil Cost**		6508930085	**650.89**
E	Land Acquisition Provisional Cost @ 2.25 Cr/Hect.		2507400000	**250.74**
F	Forest Clearnace & Environment Cost		0	**0.00**
G	Approx Cost of Environment Mitigation		10000000	**1.00**
H	**Total Non Civil Cost (E+F+G)**		2517400000	**251.74**
I	**Total Project Cost (D+H)**		9026330085	**902.63**

Table 9-3: Summary of project cost for Option 3 Cement Treated Base and Cement Treated Sub-Base Courses Pavement

BILL SUMMARY				
		Based on Meghalaya PWD NH BSR 2018-19		
S.N.	**PARTICULAR**	**Amount (INR)**	**Amount (INR) without GST**	**Amount in Cr**
1	BILL NO: 1 SITE CLEARANCE AND DISMANTELING	6874033	6137529	0.61

2	BILL NO: 2 - EARTHWORK	1861703525	1662235290	166.22
3	BILL NO: 3 - SUB-BASE AND BASE COURSES			
	a) GSB	20168636	18007711	1.80
	b) WMM	148734911	132799027	13.28
	c) CTSB	322337131	287801010	28.78
	d) CTB	135269638	120776463	12.08
4	BILL NO: 4 (A) - BITUMINOUS WORKS - FLEXIBLE PAVEMENT			
	a) DBM	0	0	0.00
	b) BC	237631200	212170714	21.22
	c)Tack Coat	9798522	8748680	0.87
	d) Prime Coat	16504108	14735810	1.47
	BILL NO: 4 (B) - RIGID PAVEMENT	0	0	0.00
5	BILL NO: 5 CULVERTS			
A	Box Culvert (New/Reconstruction)	123173095	109975978	11.00
B	Box Culvert (Widening)	2540403	2268217	0.23
C	Pipe Culvert (New/Reconstruction)	32396759	28925678	2.89
D	Pipe Culvert (Widening)	12220329	10911008	1.09
E	Protection Work for Widening	1757955	1569603	0.16
F	Protection Work for New construction	60112316	53671711	5.37
G	Culvert Repairing	1068529	954044	0.10
6	BILL NO:6 BRIDGES			
A	Elevated Structure			
i)	PSC GIRDER Elevated Structure	151673228	135422525	13.54
ii)	Protection Work	9495482	8478109	0.85
A	MINOR BRIDGES			
i)	SLAB MNB (New/Reconstruction)	110852356	98975318	9.90
ii)	SLAB MNB (Widening)	24687717	22042604	2.20
iii)	Box MNB (New/Reconstruction)	76002565	67859433	6.79
iv)	PSC GIRDER MNB	124739954	111374959	11.14
v)	PSC GIRDER MNB (Widening)	42697529	38122794	3.81
vi)	Protection Work (New/Reconstruction)	87251360	77903000	7.79
vii)	Protection Work (Widening)	23723269	21181490	2.12
viii)	Minor Bridge Repairing	4124725	3682790	0.37
ix)	Box LVUP	17771411	15867331	1.59
x)	Box SVUP	4668940	4168696	0.42

7	BILL NO: 7 DRAINAGE & PROTECTION WORK	980520967	875465149	87.55
8	BILL NO: 8 - TRAFFIC SIGNS, ROAD MARKINGS AND APPURTENANCES	154833766	138244434	13.82
9	BILL NO: 9 - Passenger Shelter	1400000	1250000	0.13
10	BILL NO: 10 - Utility Duct	679836	606996	0.06
11	BILL NO: 11 - Street Lighting	2883806	2574827	0.26
12	Truck Lay bye	9239144.0	8249236	0.82
13	Junction	12254875.0	10941853	1.09
14	Tree Cutting @1000/ tree for 6000 trees		6000000	0.60
15	Muck Dumping		442117	0.04
	Civil Cost As Per SOR 2018-19 Exclusive GST		**4320542135**	432.05
A	**Civil Cost In 2021-22 Considering Inflation Rate 16.36% (WPI FY 2021-22: 139.4, WPI FY 2018-19: 119.8)**		**5027382828**	**502.74**
	Utility Shifting			
B1	**Electrical (Provisional)**		**26032330**	2.60
B2	**Water**		**29688918**	2.97
B	**Cost of Utility Shifting**		**55721248**	**5.57**
C	**Estimated Civil Cost/ Cost Put to Tender (A+B)**		**5083104076**	**508.31**
	GST @ 12% of A		**603285939**	**60.33**
	GST as per Estimate given by Agency of B1 (Provisional)		**5768945**	**0.58**
	GST as per Estimate given by Agency of B2		**5344005**	**0.53**
	Contingencies @1% Of (C)		50831041	**5.08**
	Agency Charges @3% Of (C)		152493122	**15.25**
	O&M Cost For Last Five Years After Construction @2.5% Of (C)		127077602	**12.71**
	Supervision Charges @ 3% Of (C)		152493122	**15.25**
	Price Escalation @ 5% per year for 1 year on C		254155204	**25.42**
	Add other charges of Utility Shifting		8698203	**0.87**
D	**Total Project Civil Cost**		6443251261	**644.33**
E	Land Acquisition Provisional Cost @ 2.25 Cr/Hect.		2507400000	**250.74**
F	Forest Clearnace & Environment Cost		0	**0.00**

G	Approx Cost of Environment Mitigation		10000000	**1.00**
H	**Total Non Civil Cost (E+F+G)**		2517400000	**251.74**
I	**Total Project Cost (D+H)**		8960651261	**896.07**

Note: Rates considered: P.W.D Schedule of rates 2018-19 along with upto date addenda and corrigenda.

Although, the project cost is minimum in case of CTSB, CTB, Crack relief layer (WMM) and BC pavement, Option 2 of pavement composition (i.e. CTSB, WMM, DBM, and BC Composition has been considered for recommendation as per discussion had with the authority by considering the following reasons:

i. Project located over hilly terrain area and received very high rainfall, Therefore, a pavement combination which have both DBM and BC is recommendable.

ii. If, skilled workmanship is not available to execute the work at site during construction, it will be difficult to maintain the quality of work and subsequently affect the durability of the work.

10 .Material investigation

Material investigations were carried out to explore the availability and identify sources of suitable material for the construction of the road. The summary of source of available material along with lead are as follow

Table 10-1: Lead of Material

Sl. No	Name of Material	Place	Distance from Source to Start/ End Point of Project Road	Distance up to Project C.G from Start/ End Point (km)	Total Lead (Km)
1.00	Sand (Fine)	Samanda. On Williom Nagar Road	30.00	14.99	44.99
2.00	Moorum/ Rubbish	Samanda. On Williom Nagar Road	30.00	14.99	44.99
3.00	Stone Metal	Samanda. On Williom Nagar Road	30.00	14.99	44.99
4.00	Stone Boulder	Samanda. On Williom Nagar Road	30.00	14.99	44.99
5.00	Stone Chips, Aggregate	Samanda. On Williom Nagar Road	30.00	14.99	44.99
6.00	Coarse Sand	Didram Riber Bajengdoba Area	26.18	14.99	41.17
7.00	Lime	Bongaigaon Assam	132.58	14.99	147.57
8.00	Cement	Bongaigaon Assam	132.58	14.99	147.57
9.00	Steel	Bongaigaon Assam	132.58	14.99	147.57
10.00	Tar, Bitumen	Haldia West Bengal	980.00	14.99	994.99
11.00	Bitumen Emulsion	Haldia West Bengal	980.00	14.99	994.99
12.00	Structural Steel	Bongaigaon Assam	132.58	14.99	147.57

11 .Economic & Financial analysis and Implementation

11.1 Economic & Financial

The EIRR of the project has been carried out using which more than 12 % of threshold limit. Similarly as per the financial analysis the Project Highway is financially not viable on PPP VGF model or it may not attract any investor for Hybrid annuity model Execution plan.

11.2 Packaging

Given the length of the project, the entire project is planned to be bid out in Single package.

11.3 Bidding mode and timelines

The authority has proposed to initiate bidding of the project under EPC upon reviewing the improvements planned and in consultation with NHIDCL, the design and construction period for this project has been arrived at 24 months from the date of appointment of the contractor. This also includes a traffic management and lane closure plan for the period of construction.

12 .Conclusions and recommendation

The development of project road shall improve transport efficiency of Meghalaya and also serve strategic defense purposes.

This will be realized by

(i) improving the region & highway network,

(ii) facilitating safe and appropriate road usage,

(iii) increasing efficiency of transport services

Project's immediate outcome will improve accessibility to social services and markets, increase fuel efficiency, reduce travel time and accidents, vehicle emissions and better employment opportunities outside agriculture, both through improved access to economic centers and increase industrial activities in the project area.

Apart from this, the developments of this road link enhance the land values many folds along the proposed Project Road.

The Project road meets the present and future requirements of the area in terms of services and utilities. Hence, looking at above potentials it is recommended that this Improvement of road should be done.