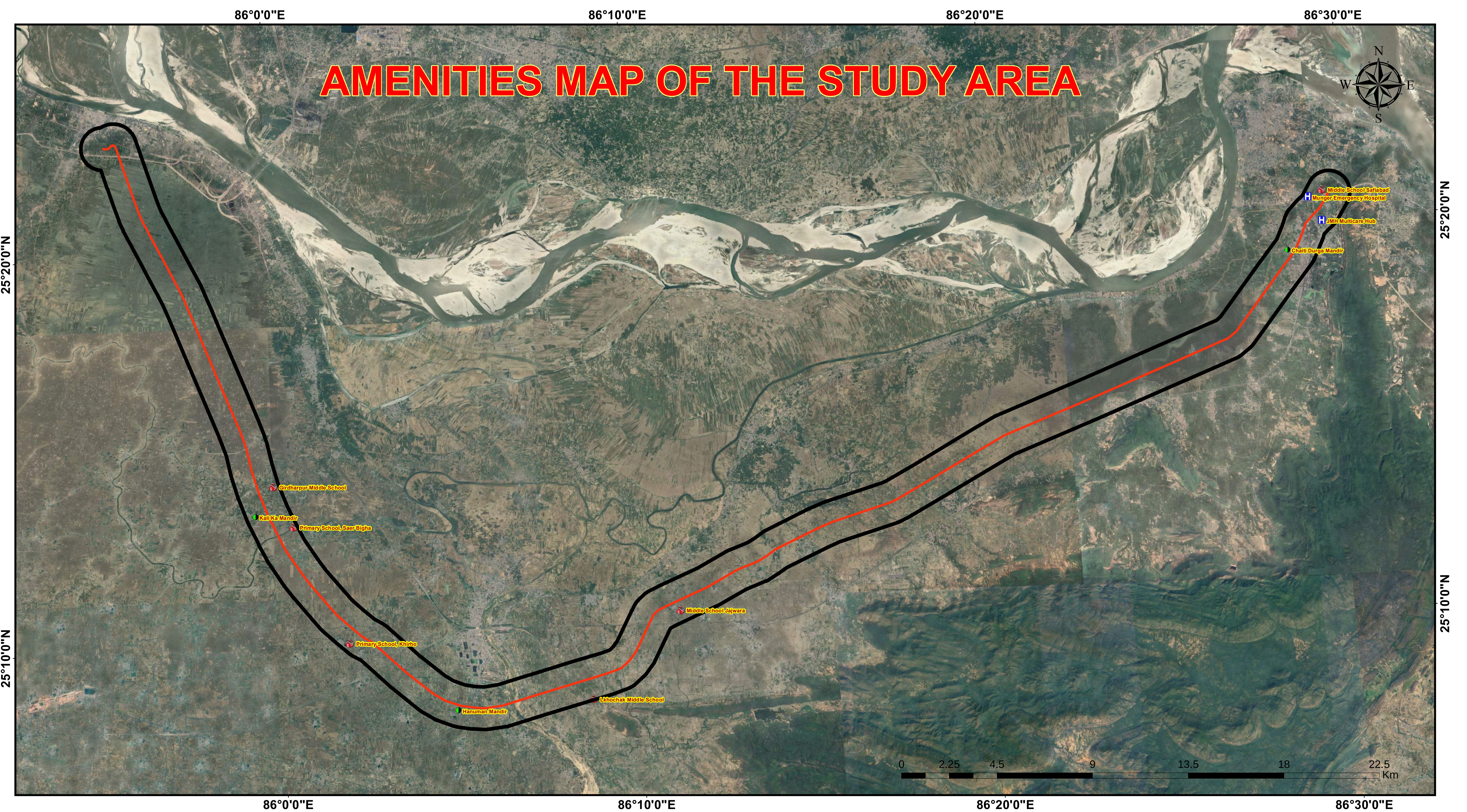
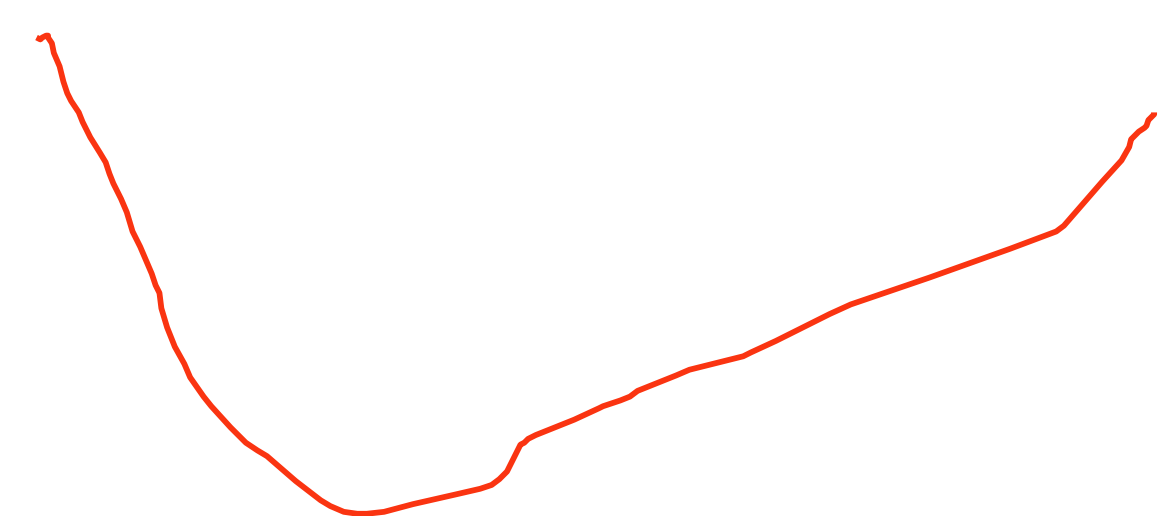


ANNEXURE-6A

Sensitivity Map



LEGEND



Project Site

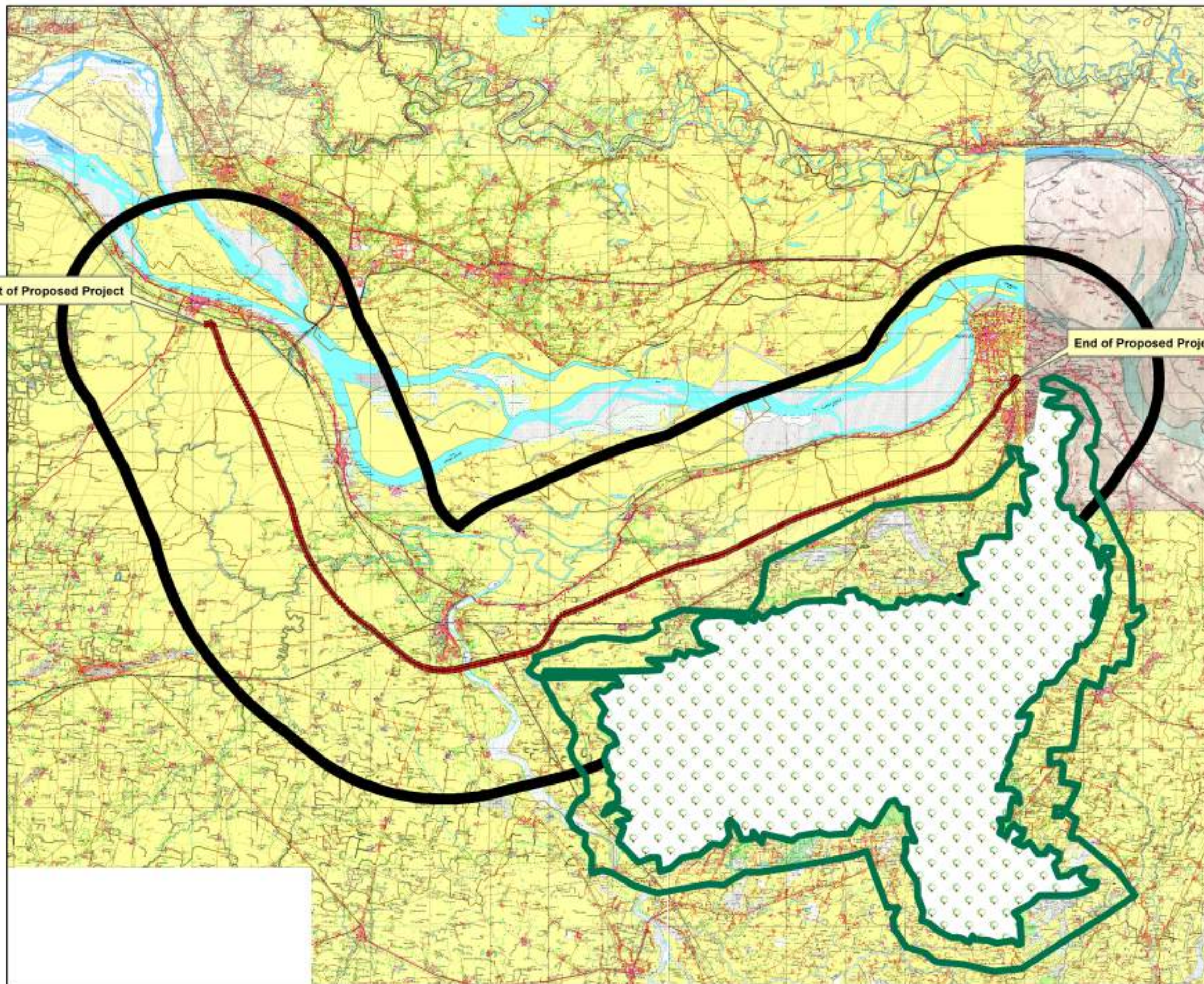
Legend

- Hospital
- School
- Temple

**Construction of 4 laning of
Green Field Alignment of NH -33
(Old NH-80) (Mokama to Munger)
in the State of Bihar.
Proposed Length – 82.100 Km**

ANNEXURE-6B

Maps



LEGEND



Buffer Boundary



Proposed Alignment



Bhimbandh Sanctuary



Eco-sensitive Zone

Development of 4 lane inter corridor of
Green Field Alignment of NH -33 (Old NH-80)
(Mokama to Munger) in the
State of Bihar.
(Total Length ~82.100 Km).

LANDUSE MAP OF THE STUDY AREA



LEGEND



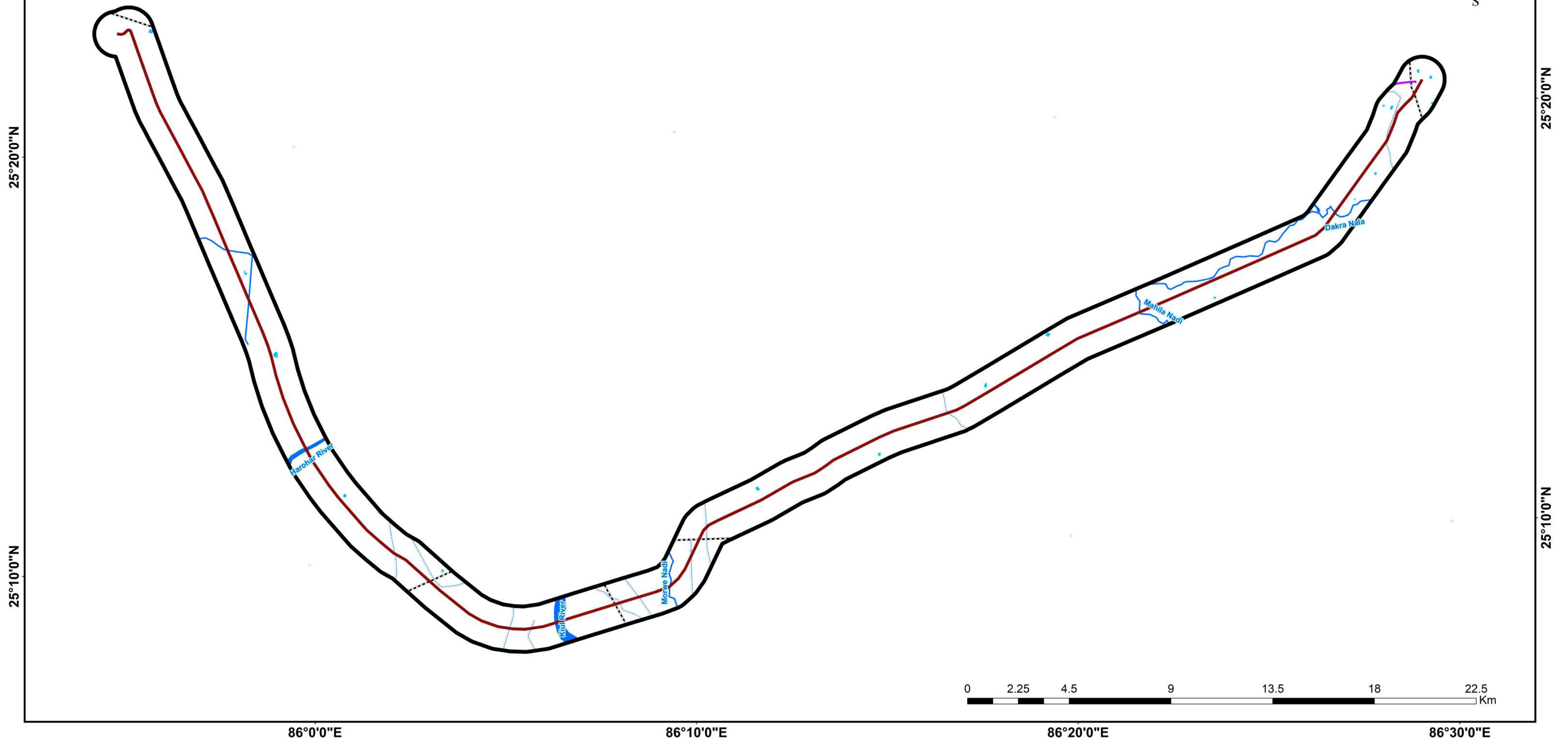
Project Site

-  River/Water Bodies
-  Vegetation
-  Settlement
-  Agricultural land
-  Open/Waste Land

Landuse Type	Area (Ha)
Open Land/Wasteland	2359.51
Vegetation	187.92
River/Water Bodies	1948.13
Settlement	1009.02
Agriculture	11008.28
AREA	16512.86

**Construction of 4 laning of
Green Field Alignment of NH -33
(Old NH-80) (Mokama to Munger)
in the State of Bihar.
Proposed Length – 82.100 Km**

DRAINAGE MAP OF THE STUDY AREA



LEGEND



Project Site

— Proposed Alignment

— National Highway

- - - Railway Line

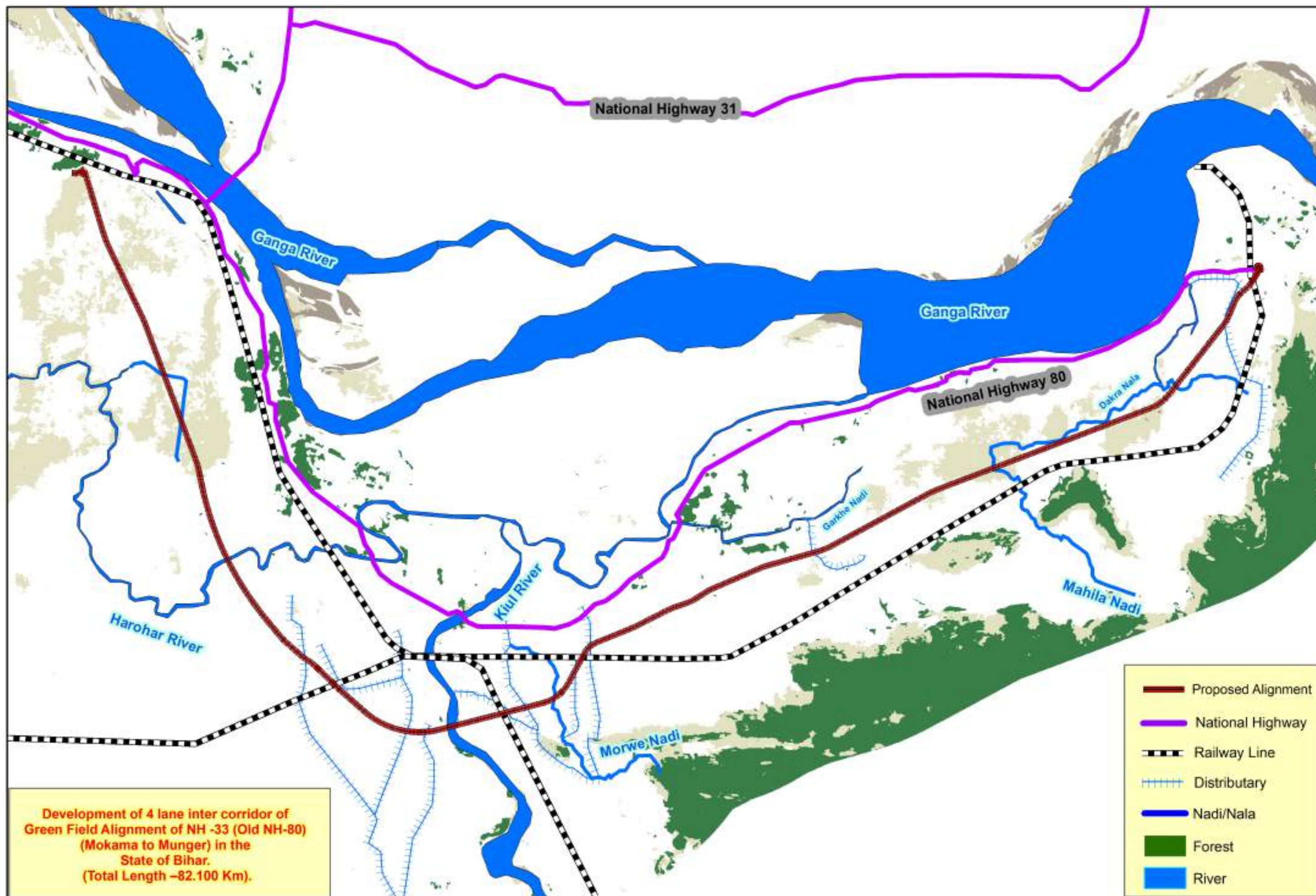
— Distributary

— Nadi/Nala

■ River

**Construction of 4 laning of
Green Field Alignment of NH -33
(Old NH-80) (Mokama to Munger)
in the State of Bihar.
Proposed Length – 82.100 Km**

KEY PLAN



ANNEXURE-7
Details of Structures

STRUCTURES DETAILS

The proposed alignment from Mokama to Munger is mainly traverses through Plain terrain. As this is a completely new proposed Green Field Alignment, it passes through few rivers and canals. Various structures have been proposed according to the settlements, hydrology data, and convenience of traffic movements. Total there are 02 no. of Major Bridge, 26 no. of Minor Bridge, 04 VUP (Single Span), 07 no. of VUP/Flyover (Multi Span), 48 no. of SVUP, 92 no. of Box culverts, 04 no. of ROB, 2 no. of Flyover at Interchange.

The animal underpasses have been given at CH49+300 and at CH64+000 which are closer to the WLS boundary and the ESZ boundary, to ensure free movement of the animals.

MAJOR & MINOR BRIDGES:

Details of Major Bridge (Over Rivers)

Sl. No.	Chainage	Name of Bridge	Side	Span Arrangement t c/c Expansion (m)	Total length C/C of Exp. Joint (m)	Skew angle	Structure Type	Deck Configuration (m)	Cross Section
	(Km)								
1	20+580	Harohar River	LHS/RHS	2X40	40	0 degree	PSC I Girder	2X16.00	As per TCS
2	35+150	Kiul River	LHS/RHS	11X40	440	0 degree	PSC I Girder	2X16.00	As per TCS

Minor Bridge (Over Rivers, Streams, Nallas and Canals)

Sr. No	Design Chainage (m)	Number of Span	Length of each span (Square)	Total Square length	Skew Angle	Type of Crossing	Total Proposed width (m)		Cross Section
		(no.)	(m)	(m)			MCW	SR	
1	7+947	1	8	8	27°	MNB	2x16.5	-	As per TCS
2	11+255	1	25	25	30°	MNB Nalla	2x16.5	-	As per TCS
3	13+658	1	30	30	54°	MNB Canal	2x16.5	-	As per TCS
4	19+188	1	40	40	0°	MNB Canal	2x16.5	-	As per

Sr. No	Design Chainage (m)	Number of Span	Length of each span (Square)	Total Square length	Skew Angle	Type of Crossing	Total Proposed width (m)		Cross Section
		(no.)	(m)	(m)			MCW	SR	
									TCS
5	19+555	1	20	20	27°	MNB Canal	2x16.5	-	As per TCS
6	23+641	1	10	10	40°	MNB Canal	2x14.5	-	As per TCS
7	24+963	1	10	10	48°	MNB Canal	2x14.5	-	As per TCS
8	26+795	1	15	15	15°	MNB Canal	2x14.5	-	As per TCS
9	32+855	1	12	12	12°	Canal cum road	2x14.5	-	As per TCS
10	38+750	1	40	40	16°	Cannal cum Road Bridge	2x16.5	-	As per TCS
11	40+100	1	10	10	27°	MNB Canal	2x14.5	-	As per TCS
12	40+167	1	30	30	43°	Canal cum road	2x16.5	-	As per TCS
13	40+370	1	25	25	48°	Nallah	2x16.5	-	As per TCS
14	43+250	1	10	10	48°	MNB Canal	2x14.5	-	As per TCS
15	46+844	1	8	8	27°	MNB	2x14.5	-	As per TCS
16	47+537	1	6	6	0°	MNB	2x14.5	-	As per TCS
17	53+925	2	25	50	26°	Canal cum road	2x16.5	-	As per TCS
18	55+127	1	40	40	0°	MNB	2x16.5	-	As per TCS
19	57+220	2	25	50	35°	Canal cum road	2x16.5	-	As per TCS
20	62+284	1	30	30	15°	MNB	2x16.5	-	As per TCS
21	64+722	1	10	10	44°	MNB	2x14.5	-	As per TCS
22	72+910	1	10	10	67°	MNB	2x14.5	-	As per TCS
23	74+424	1	10	10	27°	Nallah	2x14.5	-	As per TCS
24	76+900	1	35	35	45°	Canal cum road	2x16.5	-	As per

Sr. No	Design Chainage (m)	Number of Span	Length of each span (Square)	Total Square length	Skew Angle	Type of Crossing	Total Proposed width (m)		Cross Section
		(no.)	(m)	(m)			MCW	SR	
									TCS
25	77+750	1	35	35	74°	Canal cum road	2x16.5	-	As per TCS
26	78+460	1	35	35	55°	Canal cum road	2x16.5	-	As per TCS

VEHICULAR UNDERPASSES (VUP)

There are 4 no. of Vehicular under Pass proposed in this stretch to allow the users to connect across the road. The details of the VUP's are summarized below:

List of Proposed VUP

Sr.No.	Design Chainage (m)	LHS Roadway Width (m)	RHS Roadway Width (m)	Super Structure Provision in Median	Span Arrangement (Square) (m)	Minimum Vertical Clearance (m)	Skew Angle	Remarks
1	16+300	14.5	14.5	No	1x20m	5.50	81°	Clear Span =1x 20.00
2	18+075	14.5	14.5	No	1x20m	5.50	56°	Clear Span =1x 20.00
3	27+945	14.5	14.5	No	1x20m	5.50	50°	Clear Span =1x 20.00
4	80.700	14.5	14.5	No	1x20m	5.50	50°	Clear Span =1x 20.00

SMALL VEHICULAR UNDERPASSES

There are 48 numbers of SVUP proposed across the Village/ODR roads to facilitate the movement of the users. The details of the SVUP are summarized below:

Details of SVUP

Sr. No.	Design Chainage (m)	LHS Roadway Width (m)	RHS Roadway Width (m)	Super Structure Provision in Median	Span Arrangement (Square) (m)	Minimum Vertical Clearance (m)	Skew Angle	Remarks
1	2+100	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
2	3+855	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
3	5+445	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
4	6+550	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
5	7+650	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
6	8+380	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
7	9+800	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
8	10+538	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
9	10+865	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
10	11+610	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
11	12+110	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
12	13+200	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
13	14+020	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
14	14+864	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
15	19+367	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
16	20+550	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
17	22+853	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
18	25+232	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
19	25+965	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
20	27+542	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
21	30+072	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
22	30+592	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
23	31+300	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
24	32+422	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
25	33+833	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00

Sr. No.	Design Chainage (m)	LHS Roadway Width (m)	RHS Roadway Width (m)	Super Structure Provision in Median	Span Arrangement (Square) (m)	Minimum Vertical Clearance (m)	Skew Angle	Remarks
26	34+823	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
27	36+015	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
28	37+224	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
29	39+350	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
30	39+828	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
31	41+455	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
32	41+800	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
33	43+929	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
34	46+330	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
35	47+858	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
36	48+275	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
37	49+147	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
38	52+432	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
39	56+060	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
40	58+200	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
41	59+126	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
42	62+000	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
43	65+112	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
44	66+063	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
45	66+667	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
46	67+580	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
47	79+090	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00
48	79+820	14.5	14.5	No	1 x 7.00	4.00	0°	Clear Span =7.00

VUP/FLYOVER (MULTI SPAN)

At the starting of the Project road, a Trumpet Interchange has been proposed followed with Fly-overs which are crossing the National/State Highways. The details are given below:

Details of Fly-Over

Sr.No.	Design Chainage	Number of Span	Length of each Square Span	Total Square Length	Skew Angle	Minimum Vertical Clearance	Deck Width	Remarks
	(m)	(no.)	(m)	(m)	(deg.)	(m)	(m)	(m)
1	0+800	2X30m	60	70	21°	5.50	2x14.5	
2	33+233	1x20+1x30+1x20	30+40	70	12°	5.50	2x14.5	
3	34+352	1x20+1x30+1x20	30+40	70	38°	5.50	2x14.5	
4	51+050	1x20+1x30+1x20	30+40	70	11°	5.50	2x14.5	
5	60+438	1x20+1x30+1x20	30+40	70	35°	5.50	2x14.5	
6	69+450	1x20+1x30+1x20	30+40	70	24°	5.50	2x14.5	
7	81+463	2x30	60	60	34°	5.50	2x14.5	

CULVERTS DETAILS

Box type culverts have been proposed in this alignment as cross drainage structures and at many places culverts are being proposed to serve a pathway to the village users in the dry seasons. The details of the culverts are summarised below:

List of Culverts for Cross Drainage and Cart Track Crossing

S.No	Chainage	Structure type	Span (m)	Skew angle	Length of structure (m)	Proposal
1	1+350	Box	1X4X4	0	4	New Construction
2	1+800	Box	1X4X4	0	4	New Construction
3	2+500	Box	1X4X4	0	4	New Construction
4	2+900	Box	1X4X4	0	4	New Construction
5	3+300	Box	1X4X4	0	4	New Construction
6	4+200	Box	1X4X4	0	4	New Construction
7	4+600	Box	1X4X4	0	4	New Construction
8	5+000	Box	1X4X4	0	4	New Construction
9	5+800	Box	1X4X4	0	4	New Construction
10	6+200	Box	1x4x4	0	4	New Construction

S.No	Chainage	Structure type	Span (m)	Skew angle	Length of structure (m)	Proposal
11	6+950	Box	1x4x4	0	4	New Construction
12	7+350	Box	1x4x4	0	4	New Construction
13	8+710	Box	1x4x4	0	4	New Construction
14	9+110	Box	1x4x4	0	4	New Construction
15	10+140	Box	1x4x4	0	4	New Construction
16	12+450	Box	1x4x4	0	4	New Construction
17	12+850	Box	1x4x4	0	4	New Construction
18	14+360	Box	1x4x4	0	4	New Construction
19	15+200	Box	1x4x4	0	4	New Construction
20	16+640	Box	1x4x4	0	4	New Construction
21	17+040	Box	1x4x4	0	4	New Construction
22	17+440	Box	1x4x4	0	4	New Construction
23	17+840	Box	1x4x4	0	4	New Construction
24	19+900	Box	1x4x4	0	4	New Construction
25	20+300	Box	1x4x4	0	4	New Construction
26	20+980	Box	1x4x4	0	4	New Construction
27	21+380	Box	1x4x4	0	4	New Construction
28	21+765	Box	1x4x4	0	4	New Construction
29	21+965	Box	1x4x4	0	4	New Construction
30	22+165	Box	1x4x4	0	4	New Construction
31	22+565	Box	1x4x4	0	4	New Construction
32	23+190	Box	1x4x4	0	4	New Construction
33	23+980	Box	1x4x4	0	4	New Construction
34	24+380	Box	1x4x4	0	4	New Construction
35	25+580	Box	1x4x4	0	4	New Construction
36	26+300	Box	1x4x4	0	4	New Construction
37	27+133	Box	1x4x4	0	4	New Construction
38	30+850	Box	1x4x4	0	4	New Construction
39	31+600	Box	1x4x4	0	4	New Construction
40	32+000	Box	1X4X4	0	4	New Construction
41	36+360	Box	1X4X4	0	4	New Construction
42	36+760	Box	1X4X4	0	4	New Construction
43	38+090	Box	1X4X4	0	4	New Construction
44	40+720	Box	1X4X4	0	4	New Construction
45	41+120	Box	1X4X4	0	4	New Construction
46	42+140	Box	1X4X4	0	4	New Construction
47	45+000	Box	1X4X4	0	4	New Construction
48	47+180	Box	1X4X4	0	4	New Construction
49	48+100	Box	1X4X4	0	4	New Construction

S.No	Chainage	Structure type	Span (m)	Skew angle	Length of structure (m)	Proposal
50	48+610	Box	1X4X4	0	4	New Construction
51	49+500	Box	1X4X4	0	4	New Construction
52	49+900	Box	1X4X4	0	4	New Construction
53	50+300	Box	1X4X4	0	4	New Construction
54	51+800	Box	1X4X4	0	4	New Construction
55	53+200	Box	1X4X4	0	4	New Construction
56	54+200	Box	1X4X4	0	4	New Construction
57	54+600	Box	1X4X4	0	4	New Construction
58	56+400	Box	1X4X4	0	4	New Construction
59	56+800	Box	1X4X4	0	4	New Construction
60	57+500	Box	1X4X4	0	4	New Construction
61	57+900	Box	1X4X4	0	4	New Construction
62	58+550	Box	1X4X4	0	4	New Construction
63	58+950	Box	1X4X4	0	4	New Construction
64	59+450	Box	1X4X4	0	4	New Construction
65	59+850	Box	1X4X4	0	4	New Construction
66	61+600	Box	1X4X4	0	4	New Construction
67	62+400	Box	1X4X4	0	4	New Construction
68	62+800	Box	1X4X4	0	4	New Construction
69	63+200	Box	1X4X4	0	4	New Construction
70	63+600	Box	1X4X4	0	4	New Construction
71	64+000	Box	1X4X4	0	4	New Construction
72	65+450	Box	1X4X4	0	4	New Construction
73	65+850	Box	1X4X4	0	4	New Construction
74	67+920	Box	1X4X4	0	4	New Construction
75	68+320	Box	1X4X4	0	4	New Construction
76	70+600	Box	1X4X4	0	4	New Construction
77	71+000	Box	1X4X4	0	4	New Construction
78	71+400	Box	1X4X4	0	4	New Construction
79	71+800	Box	1X4X4	0	4	New Construction
80	72+200	Box	1X4X4	0	4	New Construction
81	72+600	Box	1X4X4	0	4	New Construction
82	73+000	Box	1X4X4	0	4	New Construction
83	73+400	Box	1X4X4	0	4	New Construction
84	73+800	Box	1X4X4	0	4	New Construction
85	74+200	Box	1X4X4	0	4	New Construction
86	74+600	Box	1X4X4	0	4	New Construction
87	75+000	Box	1X4X4	0	4	New Construction
88	75+400	Box	1X4X4	0	4	New Construction

S.No	Chainage	Structure type	Span (m)	Skew angle	Length of structure (m)	Proposal
89	75+800	Box	1X4X4	0	4	New Construction
90	76+200	Box	1X4X4	0	4	New Construction
91	77+000	Box	1X4X4	0	4	New Construction
92	78+100	Box	1X4X4	0	4	New Construction

ROB

Sr.No.	Design Chainage (Km)	Proposed Span Arrangement (m)	Type of super-structure (i.e Bow string, simply supported composite structure etc.	Name of crossing	Total Width m)	Skew Angle	Remarks
1	28+750	1X15+1x62+1x15	Bow String	-	2x16.50	67°	New Construction
2	37+700	1X15+1x72+1x15	Bow String	-	2x16.50	78°	New Construction
3	42+700	1X15+1x36+1x15	Composite Steel Girder	-	2x16.50	63°	New Construction
4	80+794	1X15+1x36+1x15	Composite Steel Girder	-	2x16.50	49°	New Construction

INTERCHANGE

List of Interchanges

S. No	Carriageway Width Including	Design Chainage (m)		Length (m)	TCS as per Manual	Description of Ramps,Cross Roads and Connecting Roads	Remarks
		From	To				
Interchange-01							
1	10.000	0.00	0.300	0.00	A-A	Ramp- 01 EntryfromNH-31 (from Mokama to Munger)	
2	10.000	0.00	1.100	0.00	B-B	Ramp- 02 Exit from NH-33 (from Mokma to Nh-31)	

3	10.000	0.200	0.800	0.200	C-C	Ramp- 03 Entry from NH-31(from Mokma to Munger)	
4	10.000	0.400	0.700	0.400	D-D	Loop-01 Exit from NH-33 (from Munger to Mokma)	
Interchange-02							
1	10.000	0.000	0.900	900	C-C	Ramp-01 Entry to NH-33 (from Munger to Mokma)	
2	10.000	0.000	0.800	800	B-B	Ramp-02 Exit to NH-33 (From Mokma to Munger)	
3	10.000	0.000	0.400	400	A-A	Ramp-03 Entry from NH-33 (from Bhagalpur to Mokma)	
4	10.000	0.000	0.200	200	D-D	Loop-01 Exist from NH-33 (from Munger to Bhagalpur)	

ANNEXURE-8A
Traffic Survey Analysis

CHAPTER – 7

TRAFFIC SURVEYS AND ANALYSIS

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ABBREVIATION

Abbreviation	Full Form
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
BOT	Build-Operate-Transfer
CBR	California Bearing Ratio
CC	Cement Concrete
CTB	Cementitious Base
CTSB	Cementitious Sub base
CVC	Classified Volume Count
CVPD	Commercial Vehicle Per Day
DBFO	Design Build Finance & Operate
DPR	Detail Project Report
DSV	Design Service Volumes
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
EPC	Engineering Procurement and Construction
FIRR	Financial/ Commercial Internal Rate of Return
FOB	Foot over Bridge
GAD	General Arrangement Drawings
GDP	Gross Domestic Product
GSB	Granular sub-base
GSDP	Gross State Domestic Product
IRC	Indian Roads Congress
LA	Land Acquisition
LDF	Lane Distribution Factors
LOS	Level of Service
MAV	Multi Axle Vehicle
MJB	Major Bridge
MNB	Minor Bridge
MoRT&H	Ministry of Road Transport & Highways
NHAI	National Highways Authority of India
NHDP	National Highways Development Project
NPV	Net Present Value
NSDP	Net State Domestic Product
PCI	Per Capita Income
PCU	Passenger Car Unit

PIA	Project Influence Area
PROW	Proposed Right of Way
PUP	Pedestrian underpass
ROB	Rail over Bridge
ROW	Right of Way
SCF	Seasonal Correction Factor
SPV	Special Purpose Vehicle
TBM	Temporary Bench Mark
TCS	Typical Cross Section
ToR	Terms of Reference
VDF	Vehicle Damage Factor
VOC	Vehicle Operating Cost
VUP	Vehicular underpass
WMM	Wet Mix Macadam

CHAPTER - 7

TRAFFIC SURVEYS AND ANALYSIS

7.1. General

The National Highways Authority of India (NHAI) has entrusted the assignment of preparation of Feasibility Study/Detailed Project Report of selected road stretches/corridors Four laning configuration. NHAI invited proposal from Technical consultants for carrying out detailed project report and render consultancy services for Proper structuring and implementation of projects on DBFO/BOT/EPC/PPP mode.

The consultancy assignment has been awarded to M/s Bloom Companies, LLC. in association with M/s Avaloz Consultant India Pvt. Ltd. The agreement for the same was signed on 24th March 2021, for carrying out detailed feasibility study of Four laning of Mokma to Munger section from Km: 0/000 to Km. 82/400 on National Highway No. 33 in the state of Bihar.

The brief particulars of the Project section covered under our scope are as follows:

Table 1 Project Section

Name of the National Highway	Length
Km 0/000 to Km 82/100 of NH-33 comprising the section from Mokma to Munger.	82.400 km (Approximate length)

Traffic assessment for the project corridor for the base and horizon years is an essential aspect as part of the feasibility studies and as a part of it; traffic surveys were commissioned and detailed traffic assessment were carried out during the period of 19th to 25th November, 2024.

This Report (Traffic Assessment Report) presents details on:

- ◇ Base traffic (ADT and AADT) estimates,
Axle load survey analysis and VDF calculations Methodology
- ◇ Origin & Destination survey analysis
- ◇ Findings and recommendations

7.2. Project Road

The proposed Greenfield Highway Project covers a total length of 82.100 km, passing through the districts of Patna, Lakhisarai, and Munger in the state of Bihar.

The alignment primarily comprises new (greenfield) construction and traverses through the following villages:

Mokameh Khas, Panchmahla, Kalishan, Aunta, Auta, Murarpur, Dariyapur, Hathidah Buzurg, Hathidah, Hurd, Maranchi North, Tajpur Tola, Badpur, Rampur Dumra, Pach-mahla, Nauranga, Jalalpur, Barhiya, Chak, Indupur, Hirdan, Bishanpur, Rampur, Saidpur, Mano, Kasoi, Saidpura, Jagdishpur, Nista, Adhupur, Bikrampur, Toralpur, Rampur San-grampur, Jhajha, Herudiyara, Maksuspur, and Munger. Map of project road location is depicted in **Fig.-1**.

Mostly the project corridor has four lane carriageway except all grade separators all the grade separators are 6 lane. In general the terrain is plain and land use pattern is mainly agricultural, commercial and built-up area. Proposed road has 1.5 m earthen shoulder on both sides.



Figure 1 Location Map of Road Network

7.3. Traffic Surveys

Estimation of traffic over the project corridor is an essential step in project preparation. This includes conducting field traffic surveys, data analysis estimation of traffic (ADT & AADT) and estimating commercial vehicles loading (CSA) for pavement design.

The present traffic surveys have been planned in a way to obtain all the necessary information and data deemed necessary for the detailed project preparation. In order to identify traffic survey locations, the project road is divided into homogeneous sections based on traffic flow pattern as given in **Table 2**.

Table 2 Homogeneous Sections

Section	Existing Km reference		Length (km)	Remark
	From	To		
Section-1	0/000	36/000	36.00	Mokma - Lakhisarai
Section-2	36/00	82/100	46.100	Lakhisarai -Munger

To establish the traffic flow characteristics and travel pattern on the corridor and to evaluate the viability of the project road on suitable DBFO/BOT/EPC/PPP mode, the following surveys were conducted on the identified locations along the project road sections.

- ◇ 7-days Classified Traffic Volume Count (CTVC) Survey
- ◇ 1-day 24 hr. Axle Load Survey
- ◇ 1-day 24hr. Turning Movement Count Survey
- ◇ 1-day 24hr. Origin & Destination Survey
- ◇ 1-day 12hr. Pedestrian Count Survey
- ◇ Intersection Volume Count
- ◇ Speed Delay Survey

7.3.1. Traffic Survey Locations

Location for carrying out traffic surveys were selected so as to coincide with the Existing toll plaza locations based on site reconnaissance and was finalized in-consultation with the client. The surveys were undertaken during the period 19th to 25th October 2024. The traffic survey locations on project road along with survey schedule are presented in **Table 3**.

Table 3: Traffic Survey Location

S. No.	Type of Survey	Survey No.	Survey Location/Section	Chainage (km)	Duration
1	Classified Traffic Volume Count	2	1. GARHI BISHANPUR 27+700 NH-33 2. Munger 69+050 NH-33	a) KM: 27+700 b) KM: 69+050	7 Days
2	Axle Load Survey	AL 1	. GARHI BISHANPUR 27+700 NH-33	KM 27+700, NH-33	24 hrs
		AL 2	Munger 69+050 NH-33	KM 69+050, NH-33	24 hrs
4	Origin & Destination Survey	OD 1	GARHI BISHANPUR 27+700 NH-33	KM 27+700, NH-33	24 hrs
		OD 2	Munger 69+050 NH-33	KM 69+050, NH-33	24 hrs



Figure 2 Details of Traffic Survey Locations

7.3.2. Methodology for Traffic Surveys

For carrying out these surveys, the vehicles were grouped into the following categories:

Table 4: Vehicle Classification System

Motorized Traffic	
Two-Wheeler	Motor cycle & Scooter
Three-Wheeler	Auto Rickshaws
Car / Jeep / Van	Private
	Taxi
Bus	Mini Bus
	Government Bus
	Private Bus
	School Bus
Commercial Vehicles (Trucks)	Mini Light Commercial Vehicle
	Light Commercial Vehicle (LCV) – 4 Tyres
	Light Commercial Vehicle (LCV) – 6 Tyres
	2-Axle Rigid Chassis Truck (2AT)

Motorized Traffic	
	3-Axle Rigid Chassis Truck (3AT)
	Multi Axle Truck (MAV) – 4 to 6 axles
	Multi Axle Truck (MAV) – >6 axles
Farm Vehicle	Agricultural Tractor (AgT)
	Agricultural Tractor & Trailer (AgTT)
Non-motorized Vehicles	Pedal Cycle
	Hand Cart
	Animal Drawn

7.3.3. Mid-block Classified Traffic Volume Count

The CTVC surveys were conducted for 7 days for both directions separately using manual counting method on project road sections. The count data was recorded hourly by manual count and compare the manual CVC data with Indian Highways Management Company Ltd. (IHMCL) ATCC data.

7.3.4. Axle Load Surveys

Traffic loading on highway pavements is a heterogeneous combination of different types of vehicles, carrying a wide spectrum of wheel loads. It is very much essential to convert this heterogeneous traffic to an equivalent homogenous traffic in terms of a chosen standard vehicle. One means of achieving this objective is the use of Equivalent Standard Axle Load (ESAL) factors. Axle load surveys of commercial vehicles were carried out for 1-day 24 hour durations, to establish Vehicle Damage Factor for use in pavement design. Since, lighter vehicles have a very small equivalent standard axle load value and less damaging effect, these vehicle types were excluded in the present axle load survey.

7.3.5. Traffic Volume Count Data Analysis

This section describes the baseline traffic and travel characteristics in the Project Influence Area (PIA) based on the analysis of primary data. The findings from the analysis of classified traffic volume observed at various count locations is given in this section. Analysis has been carried out for:

- ADT (Average Daily Traffic)
- Traffic composition
- Daily Variation
- Hourly variation
- Directional Distribution
- Seasonal Variation
- AADT (Annual Average Daily Traffic)

In the absence of regular count data in the PIA, monthly fuel sales (both petrol and diesel) have been used as proxy for seasonal variation in traffic.

7.4. Passenger Car Equivalents

Different vehicle types having different size and characteristics were converted into equivalent passenger car units. The Passenger Car Unit values (PCU) suggested by the Indian Roads Congress

in IRC: 64-1990 “Guidelines for Capacity of Roads in Rural Areas” have been adopted and the same are given in **Table-5**.

Table 5: Values of PCU Factors Adopted for the Study

Vehicle Type	PCU	Vehicle Type	PCU
Car/Jeep/Taxi	1.0	Auto Rickshaw	1.0
Mini Bus/ LCV	1.5	Agricultural Tractor	1.5
Standard Bus	3.0	Agricultural Tractor & Trailer	4.5
2/3 Axle Truck	3.0	Animal Drawn Vehicle	6.0
MAV	4.5	Cycle	0.5
Two Wheeler	0.5	Hand Cart	3.0

Source: IRC: 64-1990: Guidelines for capacity of Roads in Rural Areas

7.5. Average Daily Traffic and Traffic Composition

The hourly traffic data collected at respective count station for each day was totaled to obtain the daily traffic volumes. The seven-day traffic volumes were then averaged out to obtain the Average Daily Traffic (ADT) at respective survey stations. A summary of Average Daily Traffic (ADT) on project road sections is presented in **Table-6**. CVC locations on project road sections witness average daily traffic (ADT) in the range of 19,066 – 37,945 vehicles (33,312 – 54,507 PCUs).

Composition of cars is in the range of 27.8-32.1 percent, mini buses and buses is in the range of 5.9-11.4 percent. Among commercial vehicles, mini LCVs and LCVs is in the range of 14.2-15.8 percent and all categories of trucks together constitute about 16.1-23.1 percent in total traffic. Mode wise composition is presented in **Table-7**.

Table 6: Summary ADT on Project Road Sections

Vehicle Category	ADT	
	GARHI BISHANPUR 27+700	Munger 69+050 NH-33
2-Wheeler	10716	8145
3-Wheeler	1402	1289
Car / Jeep /Van	1710	1462
Mini Bus	35	27
School Bus	16	0
Govt Bus	0	0
Private Bus	28	54
Mini LCV	648	720
LCV	315	338
2 Axle Truck	117	111
3 Axle Truck	126	136
MAV	2046	2212

Vehicle Category	ADT	
	GARHI BISHANPUR 27+700	Munger 69+050 NH-33
MAV (more than 6 Axles)	0	0
Tractor	26	39
Tractor + Trailer	366	188
Pedal Cycle	780	1744
Hand Cart	20	14
Animal Drawn	7	3
Toll Exempted - Car	48	40
Toll Exempted - Bus	0	0
Toll Exempted - LCV	0	0
Toll Exempted - Truck	0	0
Vehicles (Nos)	18406	16523
Vehicles (PCUs)	21938	20826

Table 7: Composition of Traffic (%)

Location	2-W	3-W	Car	Bus	Mini Bus	Mini LCV	LCV	2-AT	3-AT	MAV	FV	NMV	Total
KM 27+700	58.2	7.6	9.5	0.2	0.2	3.5	1.7	0.6	0.7	11.1	2.1	4.4	100
KM 69+050	49.3	7.8	9.1	0.3	0.2	4.4	2.0	0.7	0.8	13.4	1.4	10.7	100

Analysis has been carried out for hourly variation of traffic. Daily Variation and Hourly variation will be useful in deriving the capacity of the Road. Daily variation in traffic is shown in **Fig.-3**.

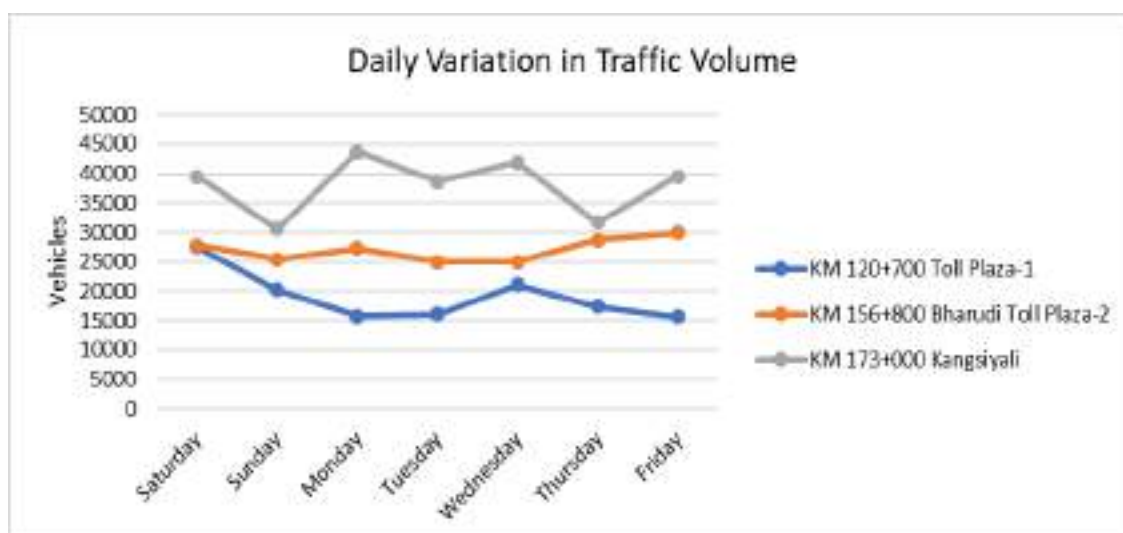


Figure 3 Daily Variation in Traffic Volume

Directional distribution of traffic

Directional split at count locations is shown in **Table 8**. This is a useful input for capacity analysis and pavement design. As seen, the directional split for up and down traffic is almost equal along the project corridor.

Table 8: Directional Distribution of Traffic

Location	Rajkot To Porbandar	Porbandar To Rajkot
KM 27+700	51%	49%
KM 69+050	50%	50%

Day wise flows at traffic count locations is presented in **Table 9, 10** and **11**.

Table 9: Traffic Volume at Km 27+700

Vehicle Category	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	ADT
	19-11-24	20-11-24	21-11-24	22-11-24	23-11-24	24-11-24	25-11-24	
2 Wheeler	10965	10512	10657	10965	10512	10657	10741	10716
3 Wheeler	1437	1355	1406	1437	1355	1406	1415	1402
Car / Jeep /Van	1736	1666	1727	1736	1666	1727	1711	1710
Mini Bus	39	35	29	39	35	29	37	35
School Bus	0	24	20	0	24	20	24	16
Govt Bus	0	0	0	0	0	0	0	0
Private Bus	49	20	18	49	20	18	23	28
Mini LCV	696	621	620	696	621	620	665	648
LCV	334	305	303	334	305	303	322	315

Vehicle Category	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	ADT
	19-11-24	20-11-24	21-11-24	22-11-24	23-11-24	24-11-24	25-11-24	
2 Axle Truck	123	123	107	123	123	107	115	117
3 Axle Truck	121	133	122	121	133	122	129	126
MAV	2060	2047	2007	2060	2047	2007	2091	2046
MAV (more than 6 Axles)	0	0	0	0	0	0	0	0
Tractor	34	24	21	34	24	21	27	26
Tractor + Trailer	397	332	359	397	332	359	386	366
Pedal Cycle	789	780	748	789	780	748	827	780
Hand Cart	23	21	13	23	21	13	26	20
Animal Drawn	5	10	7	5	10	7	8	7
Toll Exempted - Car	58	42	44	58	42	44	45	48
Toll Exempted - Bus	0	0	0	0	0	0	0	0
Toll Exempted - LCV	0	0	0	0	0	0	0	0
Toll Exempted - Truck	0	0	0	0	0	0	0	0
Vehicles (Nos)	18866	18050	18208	18866	18050	18208	18592	18406
Vehicles (PCUs)	22449	21605	21558	22449	21605	21558	22345	21938

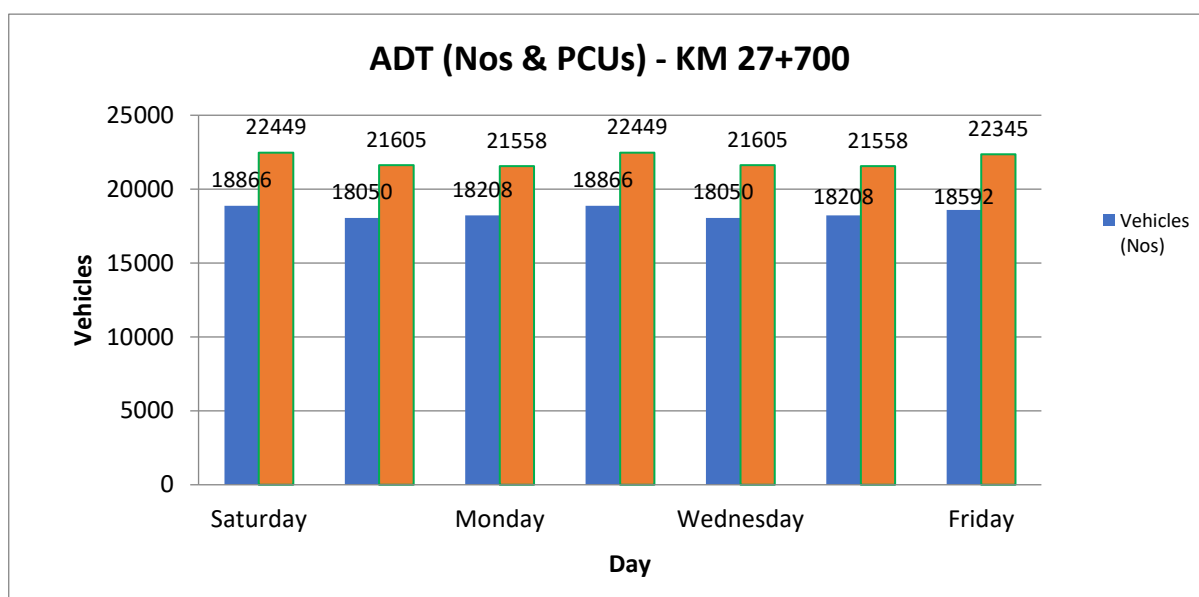


Figure 4 ADT Comparison at KM 27+700

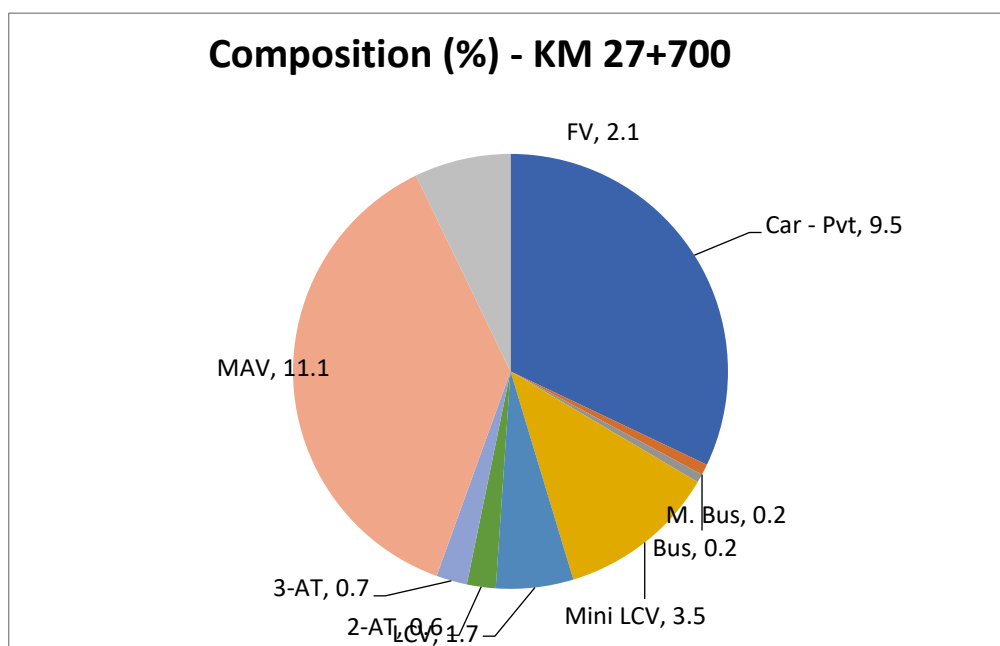


Figure 5 Composition comparison at Km. 27+700

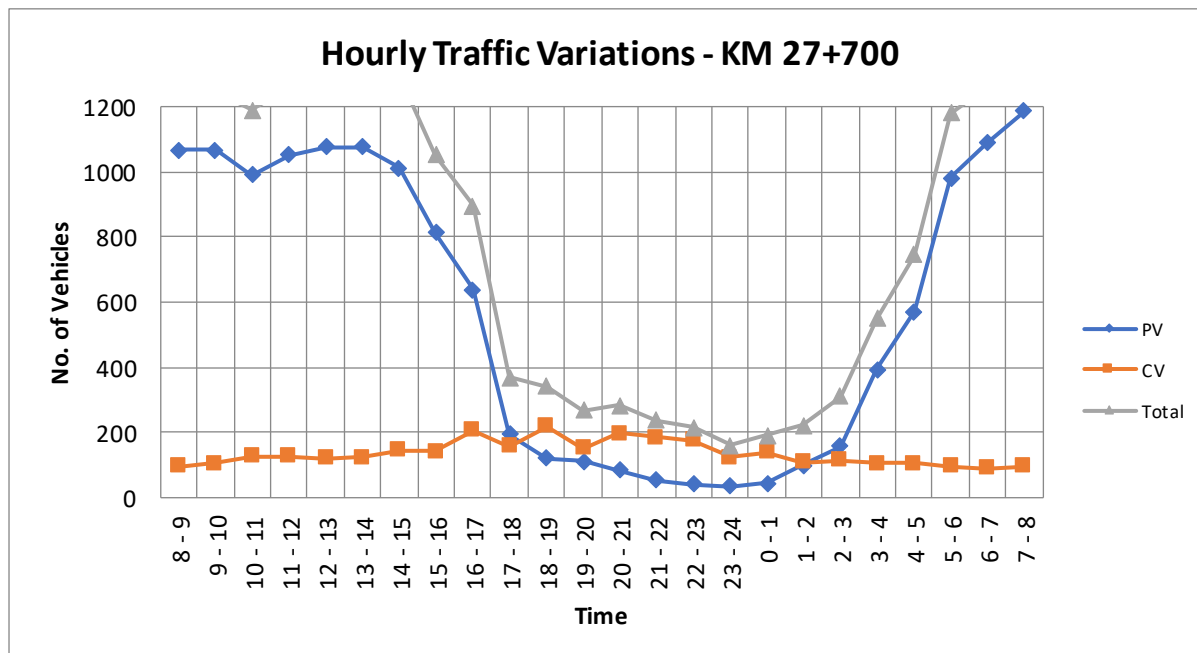


Figure 6 Hourly Traffic Variations at Km. 27+700

Table 10: Traffic Volume at Km Munger 69+050

Vehicle Category	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	ADT
	19-11-24	20-11-24	21-11-24	22-11-24	23-11-24	24-11-24	25-11-25	
2-Wheeler	7569	7685	7536	7569	7685	11358	7615	7569
3-Wheeler	1144	1252	1179	1144	1252	1838	1216	1144
Car / Jeep /Van	1321	1394	1345	1321	1394	2084	1377	1321
Mini Bus	22	29	22	22	29	43	25	22
School Bus	0	0	0	0	0	0	0	0
Govt Bus	0	0	0	0	0	0	0	0
Private Bus	48	56	42	48	56	77	54	48
Mini LCV	640	702	642	640	702	1047	668	640
LCV	301	333	291	301	333	492	313	301
2 Axle Truck	96	114	91	96	114	162	105	96
3 Axle Truck	120	139	119	120	139	190	124	120
MAV	2017	2098	2000	2017	2098	3214	2039	2017
MAV (more than 6 Axles)	0	0	0	0	0	0	0	0
Tractor	40	40	28	40	40	53	32	40
Tractor + Trailer	199	175	152	199	175	252	163	199
Pedal Cycle	1735	1614	1525	1735	1614	2397	1587	1735
Hand Cart	12	12	17	12	12	20	14	12
Animal Drawn	1	3	5	1	3	3	5	1
Toll Exempted - Car	40	39	32	40	39	55	36	40
Toll Exempted - Bus	0	0	0	0	0	0	0	0
Toll Exempted - LCV	0	0	0	0	0	0	0	0
Toll Exempted - Truck	0	0	0	0	0	0	0	0
Vehicles (Nos)	15305	15685	15026	15305	15685	23285	15373	15305
Vehicles (PCUs)	19148	19849	18761	19148	19849	29746	19283	19148

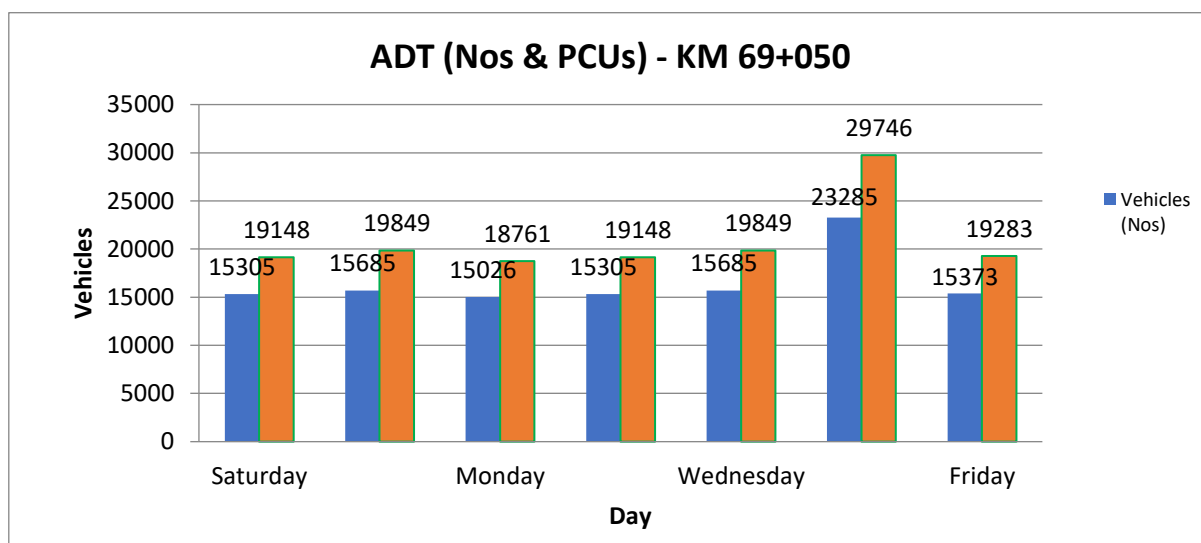


Figure 7 ADT Comparison at Km. 69+050

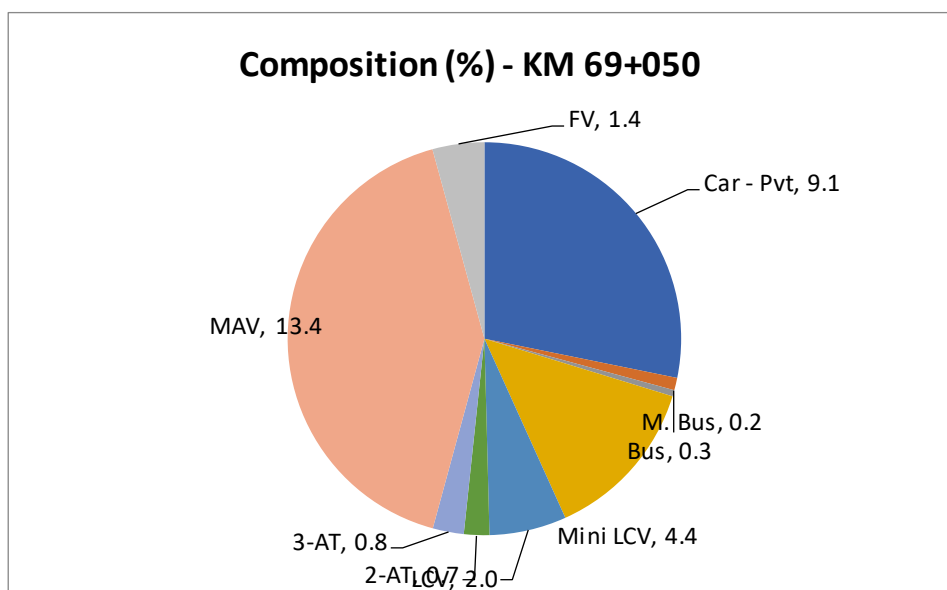


Figure 8 Composition comparison at Km. 156+800

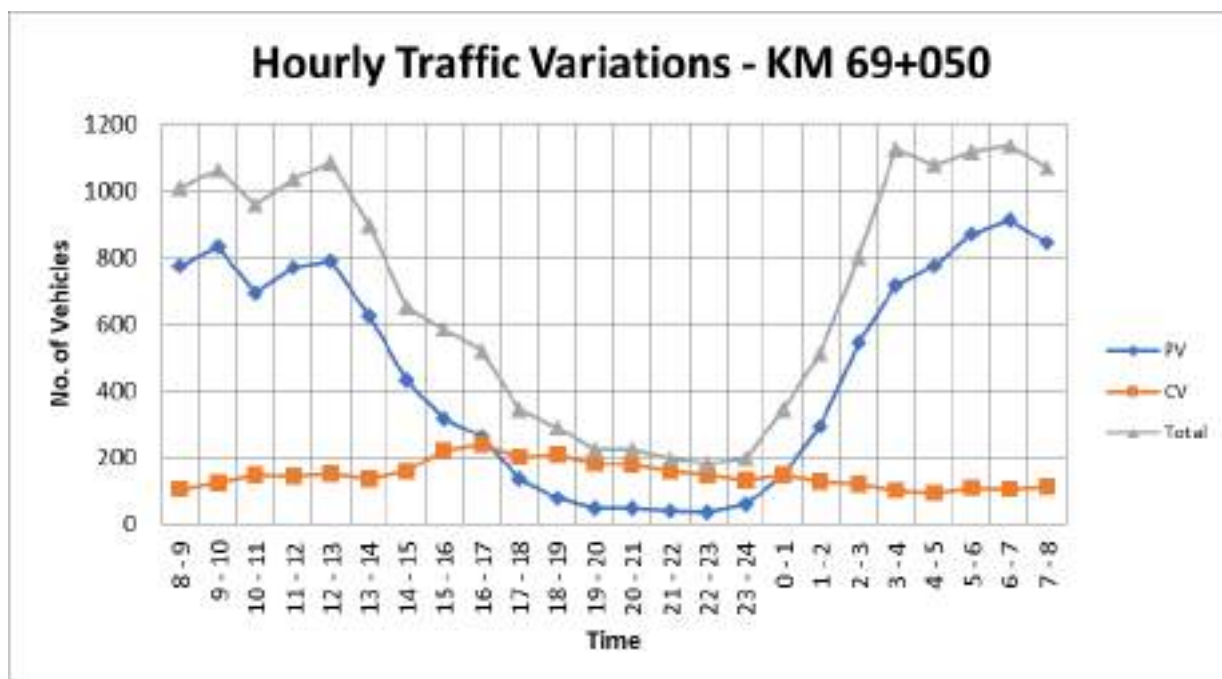


Figure 9 Hourly Traffic Variation at Km. 69+050

7.5.1. Seasonal Correction and Annual Average Daily Traffic (AADT)

To convert ADT to AADT the traffic in the month(s) of the year in which survey is conducted is compared with the annual traffic to obtain the factor. This factor, termed as seasonality correction factor, is applied to the ADT to obtain the Annual Average Daily Traffic (AADT).

Estimation of seasonality correction factor is based on the sale of monthly Petrol and Diesel along the project corridor (**Table-12**). Because of non-availability of regular counts, for the project influence area fuel (petrol and diesel) sales data was collected by the consultants in the present study from November, 2018 to October, 2019. All the petrol driven vehicles were converted into AADT by applying seasonal correction factor determined from the motor spirit (MS) data (1.09 for October), whereas for all diesel driven vehicles, seasonality factor was calculated from High Speed Diesel (HSD) sales data (0.98 for October). Variations in monthly fuel sales with respect to average sales are presented in **Fig.-13**.

Table 11 Seasonal Factors

Month	SCF Diesel	SCF Petrol	SCF Combined	Average
Nov-23	1.05	1.12	1.035	1
Dec-23	1.01	0.93	1.008	1
Jan-24	1.04	0.96	1.052	1
Feb-24	1.11	1.02	1.116	1
Mar-24	1.10	1.04	1.125	1
Apr-24	1.01	1.06	1.070	1
May-24	1.10	1.31	1.218	1
Jun-24	0.97	1.01	0.980	1
Jul-24	0.90	0.84	0.836	1
Aug-24	0.93	0.94	0.852	1
Sep-24	0.80	0.69	0.720	1
Oct-24	0.98	1.09	0.992	1

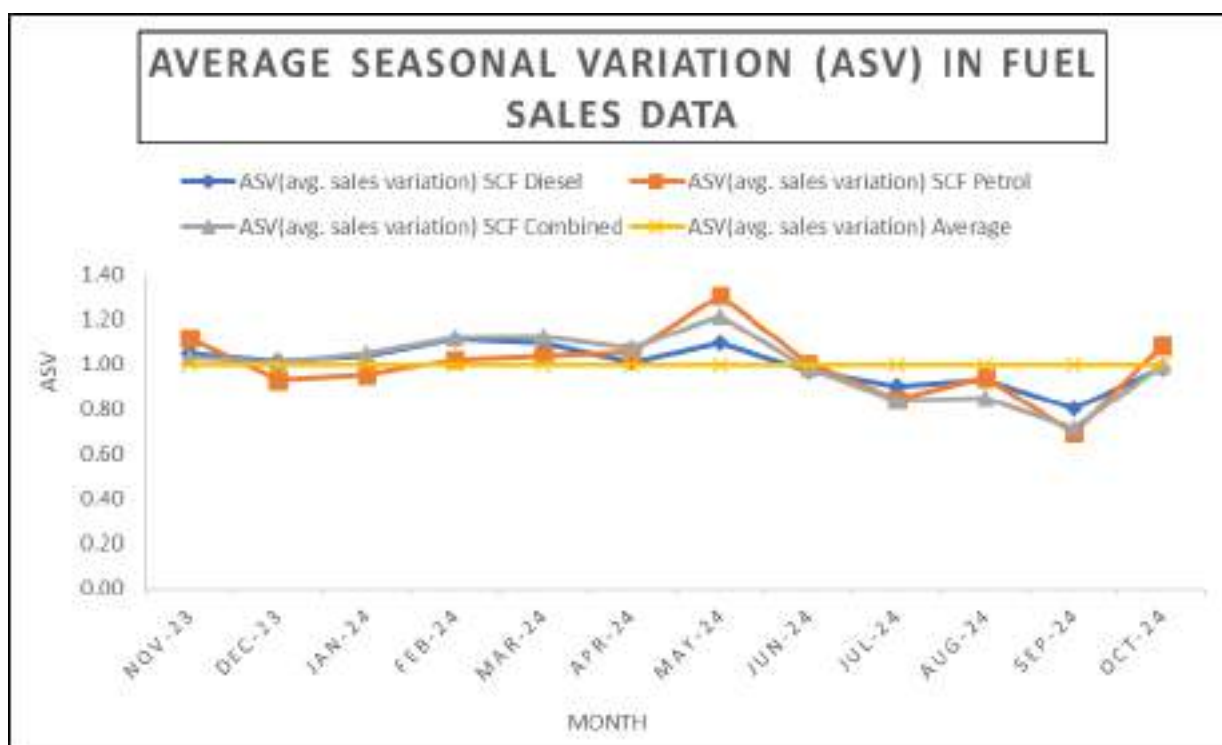


Figure 10 Average Seasonal Variation

7.5.2. Annual Average Daily Traffic (AADT)

The Annual Average Daily Traffic (AADT) is calculated by multiplying ADT with a seasonality factor. Seasonal variation factors by vehicle types are required to account for variations in the pattern of traffic volume on various sections of the project road over different months or seasons of the year. In this study, the seasonal factor has been derived from the monthly petrol and diesel sale data. The ratios of average monthly petrol and diesel sale data with the sale during October (the survey month) have been used to determine the seasonal correction factor. The diesel sale data has been used to find the seasonality factor for the freight vehicles, whereas the petrol sale data has been used to calculate seasonality factor for passenger vehicles based on the fuel used by the vehicles in the two categories. The seasonality factors are given in **Table-12**.

The seasonality factors thus obtained are used to convert Average Daily Traffic (ADT) to Annual Average Daily Traffic (AADT) for various survey locations of the project road. Section-wise AADT thus obtained is shown in **Table-13**, which gives the mode-wise AADT for all the survey locations.

Table 12: Annual Average Daily Traffic for various surveyed locations

Vehicle Category	AADT	
	KM 27+700	Km 69+050
2 Wheeler	10716	8145
3 Wheeler	1402	1289
Car / Jeep /Van	1710	1462

Mini Bus	35	27
School Bus	16	0
Govt Bus	0	0
Private Bus	28	54
Mini LCV	648	720
LCV	315	338
2 Axle Truck	117	111
3 Axle Truck	126	136
MAV	2046	2212
MAV (more than 6 Axles)	0	0
Tractor	26	39
Tractor + Trailer	366	188
Pedal Cycle	780	1744
Hand Cart	20	14
Animal Drawn	7	3
Toll Exempted - Car	48	40
Toll Exempted - Bus	0	0
Toll Exempted - LCV	0	0
Toll Exempted - Truck	0	0
Vehicles (Nos)	18406	16523
Vehicles (PCUs)	21938	20826

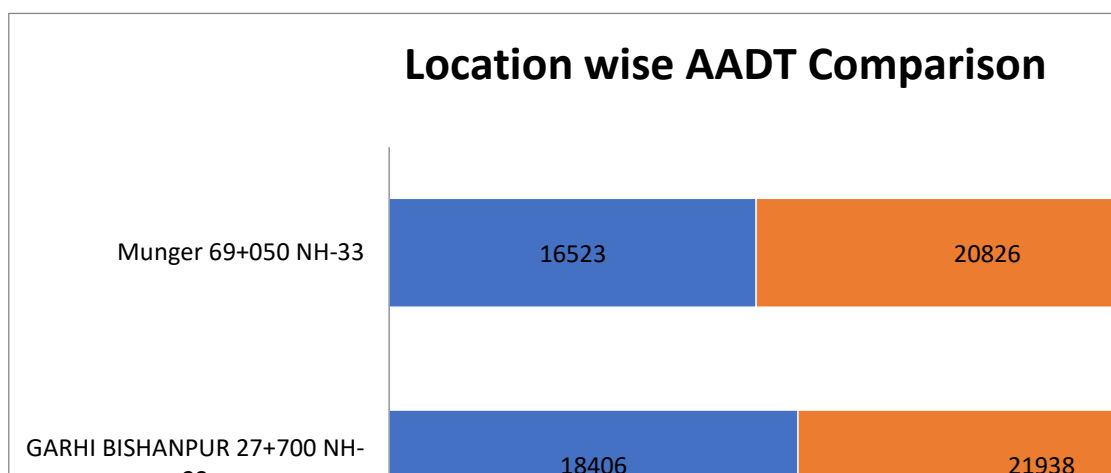


Figure 11 Location wise AADT Comparison

7.5.3. Comparison of AADT for all survey locations

The graph comparison between AADT (Vehicle No. & PCU's) for all survey locations on project road is presented in **Fig: 15, 16, 17.**

Table 13 Annual Average Daily Traffic for Km. 27+700

Vehicle Category	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	AADT
	19-11-24	20-11-24	21-11-24	22-11-21	23-11-21	24-11-21	25-11-25	
2 Wheeler	10965	10512	10657	10965	10512	10657	10741	10965
3 Wheeler	1437	1355	1406	1437	1355	1406	1415	1437
Car / Jeep /Van	1736	1666	1727	1736	1666	1727	1711	1736
Mini Bus	39	35	29	39	35	29	37	39
School Bus	0	24	20	0	24	20	24	0
Govt Bus	0	0	0	0	0	0	0	0
Private Bus	49	20	18	49	20	18	23	49
Mini LCV	696	621	620	696	621	620	665	696
LCV	334	305	303	334	305	303	322	334
2 Axle Truck	123	123	107	123	123	107	115	123
3 Axle Truck	121	133	122	121	133	122	129	121
MAV	2060	2047	2007	2060	2047	2007	2091	2060
MAV (more than 6 Axles)	0	0	0	0	0	0	0	0
Tractor	34	24	21	34	24	21	27	34
Tractor + Trailer	397	332	359	397	332	359	386	397

Vehicle Category	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	AADT
	19-11-24	20-11-24	21-11-24	22-11-21	23-11-21	24-11-21	25-11-025	
Pedal Cycle	789	780	748	789	780	748	827	789
Hand Cart	23	21	13	23	21	13	26	23
Animal Drawn	5	10	7	5	10	7	8	5
Toll Exempted - Car	58	42	44	58	42	44	45	58
Toll Exempted - Bus	0	0	0	0	0	0	0	0
Toll Exempted - LCV	0	0	0	0	0	0	0	0
Toll Exempted - Truck	0	0	0	0	0	0	0	0
Vehicles (Nos)	18866	18050	18208	18866	18050	18208	18592	18866
Vehicles (PCUs)	22449	21605	21558	22449	21605	21558	22345	22449

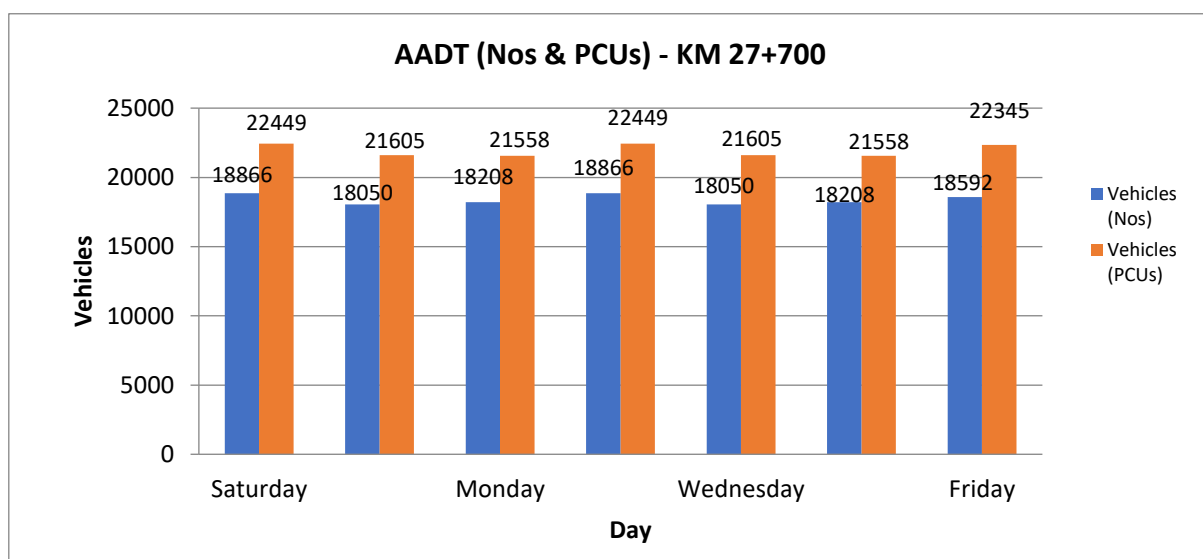


Figure 12 AADT Comparison at Km. 27+700

Table 14 Annual Average Daily Traffic for Km. 69+050

Vehicle Category	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	AADT
	19-11-24	20-11-24	21-11-24	22-11-24	23-11-24	24-11-24	25-11-25	
2 Wheeler	7569	7685	7536	7569	7685	11358	7615	8145
3 Wheeler	1144	1252	1179	1144	1252	1838	1216	1289
Car / Jeep /Van	1321	1394	1345	1321	1394	2084	1377	1462
Mini Bus	22	29	22	22	29	43	25	27
School Bus	0	0	0	0	0	0	0	0
Govt Bus	0	0	0	0	0	0	0	0
Private Bus	48	56	42	48	56	77	54	54
Mini LCV	640	702	642	640	702	1047	668	720
LCV	301	333	291	301	333	492	313	338
2 Axle Truck	96	114	91	96	114	162	105	111
3 Axle Truck	120	139	119	120	139	190	124	136
MAV	2017	2098	2000	2017	2098	3214	2039	2212
MAV (more than 6 Axles)	0	0	0	0	0	0	0	0
Tractor	40	40	28	40	40	53	32	39
Tractor + Trailer	199	175	152	199	175	252	163	188
Pedal Cycle	1735	1614	1525	1735	1614	2397	1587	1744
Hand Cart	12	12	17	12	12	20	14	14
Animal Drawn	1	3	5	1	3	3	5	3
Toll Exempted - Car	40	39	32	40	39	55	36	40
Toll Exempted - Bus	0	0	0	0	0	0	0	0
Toll Exempted - LCV	0	0	0	0	0	0	0	0
Toll Exempted - Truck	0	0	0	0	0	0	0	0
Vehicles (Nos)	15305	15685	15026	15305	15685	23285	15373	16523
Vehicles (PCUs)	19148	19849	18761	19148	19849	29746	19283	20826

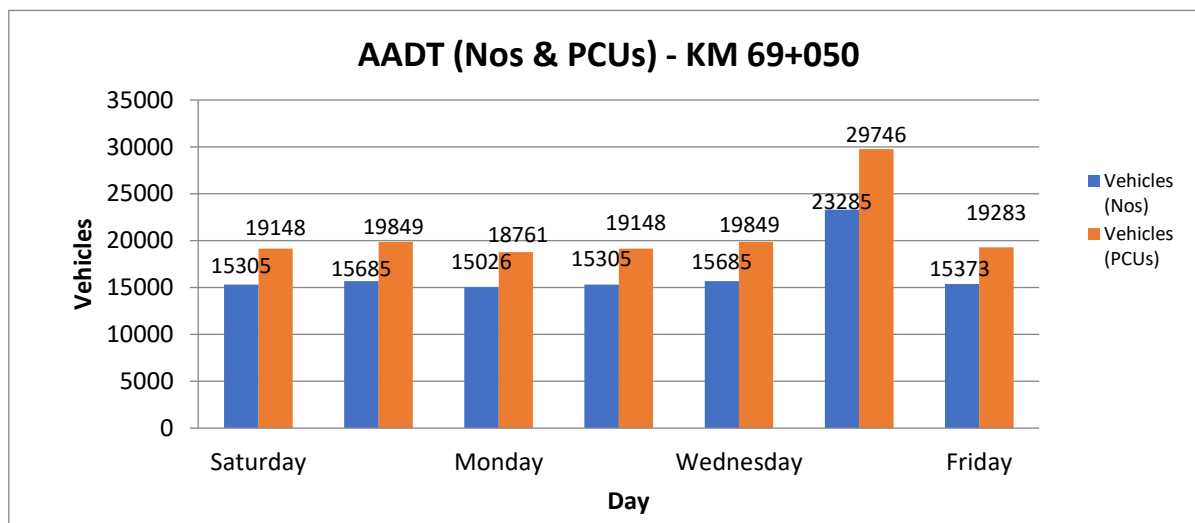


Figure 13 AADT Comparison at Km. 69+050

7.5.4. Annual Average Daily Traffic at Km. 156+800

A summary of Average Annual Daily Traffic (AADT) on Bharudi section at Km. 156+800 of project road is presented in **Table 23**.

Table 15 AADT Comparison at Km. 156+800

Vehicle Category	MCVC	IHMCL-1	IHMCL-2	IHMCL-3
Bicycle	2	22	8	9
2 Wheeler	5882	13340	1062	13200
3 Wheeler	2329	2192	150	2367
Tractor	17	17	1	16
Tractor with Trailer	66	72	10	94
LMV 2 Axle LMV	11132	22360	21258	18332
LCV 2 Axle	1668	1901	4066	1463
2 Axle Truck or Bus	3111	2427	4496	2429
3 Axle Truck or Bus	1261	1106	3268	1138
Multi Axle Vehicles	1755	1102	4131	1262
Oversized Vehicle OSV		0	1	0
Cycle Rickshaw	2	3	0	0
Earth Moving Equipment		9	3	9
AADT	27225	44549	38456	40319

7.6. Axle Load Surveys and Data Analysis

Traffic loading on highway pavements is a heterogeneous combination of different types of vehicles, carrying a wide spectrum of wheel loads. It is very much essential to convert this heterogeneous traffic to an equivalent homogenous traffic in terms of a chosen standard vehicle. One means of achieving this objective is the use of Equivalent Standard Axle Load (ESAL) factors. Axle load surveys of commercial vehicles were carried out to establish Vehicle Damage Factor for use in pavement design. Since, lighter vehicles have a very small equivalent standard axle load value and less damaging effect, these vehicle types were excluded in the present axle load survey.

7.6.1. Locations of Survey Station

To estimate the Equivalent Standard Axle Load of traffic, axle load surveys were carried out at two locations at Km 27+700, and Km 69+050, as indicated in **Table-26**.

Table 16 Locations of Axle Load Survey Station

Sr. No.	Survey Location	Chainage
1	GARHI BISHANPUR 27+700 NH-33	27+700
2	Munger 69+050 NH-33	69+050

7.6.2. Measurements of Axle Loads in the Field

At the selected survey location, arrangements were made for the installation of the portable weighing pads by placing it at the edge of the uniform and level pavement surface available. The portable and pre-calibrated wheel-weighing pads were used for the measurement of wheel loads. The size of the weighing unit permitted only one single or dual tyre assembly to be weighed at a time. Each vehicle to be weighed was aligned so that both the front axle and rear axle's wheels on one (outer) side of the vehicle were in line with the weighing unit. The vehicle was then driven slowly on to the unit and stationed with the wheel being weighed at the center of the top plate of the weighing pad. The vehicle was stopped long enough for the reading on the display unit to stabilize. The same procedure was repeated with the next axle.

Assuming the load on each axle is evenly distributed the axle load is taken to be twice the wheel load. Axle loads were weighed for the fast commercial modes (LCV, 2-Axle Trucks, 3 Axle Trucks, Multi-Axle Vehicles (MAV) and Buses) on a sample basis for 24 hours. While the vehicles were being weighed, information about the axle-type was also recorded.

7.6.3. Computation of Vehicle Damage Factor (VDF) using Field Data

The Vehicle Damage Factor (VDF) is a multiplier to convert the number of commercial vehicles of different axle loads and axle configuration into the number of repetitions of standard axle load of magnitude 80 KN (8.2 Tons). It is defined as equivalent number of standard axles per commercial vehicle. The VDF varies with the vehicle axle configuration and axle loading.

The spectrum of axle load in terms of axle weights of single, tandem, tridem and multi-axle have been determined and compiled under various classes with class intervals of 10 KN, such as 10 KN, 20 KN and 30 KN for single, tandem and tridem axles respectively.

The equations for computing equivalency factors for single, tandem and tridem axles given below have been used for converting different axle load repetitions into equivalent standard axle load repetitions.

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

Summation of all ESA gives the total damaging effect for that location. By knowing the number of vehicles weighed and number of axles weighed and total damaging effect, VDF and Axle Equivalency were computed.

$$\text{VDF} = \text{Total ESA} / \text{No. of vehicles weighed}$$

$$\text{Axle Equivalency} = \text{Total ESA} / \text{No. of axles weighed}$$

For the purpose of structural design of pavement, only the number of commercial vehicles with laden weight of 30 KN or more and their axle loading pattern has been considered.

The vehicle damage factor is a multiplier for converting the number of commercial vehicles of different axle loads to the number of standard axle load repetitions. Design of new pavement for additional lane or strengthening of existing pavement is based upon the cumulative number of 80 KN (8.16 ton) equivalent standard axles (ESA) that will pass over during the design period. The classes of traffic which lead to significant axle loads (or damage) to the pavement and accordingly considered for design are: LCVs, Buses, two / three axle and multi axle trucks. Vehicle damage factors (VDF) are calculated in accordance with the guidelines provided in IRC: 37 – 2018. Based on the axle load data analysis, the resulting VDFs are as given in **Table-27**.

Table 17 Vehicle Damage Factors

Location	Direction	Bus	Private Bus	LCV	2-AT	3-AT	4-AT	5-AT	6-AT
KM 27+700	Mokma To Munger	1.0	1.0	0.95	1.0	1.74	0.24	1.0	1.0
	Munger To Mokma	1.0	1.0	3.90	1.0	1.92	7.09	1.0	1.0
Adopted values for all sections of project road		1.00	1.00	3.90	1.00	1.92	7.09	1.00	1.00
KM 69+050	Mokma To Munger	1.0	1.0	0.95	1.0	1.0	1.0	1.0	1.0
	Munger To Mokma	1.0	1.0	3.90	1.0	1.63	1.0	4.89	1.0
Adopted values for all sections of project road		1.00	1.00	3.90	1.00	1.63	1.00	4.89	1.00

7.7. O-D Survey and Data Analysis

Origin-Destination survey has been carried out at four locations along the project road. Data collected from the site was fed to the computer and compiled for the base year (2019), using the zoning system adopted for the study.

7.7.1. Zoning System

In order to assess the movement pattern on the project influence area the zoning system was developed keeping in view the major generation and attraction points in the influence area. Following O-D zones were designated to study the traffic movements in the study area as shown in **Table-28**. The internal zones and some of the external zones in the vicinity of the project road are shown in **Fig. 20 and 21**.

Table 18: Adopted Zoning System for the Study







7.1. Design Traffic

The Average Annual daily traffic (AADT) of commercial vehicles derived for the project has been considered as the design traffic in the base year 2025. At this stage of feasibility, we have generalized the traffic without giving importance to the section wise variations. The average traffic of all the seven locations shall form the basis for calculation of CSA for the entire project road.

Table 19 Design Traffic Volume (AADT) – Year 2025

Location	Buses	LCV	2AT	3AT	MAV
KM 27+700	1609	1882	1341	1250	1719
Km 69+050	1356	2141	1268	1261	1755
Max. Traffic on Project Road (AADT)	1769	2141	2767	1802	1788

7.8. Traffic Forecast

7.8.1. Introduction

Financial resources available are always scarce and has competing demands, and therefore, the investments in a highway project has to be carefully planned, keeping in view not only the present demand but also the requirements for a reasonable period in future. This underlines the need for estimating the future traffic accurately, whether the plan is for the construction of a new facility or the improvement of existing facilities. The accurate estimate of future traffic will not only have a significant impact on the engineering design of the facility, but also influence the financial viability of the project.

Traffic forecasting is at best an approximation, which is based on analysis of available data. Traffic is generated as a result of the interplay of a number of contributory factors. Forecasts of traffic have, therefore, to be dependent on the forecasts of factors such as population, Gross domestic product, vehicle ownership, agricultural output, fuel consumption etc. Future pattern of change in these factors can be estimated with only a limited degree of accuracy and hence the forecasting of future traffic levels cannot be precise.

In the process of traffic forecast, it is necessary to distinguish between the following types of traffic:

7.8.2. Current Traffic and its Growth

This represents the existing traffic that would use the improved highway when it is opened to traffic. It is growing at a normal growth. This represents the increase in traffic, which would in any event occur even if no improvement is made for the road, this being the result of the general increase in the number and usage of motor vehicles.

7.8.3. Development/Generated Traffic

This represents the increase in traffic, if any, that may arise from improvements and development of adjacent land uses due to added accessibility and mobility and associated new policy and decisions to locate development activities within the influence area of the project road.

7.8.4. Secondary Data

Besides primary surveys, the following data were collected from various sources:

- Population data
- Vehicle registration data
- NSDP, NDDP, and per-capita income data.

These data were collected for the state of Gujarat.

7.8.5. Vehicle Registration

Vehicle registration data for the state of Gujarat have been obtained from the website of Ministry of Road Transport & Highways, which were used in estimating the growth in vehicle registration.

Table 20 Vehicle Registration

Years	Car	Growth %	Buses	Growth %	LCV	Growth %	Trucks	Growth %	2-W	Growth %
2025-2026	1579889	-	67546	-	448958	-	301533	-	10512304	-
2026-2027	1867957	18.2%	70615	4.5%	499277	11.2%	319207	5.9%	11500292	9.4%
2027-2028	2047621	9.6%	72998	3.4%	542918	8.7%	332185	4.1%	12502698	8.7%
2028-2029	2297572	12.2%	76435	4.7%	589984	8.7%	352225	6.0%	13704879	9.6%
2029-2030	2559308	11.4%	82734	8.2%	633599	7.4%	375265	6.5%	14919493	8.9%
Average		12.82 %		5.20%		8.99%		5.62 %		9.15 %

7.8.6. Elasticity of Transport Demand

The method of long-term traffic forecasting incorporates analyses of some of the key socio-economic characteristics in the influence area of the project road and their anticipated rates of change during the study period upto horizon year. These characteristics are being taken as indicators for the future growth of traffic.

The Consultants have used the elasticity approach for determining the growth rates of future traffic. This involved establishing a quantitative relationship between traffic growth as the dependent variable and growth in NSDP, Industry or sectoral income as the independent variable. The methodology involved fitting of a log-log regression equations to the time series data.

The growth rates for normal traffic obtained from this approach take some account of the following factors, which affect future traffic levels:

- The prospective growth in the economy
- The prospective demographic growth
- The estimated elasticity of demand for transport, and Change in the structure of the vehicle fleet, for example vehicle productivity and changes in the inter-modal share of passenger and freight demand.

7.8.7. NSDP and Per-Capita Income

Population, economic and industrial data was obtained for the state of Gujarat. Economic indicators on Net State Domestic Product and PCI were obtained for the period 2004/05 to 2017/18 for Gujarat, and their rate of growth is estimated as follows:

Table 21 NSDP and Per-Capita Income

Year	GDP Growth (%)	NSDP Growth (%)	PCI Growth (%)
------	----------------	-----------------	----------------

2025-2030	13.40	13.08	10.99
2030-2035	13.20	12.24	10.32
2035-2040	13.00	11.40	9.64
Beyond 2040	12.80	10.57	8.97

7.8.8. Traffic Growth Rates

The TOR specifies adopting 5% growth rate for the feasibility study. This suggested growth rate may be used for revenue determination during the financial analysis. In order to be on the conservative side, for estimating the future traffic loading on pavement in terms of cumulative million standard axles (MSA), higher traffic growth rates is considered.

Table 22 Estimation of Normal Growth Rate 2025-2030

Modes	Coefficient	Variable Growth Rates	Growth Rates	Registered Vehicles Growth Rate	Weighted Growth Rate
Car/ PCI	1.49	10.99	16.43	12.82	14.62
Buses/ POP	3.68	1.33	4.88	5.20	5.04
Buses/ PCI	0.62	10.99	6.77	5.20	5.99
Goods Vehicles vs GDP					
Trucks	0.58	13.40	7.81	5.62	6.72
Goods Vehicles vs NSDP					
LCV	0.93	13.08	12.20	8.99	10.60
Trucks	0.58	13.08	7.64	5.62	6.63
2-W/ PCI	1.11	10.99	12.21	9.15	10.68

Table 23 Estimation of Normal Growth Rate 2023-2027

Modes	Coefficient	Variable Growth Rates	Growth Rates	Registered Vehicles Growth Rate	Weighted Growth Rate
Car	1.35	10.32	13.88	12.82	13.35
Buses	3.31	1.33	4.39	5.20	4.80
Buses/PCI	0.55	10.32	5.72	5.20	5.46
Goods Vehicles vs GDP					
Trucks	0.52	13.20	6.93	5.62	6.27
Goods Vehicles vs NSDP					
LCV	0.84	12.24	10.27	8.99	9.63
Trucks	0.53	12.24	6.43	5.62	6.03

Modes	Coefficient	Variable Growth Rates	Growth Rates	Registered Vehicles Growth Rate	Weighted Growth Rate
2-W	1.00	10.32	10.32	9.15	9.73

Table 24 Estimation of Normal Growth Rate 2028-2032

Modes	Coefficient	Variable Growth Rates	Growth Rates	Registered Vehicles Growth Rate	Weighted Growth Rate
Car	1.21	9.64	11.67	12.82	12.24
Buses	2.98	1.33	3.95	5.20	4.58
Buses/PCI	0.50	9.64	4.81	5.20	5.01
Goods Vehicles vs GDP					
Trucks	0.47	13.00	6.14	5.62	5.88
Goods Vehicles vs NSDP					
LCV	0.76	11.40	8.61	8.99	8.80
Trucks	0.47	11.40	5.39	5.62	5.51
2-W	0.90	9.64	8.68	9.15	8.91

Table 25 Estimation of Normal Growth Rate Beyond 2032

Modes	Coefficient	Variable Growth Rates	Growth Rates	Registered Vehicles Growth Rate	Weighted Growth Rate
Car	1.09	8.97	9.77	12.82	11.30
Buses	2.68	1.33	3.56	5.20	4.38
Buses/PCI	0.45	8.97	4.03	5.20	4.62
Goods Vehicles vs GDP					
Trucks	0.42	12.80	5.44	5.62	5.53
Goods Vehicles vs NSDP					
LCV	0.68	10.57	7.19	8.99	8.09
Trucks	0.43	10.57	4.50	5.62	5.06
2-W	0.81	8.97	7.27	9.15	8.21

Table 26 Realistic, Optimistic and Pessimistic Traffic Growth Rates

Mode	2018-2022	2023-2027	2028-2032	Beyond 2032
Realistic Growth Rate (%)				
Car	14.6	13.4	12.2	11.3
Buses	5.0	4.8	4.6	4.4
LCV	10.6	9.6	8.8	8.1
Truck	6.6	6.0	5.5	5.1
2-W	10.7	9.7	8.9	8.2
Optimistic Growth Rate (%)				
Car	16.1	14.7	13.5	12.4
Buses	5.5	5.3	5.0	4.8
LCV	11.7	10.6	9.7	8.9
Truck	7.3	6.6	6.1	5.6
2-W	11.7	10.7	9.8	9.0
Pessimistic Growth Rate (%)				
Car	13.2	12.0	11.0	10.2
Buses	4.5	4.3	4.1	3.9
LCV	9.5	8.7	7.9	7.3
Truck	6.0	5.4	5.0	4.6
2-W	9.6	8.8	8.0	7.4

Table 27 Summary of Actual Traffic Growth Rates

Mode	Car	3-W	2-W	Mini Bus	Bus	LCV	Truck
2025-2030	14.6	10.7	10.7	5.0	5.0	10.6	6.6
2030-2035	13.4	9.7	9.7	4.8	4.8	9.6	6.0
2035-2040	12.2	8.9	8.9	4.6	4.6	8.8	5.5
Beyond 2040	11.3	8.2	8.2	4.4	4.4	8.1	5.1

Table 28 Summary of Adopted Traffic Growth Rates

Mode	Car	3-W	2-W	Mini Bus	Bus	LCV	Truck
2025-2030	14.6	10.7	10.7	5.0	5.0	10.6	6.6
2030-2035	13.4	9.7	9.7	5.0	5.0	9.6	6.0
2035-2040	12.2	8.9	8.9	5.0	5.0	8.8	5.5
Beyond 2040	11.3	8.2	8.2	5.0	5.0	8.1	5.1

7.8.9. Traffic Loading

As suggested in IRC: 37 – 2018, the design traffic loading is considered in terms of the cumulative number of standard axles in the lane carrying maximum traffic, to be carried during the design life of the road. Design Traffic loads were computed using the following equation:

$$N = 365 \times \left\{ (1 + r)^n - 1 \right\} \times A \times D \times \frac{F}{r}$$

Where,

N = the cumulative number of standard axles to be catered for in the design

- A = Initial traffic in the years of completion of construction (number of CVs per day).
D = lane distribution factor as per IRC: 37 – 2018 (Para 4.5.1)
F = Vehicle Damage Factors
n = Design life in years
r = Annual growth rate of commercial vehicles

The traffic in the year of completion is estimated using the following formula:

$$A = P (1 + r/100)^x$$

Where,

- P = Number of commercial vehicles
x = Number of years between the count and the year of completion of construction
A = Traffic in the year after completion of construction
r = Average Annual growth rate (as estimated)

The design traffic (msa) is worked out for the entire project road as per IRC: 37-2012 Para 4.5.1.

Traffic loading in terms of MSA (Million Standard Axles) have been arrived and presented in **Table-60** for 6-lane carriageway configuration.

Table 29 Traffic Loading (MSA) – 4Lane Sections

Sl. No.	Homogenous Section	Design Traffic (10 years MSA)	Design Traffic (15 years MSA)
1	KM 0/000 To KM 82/100)	100.80	163.77
Average		100.80	163.77

7.9. Traffic Projection and Capacity

The AADT obtained at all the traffic survey locations are projected at a uniform growth rate of 5% for all categories of vehicles as mentioned in the TOR. The year in which the project road reaches its design service volume at LOS-B is worked out for 6-lane configuration. The results are tabulated **Table 61**.

Table 30 Year of Achieving DSV (PCUs/day)

Sl No	Location	Traffic (PCUs/Day) Base Year, 2025	4-Lane		6-Lane	
			LOS-B	LOS-C	LOS-B	LOS-C
			40000	60000	80000	120000
1	KM 27+700	21938	2038	2047	2053	-
2	KM 69+050	20826	2038	2047	2053	-
	Average	42754	Exceeded	2047	2053	-

KM 27+700

To serve in LOS B the 4 lane facility should be ready by 2038 and to serve in LOS B 6 lane facility should be ready by 2053.

KM 69+050

To serve in LOS B the 6 lane facility should be ready by 2038 and to serve in LOS C 6 lane facility should be ready by 2053.

The year-wise projection of traffic and year of reaching DSV (PCUs/day) for LOS-B and LOS-C of 4-lane and 4-lane highway is presented and highlighted in **Table-62**.

Table 31 Projection of AADT (PCUs/day)

S. No.	Years	KM 27+700	KM 69+050	Average (Loc1,2)
Base Year	2025	21938	20826	21382
1	2026	23035	21867	22451
2	2027	24187	22961	23574
3	2028	25396	24109	24753
4	2029	26666	25314	25990
5	2030	27999	26580	27290
6	2031	29399	27909	28654
7	2032	30869	29304	30087
8	2033	32413	30770	31591
9	2034	34033	32308	33171
10	2035	35735	33923	34829
11	2036	37522	35620	36571
12	2037	39398	37401	38399
13	2038	41368	39271	40319
14	2039	43436	41234	42335
15	2040	45608	43296	44452
16	2041	47888	45461	46675
17	2042	50283	47734	49008
18	2043	52797	50120	51459
19	2044	55437	52626	54032
20	2045	58209	55258	56733
21	2046	61119	58021	59570
22	2047	64175	60922	62548
23	2048	67384	63968	65676
24	2049	70753	67166	68960
25	2050	74291	70524	72408

S. No.	Years	KM 27+700	KM 69+050	Average (Loc1,2)
26	2051	78005	74051	76028
27	2052	81905	77753	79829
28	2053	86001	81641	83821
29	2054	90301	85723	88012
30	2055	94816	90009	92412

7.10. Capacity of Four-Lane Highway as Per IRC SP -84 2014

For the purpose of augmentation of the facilities and up-gradation of the Project Highway, the Design service volume for different terrain conditions and level of service shall be as specified In.

Design Service Volume for Four-Lane Highways in PCU per Day

Terrain	Design Service Volume in PCU Per Day	
	Level of Service 'B'	Level of Service 'C'
Plain and Rolling	40,000	60,000
Mountainous and Steep	20,000	30,000

Note: The definition of PCU here is as per IRC Codes and Guidelines and not as per the definition

Given in MCA

7.11. Warrants for Six-Laning

Unless otherwise specified in the Concession Agreement, the Project Highway shall be widened to 6-lane when total traffic including the traffic on service roads, if any, reaches the design service volume corresponding to Level of Services 'C' for 4-lane highway specified in Table 2.9. The augmentation to six laning shall be as per **IRC: SP: 87**

OFFICE MEMORANDUM (NHAI/Bharatmala/EC/DPR/2016/143430 dt 30.10.2019)

* **Circular ref:** (I) Design principles for various category of road under BMP and cost optimization Circulated Vide letter no. NHAI/ Bhartmala/ EC/ DPR/ 2016/117548 dated 14.05.2018

Policy for development of Highways under Bharatmala Pariyojana

7.12. Development Strategy:

The following guidelines were decided for end-lane configuration status and the stage development guidelines based on the present traffic including the induced traffic (PCU) and the present lane status of the stretch

Sr. NO	Present traffic including induced traffic (PCU)	Present Lane status	End Lane status	Stage development/Remarks	ROW
C. All categories of road					
(iv)	Beyond 20,000 PCUs	2L/2L+PS/4L	6 Lane	6 lane highway with 6 lane structures, with paved shoulder of 1.5m and earthen shoulder of 2m.	60 m

As per the OM dated 30-10-2019 (Mentioned above) the capacity of the 6 lane has been given Beyond 20,000 PCUs.

Table 32 LOS differentiation with Color ID

Color ID	DSV (PCU/day)	Lane Configuration	LOS
	40000	Four Lane Highway	LOS - B
	60000	Four Lane Highway	LOS - C
	80000	Six Lane Highway	LOS - B
	120000	Six Lane Highway	LOS - C

7.13. Tollable Traffic Details

The details of tollable and non-tollable traffic are presented in following **Table 64** and depicted in **Figure 42,43,44**.

Table 33 Tollable and Non-Tollable Traffic Details

Tollable Traffic Volume	Car / Jeep /Van	Bus	LCV+ M Bus	2AT	3AT	MAV	Total Tollable		Total Non-tollable		Percentage (PCUs)	
							Vehs	PCUs	Vehs	PCUs	Tollable (PCUs)	Non-Tollable (PCUs)
KM 27+700	2358	44	350	117	126	2046	5041	12950	13365	8988	59%	41%
KM 69+050	2182	54	365	111	136	2212	5061	13588	11463	7238	65%	35%

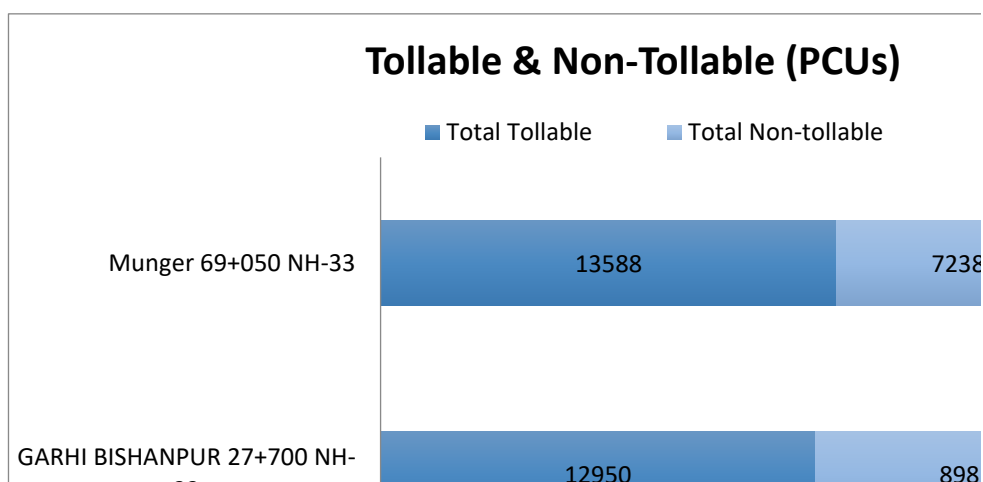


Figure 14 Tollable and Non-Tollable PCU Traffic Details

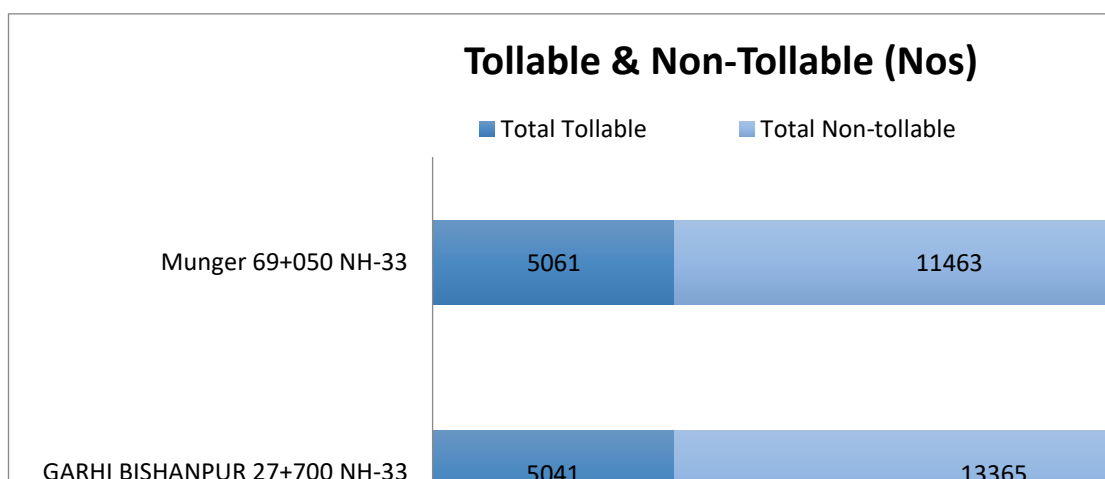


Figure 15 Tollable and Non-Tollable Traffic Details

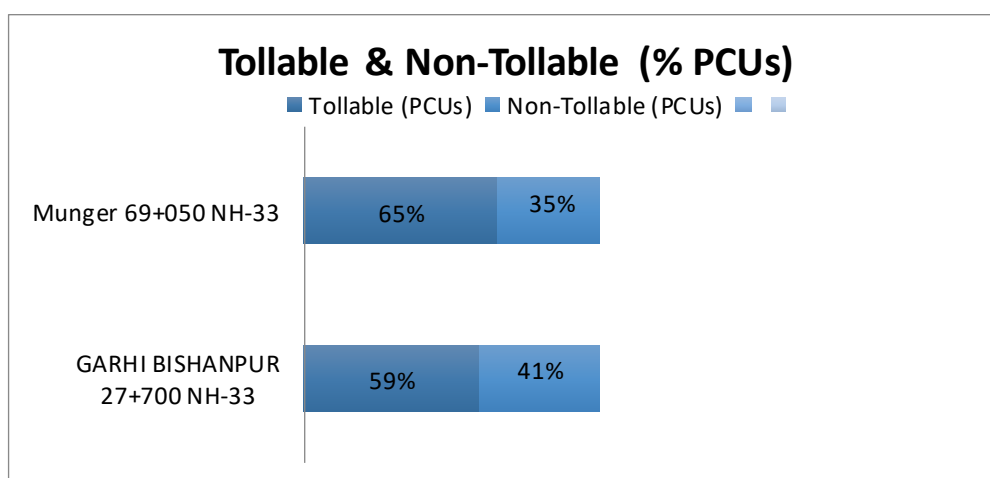


Figure 16 Tollable and Non-Tollable %Traffic Details

ANNEXURE-8B

Road safety audit report

Road Safety

1.1 Crash Barriers Metal Beam Crash Barriers is proposed at high embankment locations and at major bridge approaches. The barrier would be of “Thrie” beam type consisting of steel posts and a 3mm thick “Thrie” beam rail. There would be a steel spacer block between the post and the beam to prevent the vehicle from snagging on the post. The steel posts and the blocking out spacer would be channel section of 75mm x 150mm size and 5mm thick. The posts are spaced 2m centre to centre. All members of the system would be hot dipped galvanized. Crash barrier system absorbs impact of vehicle and laterally restrains a vehicle from veering off. This would ensure minimum damage to the vehicle and passengers.



1.2 TRAFFIC CONTROL DEVICES

Traffic control devices used to regulate the traffic in Road Construction Zones include,

1. Road Signs
2. Delineators
3. Barricades
4. Cones
5. Pylons
6. Pavement markings
7. Flashing lights

Average Speed (Km/h)	Distance of first sign in advance of the first channelizing device (m)	Size of Warning Sign (mm)	Minimum no of signs in advance of the hazard
Under 50	100	600	3
51 – 60	100 – 300	750	3
61 – 80	120 – 300	900	3 or 4
81 – 100	300 – 500	1200	4
Over 100	1000	1200 to 1500	4

Cautionary / Warning Signs

In case of divided carriageways, the signs should be provided both adjacent to the shoulder and on the central median so as to be visible from all lanes.

Delineators

Delineators are devices or treatment which outlines the roadway or portion thereof. They include Safety Cones, Traffic Cylinders, Tapes, Drums, Painted lines, Raised Pavement Markers, Guide Posts, and Post-mounted Reflectors *etc.* They are used in or adjacent to the roadway to control the flow of traffic. Delineators are basically driving aids and should not be regarded as a substitute for warning signs or barriers for out-of-control vehicles.

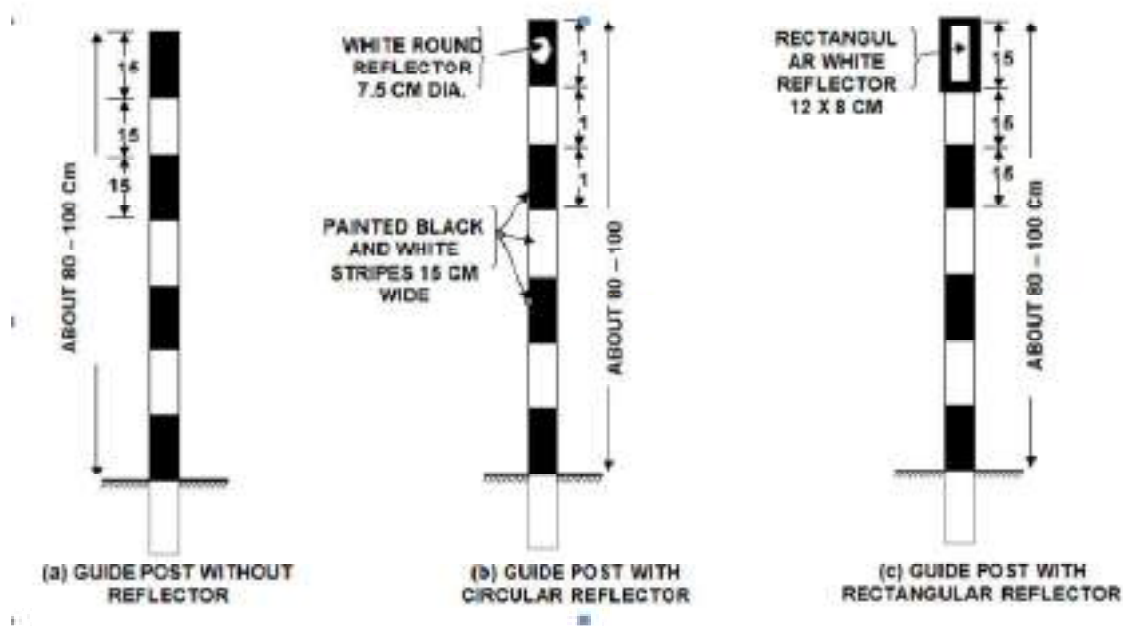


Guide Post

They are intended to delineate the edges of the midway so as to guide driven about the alignment ahead, particularly where it might be confusing. Guideposts can be of metal, concrete, cut stone, amber or plastic. The posts can be made of Circular, Rectangular or Triangular Cross-section but the side facing traffic should be at least 10 cm wide.

Drums

Drums of height 800 mm to 1000 mm high and 300 mm in diameter can be used as either channelizing or warning devices. Both plastic and metallic drums (e.g. Bitumen drums) can be used for this purpose. Drums need to be filled up with earth or sand to increase its stability. Drums should be reflective and painted as shown in the **Figure 7.1**.



Drum Reflections

Safety Cones

Safety cones are 500 mm, 750 mm and 1000 mm high and 300 mm to 500 mm in diameter. They are usually made of plastic, rubber, HDPE, PVC and have retro reflectors red and white bands. Safety cones would be displaced or blown unless their bases are anchored or loaded with ballast. This can be avoided by, using sand bag rings to provide increased stability. Using heavier weighted cones. Using cones with special weighted bases. Doubling the cones to provide added weight.

Barricades

CMRL prescribed standard barricades are used.

Flagmen

- An authorised personnel at least average intelligence, be mentally alert and good in physical condition be selected, since flagmen are responsible for public and workmen safety.

- Flagmen should be equipped with yellow helmet with green reflective sticker fixed around and reflective jacket along with hand signalling devices such as flags and sign paddles. The typical specification are given below,
- Flagmen need to maintain the flow of traffic continuous past a work zone at relatively reduced speeds by suitably regulating the traffic. He shall stop the traffic for a short while whenever required (e.g. for entry and exit of construction equipment in to work zone).
- Flagman should be positioned in a place where he is clearly visible to approaching traffic and at a sufficient distance to enable the drivers to respond for his flagging instructions. A flagman never leaves his post until properly relieved,
- The standard distance shall be maintained at 60 – 100 m but can be altered depending upon the approach speed and site conditions. In urban areas this distance shall be taken as 20 m to 50 m.

Traffic Management Practices

Definitions

Road traffic control involves directing vehicular and pedestrian traffic around a construction zone, accident or other road disruption, thus ensuring the safety of emergency response teams, construction workers and the general public.

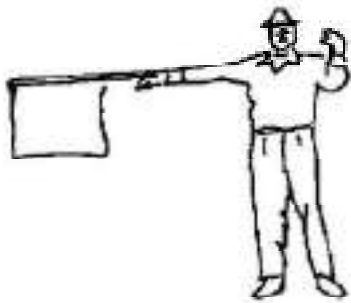
Working zone:

The Plant Site, construction zone of road *etc.* at which workmen will be working.

Working space:

The space around the works area that will require storing tools, excavated material and other equipment. It is also the space to allow workmen, movement and operation of plant, (e.g. swing of jibs, excavator arms) to move around to do the job. Materials and equipment must not be placed in the zone either. Workmen will only need to enter the zone to maintain cones and other road sign.

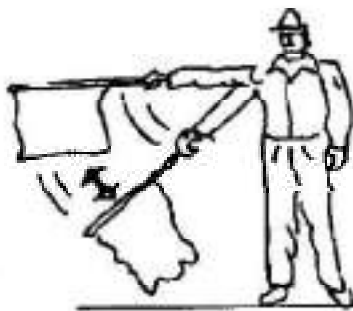
FLAG



TO STOP
TRAFFIC

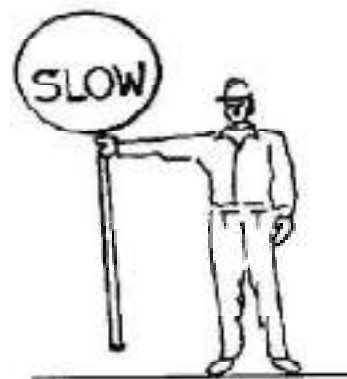
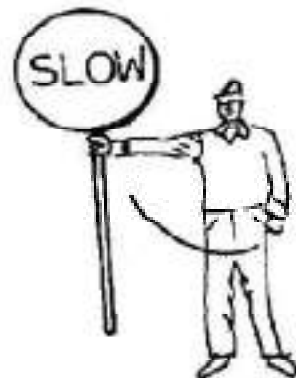


TRAFFIC
PROCEED

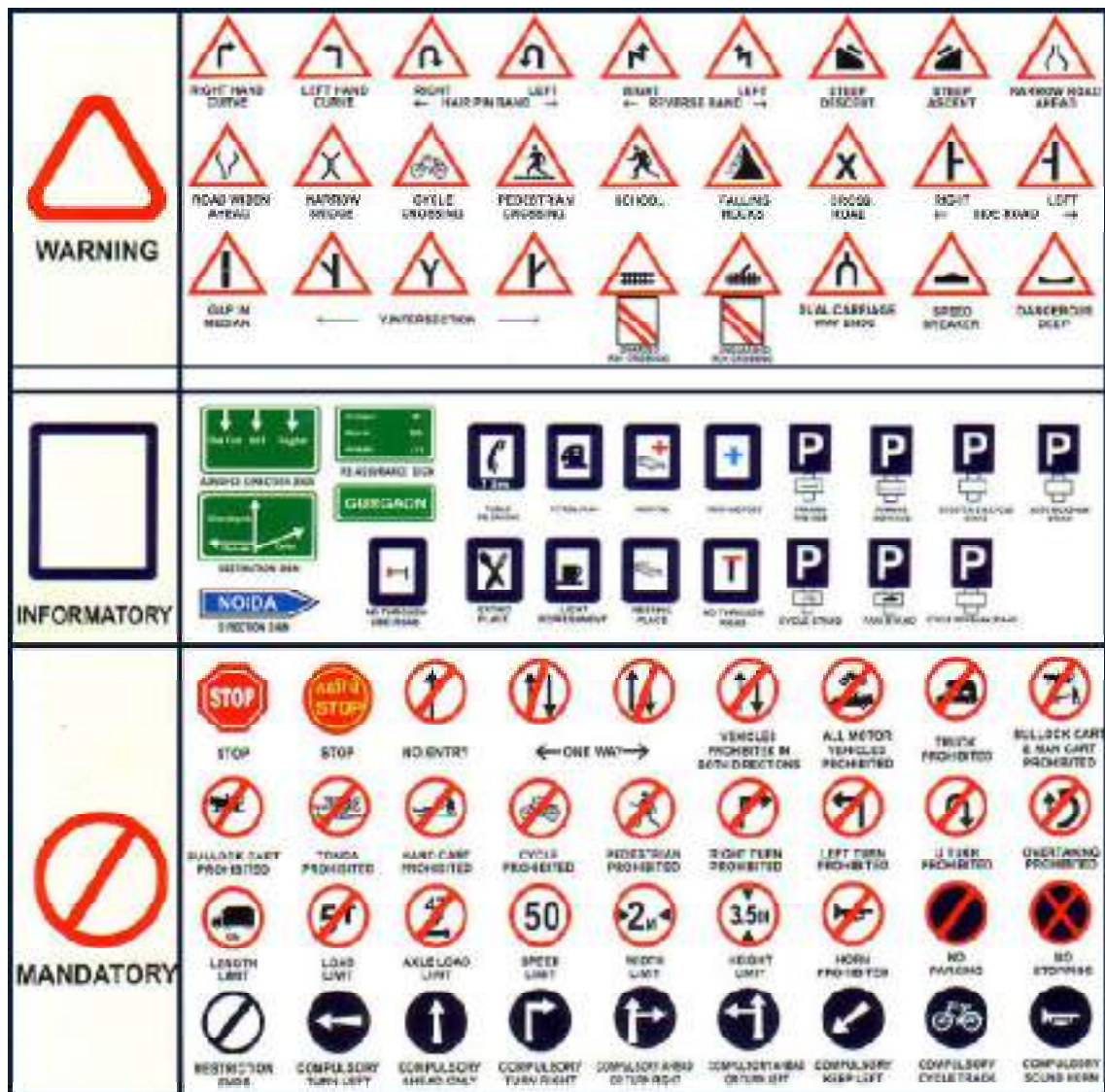


TO ALERT
AND SLOW
TRAFFIC

PADDLE



Road Signals Traffic Signals



Traffic Signals

Safety zone:

The zone that is provided to protect workmen from the traffic and to protect from them.

Approach Transition zone:

This will vary with the speed limit and the width of the works as given in (diag: Traffic Control zone)

Longitudinal buffer zone:

This is the length between the end of the lead-in taper of cones (T) and the working space. It will vary with the speed limit as given in table (Traffic Control zone).

Lateral buffer zone:

This is the width between the working space and moving traffic. It will vary with the speed as given in table (Traffic Control zone). The lateral buffer zone safety clearance is measured from the outside edge of the working space to the bottom of conical sections of the cones on the side nearest to the traffic.

Traffic Management on Road Junction

Construction traffic meets live traffic from quarry/plant/borrow pit

- Where vehicles are more to the approach junction from the side road, permission shall be seek for providing speed breaker at junction from local traffic police and road-authority.
- The layout for signs and traffic control devices.
- Flag man shall be kept in the peak time provided with the traffic circle painted with red and white at the corner at a height of 500 mm, clearly visible to approaching traffic for a distance provided with while gloves and STOP, GO Paddle. And night time flagman should use LED Batons.
- All vehicles from approaching road should be STOP, LOOK and GO.
- Spillage of earth / Gravel / Aggregates / Bituminous mix from the tipper shall be cleaned on regular basis, if required 2 coolies permanently posted for booming.
- All Construction vehicles must follow lane discipline and road signs.

Activities inside Median / Island

- The traffic would discontinue from plying temporarily on the carriageway; for 2 min for reversing & dumping earth / stones / etc., , by the direction of helper and the flagman controls the traffic as shown in Picture- 01 and made continue the traffic and for the next trip repeating the same.
- The construction zone shall be barricaded with standard CMRL barricade.
- One Flagman (refer flag man clause) shall be appointed at traffic coming side of the transition zone.
- No personnel are allowed to come out of the safety zone, unless flagman guidance.

ANNEXURE-9

R and R



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CHAPTER 9

INITIAL SOCIAL ASSESSMENT AND PRELIMINARY LAND ACQUISITION/ RESETTLEMENT PLAN

9.1 Introduction

9.1.1 Project Description

The National Highways Authority of India (NHAI) has been entrusted with the assignment of consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana, NH(o) Scheme.

In pursuance of the above, M/s Bloom Companies, LLC. in association with M/s Avaloz Consultant India Pvt. Ltd. have been appointed as consultants for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana NH(o) Scheme for Section: - Mokama– Munger for carrying out detailed feasibility study for 4 Laning of– Mokma– Munger Section from km. 0/00 to km. 82/400 on National Highway No. 33 in the state of Bihar.

The agreement for the same was signed on 24th March 2021

The Project starts from Mokma of NH-33 connecting ChintaManchak-29, Goshain Gaon, Ghoswari, Auta, Maranchi, Naurang Jalal-pur, Barahiya, English-186, Chhabisaia, Kuthwa, Birupur, Nizampur, Rustampur, Sarma 166, Alapur, Babhanganwan 145, Pataner, Bhelaura, Kandarpa, Wofapur, Damodarpur-91, Aureva, Khairi-88, Mohan (East), Gauripur, Mughraura, Safiabab ChintaManchak-29, Goshain. and District Patna and Lakhi-sarai and terminating at Munger of NH-33 stone 82/100) in the state of Bihar.

This submission is Draft Feasibility Report

9.1.2 Expected Project Benefits

Implementation of the project is expected to yield the following benefits.



- Improved road transport corridors and road network connectivity
 - ❖ Safe journey
 - ❖ Risk reduction
 - ❖ Improvement in basic amenities to the towns/village along the highway
- Economic benefits in the terms of
 - ❖ Saving in Vehicle operating cost including fuel and maintenance.
 - ❖ Time savings for passengers and goods transport.
 - ❖ Savings in road maintenance cost
 - ❖ Avoidance of congestion
 - ❖ Industrialization and other economic activities will develop rapidly which will lead to increased production; thereby bring prosperity to those areas.
 - ❖ Lower transport costs for freight and passengers of motorized and non-motorized vehicles.

9.1.3 Negative Impacts

Certain negative social impacts are inherent and unavoidable in any of the development projects. Our project is also no exception, as the following negative impacts are anticipated due to the implementation of the project.

- ❖ Loss of source of income to PAP's
- ❖ Loss of private, immovable properties, including agriculture land, commercial & residential buildings, shops, wells, trees, standing crops, etc.
- ❖ Sentimental values with respect to some property ownerships.

9.2 Resettlement & Rehabilitation Action Plan



This chapter summarizes the resettlement and rehabilitation action plan for the Greenfield 4 Laning of **Mokma to Munger** from km 0/0 to 82/400 in the State of Bihar, which mainly focus on the approaches for minimizing / mitigating social and economic impacts due to the implementation of the project, especially on vulnerable group.

9.3 Need for Settlement Action Plan

In most of the development projects, some people or groups of people or the entire community are directly or indirectly benefited and some are adversely affected. Even though the project contributes to some positive benefits, it will have some adverse impacts associated with land acquisition and displacement of people.

There is existing ROW since the project is Green field and therefore no involves in land acquisition to have the prescribed 60m ROW, which will not affect large number of people living along the project road and some of whom will be displaced.

This resettlement and rehabilitation action plan (RAP) addresses the issues related to land acquisition and involuntary displacement of people. The aim of the RAP is to minimize the hardship of the displaced and the otherwise impacted people. The RAP also aims to help the PAPs' to have better or at least maintain their pre-project economic status.

The RAP meets the requirement of Government of India's Resettlement & Rehabilitation (R&R) policy, consistent with the World Bank's (Operational Directive 4.30) regulations, policies and procedures including those on public participation, environmental assessment and indigenous people.

9.4 R & R Principles and Guidelines

The resettlement and rehabilitation principles adopted for this project will provide compensation, resettlement & rehabilitation assistance to all Project Affected Persons (PAPs) (i.e., people affected due to the loss of land, residences, business establishments, etc.,) in the corridor of impact which is 60m.

The basic resettlement principles and guidelines include:



- ❖ Where land acquisition is required, it will be carried out according to the National Highway Act (NH Act), 1956 and in a way to minimize the adverse impacts and to avoid displacement as much as possible.
- ❖ Cash compensation for the land, at the market value will be provided to households affected by the loss of acquired land by the competent authority appointed under NH Act.
- ❖ Cash compensation for the affected structures of the title holders will be paid by the competent authority. The replacement cost will be calculated by the certified valuer as per schedule of rates (without depreciation) of the concerned district / division / zone of Rajasthan for the structure of the title holders. For items not covered in the SOR, market rates will be considered.
- ❖ Provision for relocation of the SBE's (Small Business Enterprises) in the form of vendor market as well as assisting restoration of business and local economics.
- ❖ Provision for multiple options for resettlement (self-relocation or assisted relocation) of the affected residential structure of the title holders and non-title holders including informal dwellers / squatters.
- ❖ Shifting assistance to the owners of residential structures and encroachers / squatter households and title holder for shifting of household goods and assets.



- ❖ Transitional assistance to PAP's due to inability to maintain livelihood during shifting.
- ❖ Assistance to affected persons in their efforts to improve their livelihood and standards of living or at least to restore the pre-project living status.
- ❖ Rehabilitation assistance including assistance for re-establishing last business and work days (for employees) due to the project.
- ❖ Special measures and assistance for vulnerable groups such as scheduled castes, scheduled tribes female headed households, disable persons, etc.,
- ❖ Public consultations and providing opportunities to PAP's to participate in planning and implementing resettlement programmes.
- ❖ Providing grievance redressal mechanism by way of providing grievance redress committee at district level to ensure speedy resolutions of disputes, if any.
- ❖ Involvement of women and vulnerable groups in all activities related to resettlement planning, implementation and monitoring.
- ❖ Before taking possession of the acquired land, compensation will be paid to the PAP's, prior to commencement of construction work.
- ❖ The resettlement plan will include a fully item-wised budget and implementation schedule.

9.5 Entitlement Frame Works

Based on the assessed impacts and the broad entitlement framework, the project affected persons will be entitled to the following five types of compensation and assistance.

- ❖ Compensation for structures (Residential & Commercial) and other immovable assets
- ❖ Assistance for loss of business / wage income
- ❖ Assistance for resettlement and relocation



- ❖ Rebuilding and restoration of community resources / facilities

9.6 Location

The starting point of the project road is located at Mokma- Munger and ends at of Patna, Lakhi-sarai and Munger district respectively.

The project area is geographically located within the following geographical co-ordinates.

- ❑ latitude or longitude between: 25°22'49.44"N, 85°55'51.14"E
- ❑ latitude or longitude between: 25°20'31.15"N, 86°29'39.73"E

9.7 Right of Way and Land Acquisition Considerations

The Greenfield Right of Way (ROW) along the entire length of the project road varies around 60 meters. Although NHA recommends maintaining a 60m ROW for such corridors, encroachments have been observed in certain sectors. Consequently, implementation of the project may require the acquisition of additional land at some locations to accommodate the 4-lane configuration with paved shoulders. This could potentially impact a significant number of people residing along the corridor, some of whom may face displacement.

A symmetrical widening approach has been proposed along most of the horizontal alignment, with due consideration of the available ROW. Since the available ROW is approximately 60m, the need for land acquisition is minimized in many areas. The design speed proposed across the project stretch is generally 100 kmph.

The project alignment traverses predominantly plain terrain, with desert land use characteristics observed throughout. The presence of vertical curves has also been accounted for in the design. In accordance with NHA guidelines and the Terms of Reference (ToR), every effort has been made to upgrade the corridor within the existing ROW, thereby minimizing the requirement for land acquisition.

In framing the land acquisition proposal, careful attention has been paid to alignment finalization to avoid large-scale acquisition of land and structures. Generally, a symmetrical widening scheme has been adopted, with acquisition planned equally on either side of the proposed centerline to ensure balance and optimization of land use.

- **Preliminary Impact Assessment**



Initial studies conducted for the preparation of this Resettlement Action Plan (RAP) indicate substantial occupancy of roadside areas. These include urban settlements comprising numerous residential houses, commercial establishments, public buildings, religious structures, and agricultural lands.

The proposed widening and infrastructure improvements may affect various assets, including:

- Residential structures
- Business and commercial establishments
- Religious shrines and structures
- Schools and hospitals
- Government and community buildings
- Agricultural and vacant lands

Resettlement will be necessary only in cases where buildings are either fully demolished or damaged to the extent that they become uninhabitable or unusable. Residents affected in this manner will need to be relocated. Similarly, affected commercial units, public buildings, and religious structures will also need to be relocated.

• **Rehabilitation Measures**

Rehabilitation will be undertaken in instances where resettlement, relocation, or other project-related impacts result in the loss of livelihood or reduction in income. The goal of the rehabilitation program will be to restore, if not enhance, the economic conditions of affected persons to at least their pre-project levels.

However, in most cases, the project is not expected to require complete demolition or significant impact on residential or commercial structures that would necessitate widespread resettlement or relocation.

• **Need for a Resettlement and Rehabilitation Plan**

In light of the above observations, it is essential to develop a comprehensive Resettlement and Rehabilitation (R&R) Plan for the entire project stretch. This plan shall encompass:

- Identification and enumeration of Project Affected Persons (PAPs)
- Inventory of impacted assets and land holdings
- Mitigation strategies to minimize displacement
- Resettlement site planning, where necessary
- Livelihood restoration strategies
- Institutional framework and grievance redress mechanisms
- Cost estimates and implementation schedule

9.8 Vulnerable Group



Majority of the people in the near vicinity of the road depend one way or other on the road for their livelihood. These consists of shops and establishments hotels, service centres, craftsmen squatting on roadside engaged in their trade, taxi and auto service, etc. Further, another section of people who serve these small businesses like small time vendors also earn their livelihood here. Many of those small businesses operate from rented premises; those rents are very low compared to current marked rates, as they had been fixed decades back.

Compensation for the land would be beneficial to the land owners who currently receive a paltry rent; on the often land, the small-time businessman who operates from a hired premises would be largely hit, as he cannot find an alternative location, with the funds currently earmarked.

Hence rehabilitation plans should cover this vendors / businessman who do not own their shops and hence would not get compensation for land acquisition. Similarly, there are people engaged in small business in unauthorized roadside constructions and kiosks will also need to be considered for proper assistance to get resettled.

9.9 Efforts to minimize v/ eliminate displacement

The prime objective of the RAP is to minimize / eliminate negative impacts on the people

/ Community because of the project execution. As such, due consideration has been given during project preparation to minimize the negative impacts within the limitations of technical requirements and cost effectiveness.

Even though many benefits are expected from the project, social assessments indicate potential adverse impacts on road side communities, which include loss of land, assets and livelihood. Every effort has however been made to reduce potential direct negative impacts of the project, both in terms of environment and social issues. Designs have been so prepared to minimize the negative impacts, where possible from a technical and economical perspective.



The project corridor passes through broad land use category namely built-up areas. The built-up areas generally have scattered developments on either side of the road. Considering the above symmetric widening is proposed in built-up settlement areas, to reduce the environmental and social impact and consequently to minimize displacement.

9.10 Income Restoration

Even though significant benefits are anticipated through development projects, it may have certain adverse impact on the income of project affected persons (PAPs). They also have a negative impact on the socio-cultural systems of affected communities. The basic postulates of all developmental activities should be that, no one is worse off than the pre- project level. Restoration of pre-project levels of income is an important part of rehabilitating socio economic and cultural system in affected communities.

To achieve this goal, preparation of income restoration programmes under rehabilitation action plan, should be designed in consultation with the affected persons and they should explicitly acknowledge the programme. Successful income restoration is achieved primarily when projects allow resettlers to share the immediate benefits created by the proposed project that caused displacement by: Helping resettlers to generate commercial establishments along the newly constructed highway

- ❖ Moving resettlers to the newly irrigated command areas without affecting the social balance.
- ❖ Helping them in building more durable houses and their non land assets.
- ❖ Helping them in developing skills by conducting skills training programme

It is essential to understand the background of the PAP's and their options, so that suitable skill training programme could be designed and targeted.

9.11 Key Elements of Resettlement Action Plan (RAP)



The main aim of the resettlement action plan is to minimise / eliminate the adverse impact on the people and community due to the implementation of the project. The following key elements are considered while designing the resettlement plan. As such the following key elements are considered for framing the resettlement plan:

- ❖ Exploring alternative design options to minimize involuntary resettlement.
- ❖ Carrying out socio economic surveys and census of affected people to identify all losses and all affected persons.
- ❖ Involve all PAP's and stakeholders in consultative process including vulnerable groups.
- ❖ Compensation to all affected persons including non-title holders for all their losses at replacement rates.
- ❖ Where relocation of housing is required, develop relocation options in consultation with affected persons and host communities in order to restore living standards.
- ❖ Establishing appropriate income restoration programmes with objectives to improve or at least restore their pre-project income levels.

9.12 Impact assessment

9.12.1 Magnitude of impact

The proposed construction scheme involves large scale land acquisition. Besides, large numbers of non-land assets such as public buildings, commercial structures, residential buildings, etc. are required to be acquired for the proposed widening. It is required to be acquired for widening of road along the stretch.

9.12.2 Type of Impact

- **Loss of Lands & Crops**



Direct impacts are anticipated on account of loss of land. Impact on agriculture land would be in terms Shrubs, trees, agricultural structure such as canals, wells, etc. Moreover, the up gradation of the project road activities in plots with close proximity to the road.

- **Loss of Residential Structure**

Direct losses of assets or livelihoods are also anticipated due to the proposed project which may lead to loss of residential houses (permanent & semi-permanent) and other structures like cattle sheds, compound wall, toilets, etc., the common loss is the displacement of road side small houses.

- **Loss of Income / Business opportunities**

The displacement caused by the proposed project may lead to loss of livelihood or income opportunities, either temporarily or permanently. The common loss is the displacement of business structures such as small roadside shops, hotels, etc., both within private land and encroached public land.

- **Indirect impacts**

In addition to direct losses of assets or livelihoods, while many of these impacts are positive some adverse impacts are also anticipated which may include road safety, access to water and some unused buried canals, access to common property resources, highway related diseases and impact on non-motorized traffic such as pedestrians, bullock carts and cattles etc., may also be affected. But as far as our stretch is concerned these indirect impacts is very less.

9.13 Entitlements

The acquisition of land proposed along the project road for the proposed construction would be carried out as per National Highways Act-1956, which provides compensation for properties to be acquired and support to be extended for meeting the replacement value of the property. The persons affected by the project, both title holders and non-title holders,



who have economic interest or loss of livelihood shall be assisted as per the broad principles of the principles and policy frame work of MORT&H/NHAI.

As per 'Principles and Policy Frame work' of the National Highways Authority of India, the broad entitlement framework is applicable to 3 categories of support group, as follows:

- ❖ Project affected families & households
- ❖ Project affected adult individuals
- ❖ Project affected groups

Specific entitlements and unit costs have not been provided in the policy. However, based on the assessed impacts and the broad entitlement frame work, the affected persons in the project will be entitled for the following 5 types of compensation and assistance:

- ❖ Compensation for loss of land, crops & trees
- ❖ Compensation for structures (residential and commercial) and other immovable assets.
- ❖ Assistance for loss of business, wage / income
- ❖ Assistance for resettlement and rehabilitation
- ❖ Rebuilding and restoration of community resources / facilities.

The PAP's are categorized based on the degree of impact and the specific entitlement for each category.

9.14 Roles & Responsibilities

9.14.1 NHAI Corporate



The Chief General Manager is the in charge of the overall project activities and participates in the state level committee to facilitate land acquisition and pre-construction activities.

The responsibilities of the General Manager would include:

- ❖ Co-ordinate the implementation of R&R activities with Corporate and staff at PIU level.
- ❖ Review the micro plans prepared by the NGO
 - ❖ Review the work progress reports prepared by the implementing NGO.
- ❖ Monitoring the progress on R&R and land acquisition.
- ❖ Appoint NGO for R&R implementation and evaluation consultants for end of project evaluation and impact assessment.
- ❖ Provide advisory support to CGM for selecting supervision consultant for monitoring RAP.
- ❖ Plan and conduct training progress for capacity building of staff.

The responsibilities of Deputy General Manager (Environment) and Manager (R&R) would be to assist the General Manager to achieve the above mentioned tasks.

9.14.2 Project implementation unit

The project implementation unit (PIU) is the unit, set up by NHA at State level / project level, and is fully responsible for smooth implementation of RAP and civil construction work. The Project Director will head the PIU and will be assisted by adequate number of experts in the areas of Resettlement & Rehabilitation, Environment, Engineering & Finance, Clerks, etc. The members of the PIU will be selected among Govt. Officials on deputation basis, who have right skills in the appropriate field.



The PIU will work as an integrated unit and the key responsibilities of the Project Director, Manager (R&R) at PIU level would include:

- ❖ Overall responsible for implementation of RAP.
- ❖ Responsible for land acquisition and R&R activities in the field.
- ❖ Propagate all relevant information to all project stakeholders.
- ❖ Ensure availability of budget for R&R activities.
- ❖ Liason with district administration for support for land acquisition and implementation of R&R.
- ❖ Liason with district administration Government's income generating and development programmes for the PAP's.
- ❖ Monitor physical & financial progress on land acquisition and R&R activities.
- ❖ Organizing fortnightly meetings with the NGO's to review the progress on R&R.

9.14.3 District level committees (DLC)

The RAP will be implemented through district level committees that will be established in each district where the project is active. These committees will provide coordinating nodes for land acquisition and compensation, relocation & rehabilitation, distribution of project provided assistance and PAP's access to most government programmes. The district level committee (DLC) will be constituted by the PIU. The NGO will assist MORT&H/NHAI in constituting DLC. The responsibilities of DLC would include:

- ❖ To meet regularly to review the progress of land acquisition and R&R.
- ❖ Facilitate the implementation of the RAP programs in the project affected area



- ❖ Assistance in setting up of village level resettlement co-ordination committees of PAP's and other for the purpose of consultation and participation.
- ❖ Determine the institutional options for resettlement implementation based on RAP.

9.14.4 Resettlement coordination committees (RCC)

The resettlement co-ordination committees will be constituted among the PAP's at village

/ block level, through special meetings in village. The RCC shall mainly comprise of members from each village panchayat, project affected women, representatives of host population and other stakeholders with interest in the project. The RCC shall select a Chair Person from among its members. The key responsibilities of the RCC would include:

- ❖ Propagate all project information to all PAP's.
- ❖ Assist the DLC / PIU in setting disputes and resolving conflicts in connection with resettlement & rehabilitation.
- ❖ Monitor the resettlement work and suggest alternative if needed to minimize future work.
- ❖ Provide support to vulnerable group by implementing income generating activity at village level.

9.14.5 Grievance Redress Cell

The major responsibilities of grievance redress cell are:

- ❖ Provide due attention to the complaints of PAP's
- ❖ Sort out the problems in consultation with NHAI & PAP's
- ❖ Consult DLC for sorting out the grievances

9.14.6 Role of NGO's



Involuntary resettlement is a sensitive problem. To overcome any problem related to management associated with RAP implementation, an experienced organization in R&R matters, will be required by the PIU and R&R cell.

A good rapport with the affected community will facilitate a satisfactory resettlement and rehabilitation of the PAP's and minimize disturbances particularly physical and economic. To meet out the above objectives, experienced and well qualified NGO in this field will be engaged to assist the NHA in the implementation of the RAP.

The role of the implementing NGO would be to mitigate the adverse effects of the project, to ensure timely completion of the project and to ensure that the rehabilitation process is taken up in a right spirit with a comprehensive livelihood system. The prime responsibility of the implementing agency is to ensure that each and every eligible PAP's receive appropriate and due entitlement within the overall frame work of R&R policy and entitlement matrix.

The NGO will work as a link between the PIU and R & R cell and the affected community. They will educate the PAPs on the need to implement the project, on aspects relating to LA and R&R measures and ensures proper utilization of various compensation extended to the PAPs under the R&R entitlement matrix.

The broad objectives of the NGO consultancy will be:

- ❖ Educate PAPs on their rights, entitlements and obligations under the RAP.
- ❖ Ensuring that PAPs receive their full entitlements.

Providing advice to PAPs on relative benefits of each option, where options are available.

The major responsibilities of the implementing NGO would include:.



- ❖ Develop rapport with the PAPs
- ❖ Survey and verification of the PAPs
- ❖ Prepare micro plan for RAP implementation
- ❖ Co-ordinate with the CRRO to implement R&R activities
- ❖ Assist to issue identify cards to PAPs.
- ❖ Valuation of properties / assets for finalization of replacement value.
- ❖ Participate with the (Clinical Research Relief Organization) CRRO to undertake public information campaign at the commencement of the projects.
- ❖ Distribute the pamphlets of R&R policy to the PAPs.
- ❖ Assist the PAP's in receiving the compensation.
- ❖ Facilitate the opening of joint accounts.
- ❖ Generate awareness about the alternate economic livelihood and enable the PAPs to make informed choice.
- ❖ Enable the PAPs to identify the alternate site for agriculture, residential and commercial plots.
- ❖ Ensure that the PAPs have received their entitlements
- ❖ Identify training needs and institutions for the PAPs for income generating operations.
- ❖ Assist the PAPs in getting benefits from various government development programmes.
- ❖ Developing information campaigns and community participation



- ❖ Delivering services too hard to reach communities in a more efficient and cost effective manner.

9.15 Co - ordination with other agencies

The R&R cell / PIU will have to establish important network relationships with many departments and organizations

The Revenue Department has an influence role in land acquisition proceedings and initiation of resettlement process. Hence the R&R Cell / PIU will have to coordinate with the project Land Acquisition Officer to expedite the land acquisition process.

For restoring the pre-project level incomes of the PAP's, the NGO will facilitate linkages to be established with the Government poverty alleviation programs for income restoration. The Public Health Engineering Departments are to be coordinated for the restoration of community assets such as hand pumps, bore wells, drainage facilities, etc., Coordination will be required from the District Officer of Education Department, where schools are affected.

9.16 Recommendations

Based on the baseline socio economics study the following recommendations are made:

- ❖ Cash compensation for land shall be paid at replacement value, free of fees and other charges.
- ❖ Advance notice shall be issued for harvesting non-perennial crops or compensation shall be given for lost standing crops.
- ❖ Compensation shall be given for perennial crops and trees at the rate of annual net product value multiplied by numbers of years required for new crops to yield.
- ❖ Replacement or compensation shall be given for loss of non-land assets and structures.



- ❖ Assistance in accessing housing schemes or other targeted support to assist poor and vulnerable in re-establishing their houses, shifting assistance and transition stipend.

Employment opportunities shall be created by the proposed project such as work related with construction of road, tree cuttings, tree plantation and their maintenance