# FEASIBILITY REPORT

## Four laning of Balaghat - Gondia Section of NH 543 from km 0.000 to km 48.070 (Package-1A & Package-1B) under Bharatmala Pariyojana in the State of Madhya Pradesh and Maharashtra

## 1.0 INTRODUCTION

The National Highway Authority of India (NHAI) under the Ministry of Road Transport & Highways (MoRT&H), Government of India has been entrusted with the assignment of Development of Economic Corridors, Inter-Corridors, Feeder Routes and Coastal Roads under **Bharatmala Pariyojana** primarily to improve freight movement in Country. With a view to this, it has been proposed to conduct a "Consultancy Services for Preparation of Detailed Project Report for up-gradation of selected stretches as Feeder road comprising of SH-9, SH-10 and SH-11 of Madhya Pradesh and SH-275 of Maharashtra through BOT / Hybrid Annuity / EPC mode (Lot-I/Madhya Pradesh/ Package-6)".

MoRTH, Government of India has declared **new National Highway (NH-543)** vide Gazette Notification dated 3rd January 2017. NH-543 starts from the junction with NH-43 Shahdol connecting Dindori, Mandla, Nainpur, Lamta, Balghat in the state of Madhya Pradesh connecting Rajegaon, Dhamangaon, Rawandi, Gondia, Amgaon, Deori, Korchi, Kurkheda, Wadsa (Desaiganj) and terminating at its junction with NH-353D near Bramhapuri in the state of Maharashtra.

The Proposed project road is part of the newly declared NH-543, **Balaghat to Gondia Section of NH-543** from km 0.000 to km 48.070 in the State of Madhya Pradesh and Maharashtra. Total length of the existing stretch is about 41.55 Km and length of proposed project road is **48.070 km**. Out of 48.070 km stretch, 29.700 km stretch is in the State of **Madhya Pradesh (Package-1A)** and 18.370 km s in the State of **Maharashtra (Package-1B).**

## 2.0 SCOPE OF CONSULTANCY SERVICES

The scope of service, inter-alia, covers the following main activities:

a) The improvement of the existing road to 4-lane road and where provision of the short bypasses, service roads, modification of alignments etc.
b) The Land Acquisition details to be furnished as per the Revenue Records/Maps for the processing of the Land Acquisition. The Land Acquisition details to include the 3a, 3A and 3D draft notification for the acquisition of land.
c) Identification of possible locations and design of toll plazas, wayside amenities, provision of service roads and fencing, wherever necessary to improve efficiency and safety.
d) The scope of services includes the items indicated in the Letter of Invitation and in TOR. The Study shall include suitable proposals for the widening/improvement of the existing road and the strengthening of the carriageways as required in the appropriate time to maintain the Level of Service (LOS) over the design period.

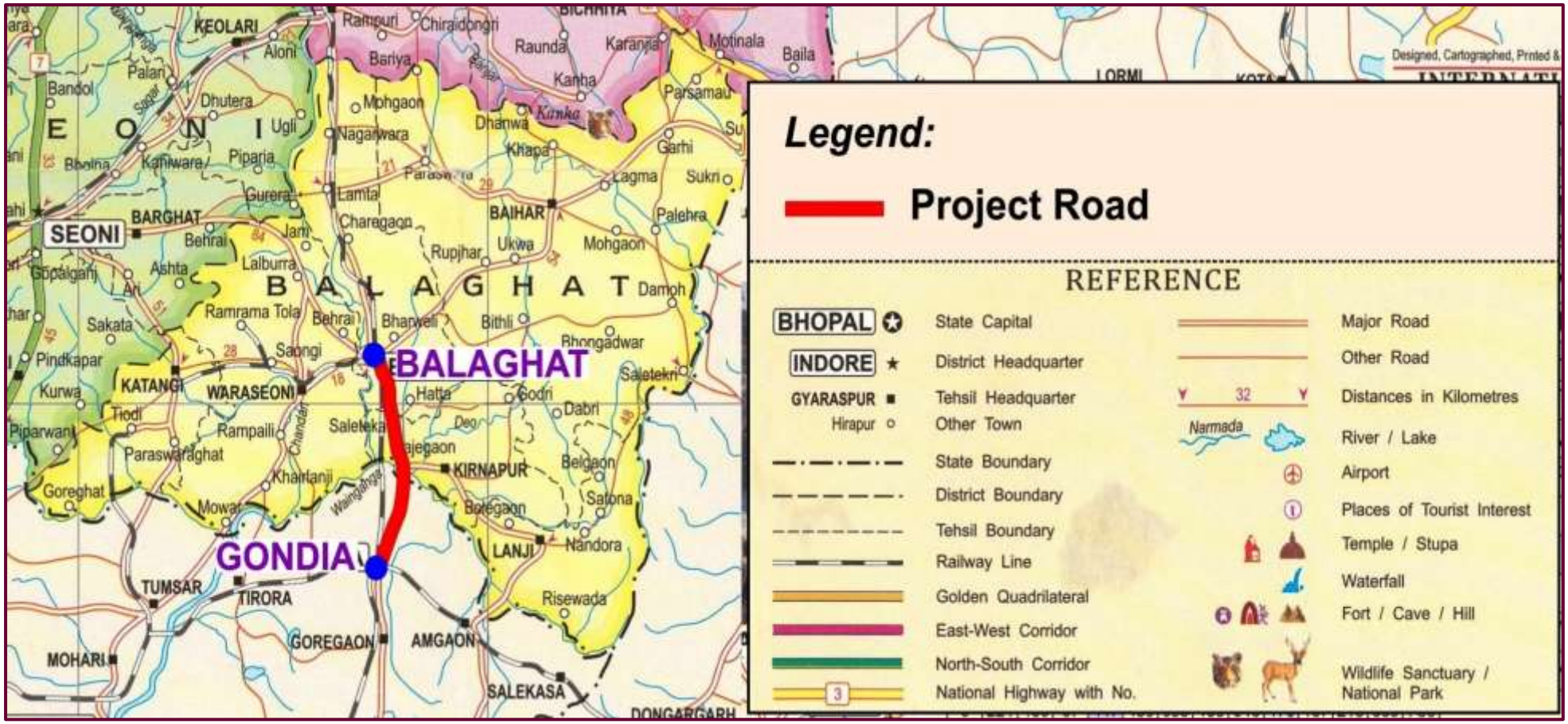



**Figure -1 Index Map showing Balaghat to Gondia Section of NH-543**

e) Environmental Impact Assessment and Environmental Management Plan and Rehabilitation and Resettlement Studies to be carried and in line with the requirements of Govt. of India or the lending agencies like ADB/World Bank/JICA, etc.
f) The Bid Documents to be prepared for the EPC/PPP Contracts or any other mode for each of the DPR Assignment.
g) The General Scope of Services consists of the following:
   - Review of the available Reports and other information about the Project Road and Project Influence Area;
   - Environmental & Social Impact Assessment;
   - Detailed Reconnaissance;
   - Identification of the Possible Improvements in the existing alignment including the provision of bypasses for the congested locations;
   - Traffic Studies including Traffic Surveys and Axle Load Survey and Demand Forecasting for the next thirty years;
   - Inventory and Condition Surveys for road including Bridges;
   - Detailed Topographical Surveys using LiDAR equipped with minimum Engineering Grade System;
   - Pavement Investigations;
   - Sub grade Investigations;
   - Identifications of the Sources of Construction Materials;
   - Detailed Design of Roads including the Horizontal and Vertical Alignment;
   - Detailed Design of Structures;
   - Identifications of the Type and Design of Intersections;
   - Design of Drainage System;
   - Value Engineering;
   - Preparation of the Bill of Quantities (BOQ) and Project Costing;
   - Economic and Financial Analysis;
   - Contract Packaging and implementation Schedule;
   - Preparation of Detailed Plan, Profile and other Drawings;
   - Financial Viability of Project for implementation; and
   - Preparation of the Detailed Project Report

## 3.0 DESCRIPTION OF EXISTING ALIGNMENT

The start point of the project is at Rani Avanti Bai Chowk (Junction with SH-26) in Balaghat (SH-11) in Balaghat District of Madhya Pradesh. Then the road traversed through Balaghat Municipality within congested 4 lane divided section upto the railway crossing for a length of 2.35 km.

The alignment crosses South East Central railway line Km 2+431 with a manned level crossing and then traversed towards south side upto the Madhya Pradesh /Maharashtra Border. There is no major development or Major road crossing within MP along the project road. Mostly the alignment passes through plain terrain with 2 lane bituminous pavement except the initial 2.4 km. Since the project is an interstate route, Madhya Pradesh border check-post (Rajegaon village) is located at Km 21+600. The project

road enters in Maharashtra after crossing Bagh River which is the Border. There is one existing 275m long 2 lane Major Bridge on Bagh River. The total **length of the project road in Madhya Pradesh** (Balaghat district) is about **24.300 km**.

**Start point at Avanti Bai Chowk**

**Hanuman Temple at Km 1+700**

**Level crossing at Km 2+431**

**Road section in Balaghat**

**Check post at Km 21+600**

**Bagh River Bridge on Border at km 24+359**

In Maharashtra section, the project road follows the existing alignment of SH-275 in Gondia district. In route, the alignment passes Ravanwadi village where MDR 42 starts. The existing road upto Ravanwadi is 2 lane standard whereas beyond this the existing

road is of 2 lane with paved shoulder configuration. At Km 41+550 the project road meets SH 249 (Km 191 of SH 249 and Km 248+500 of SH 275). The **total length of the project road in Maharashtra** (Gondia district) is about **17.25 km.** Based on the initial assessment some salient features of the Project road are given in **Table 1-1**.

**Ravanwadi village at 33+800**

**Junction with SH 249 (End point)**

**Table 1 - 1 Details of Existing Lane Configuration**

| Sl. No | Description | Balaghat to Bagh River Section (in Madhya Pradesh State) | Bagh River to Gondia Section (in Maharashtra State) |
|---|---|---|---|
| 1 | NH/SH/Other | SH 11 | SH 275 |
| 2 | Length (Km) | 24.3 | 17.25 |
| 3 | 4 Lane | 2.370 | 0 |
| 4 | 2lane+PS | 0 | 7.350 |
| 5 | 2 Lane | 21.930 | 9.900 |
| 6 | Intermediate Lane | 0 | 0 |
| 7 | Single Lane | 0 | 0 |
| 8 | Pavement type | Flexible – 24.150<br>Rigid – 0.150 | Flexible – 17.25 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

***Current and Proposed Development Activities:*** It has been observed that the existing road section from Balaghat to Rajegoan (from Km 0+000 to Km 24+300 of SH 11) was awarded to M/s AAP Infrastructure by Madhya Pradesh State Road Development Corporation (MPRDC) on BOT basis. The BOT concession period is up to October 2018.

**Toll plaza at Km 22+600.**

***Road Geometry:*** The existing road geometry except built up section, Railway crossing and village sections in route conform to IRC standard.

***Existing Right of Way (RoW):*** The average existing RoW is **25 m**. Chainage wise

details of existing RoW is given in **Table 1-2**.

**Table 1 - 2 Details of Existing Right of Way (Row)**

| Chainage (km) | | Average width (m) | Chainage (km) | | Average width (m) |
|---|---|---|---|---|---|
| To | From | | To | From | |
| 0+000 | 14+300 | 25.0 | 19+700 | 19+900 | 24.0 |
| 14+300 | 14+400 | 21.4 | 19+900 | 20+000 | 23.0 |
| 14+400 | 14+500 | 23.3 | 20+000 | 20+100 | 25.0 |
| 14+500 | 14+600 | 22.0 | 20+100 | 20+200 | 24.0 |
| 14+600 | 14+700 | 20.3 | 20+200 | 20+400 | 23.0 |
| 14+700 | 14+800 | 19.5 | 20+400 | 20+500 | 24.5 |
| 14+800 | 14+900 | 20.0 | 20+500 | 20+600 | 23.7 |
| 14+900 | 15+000 | 18.4 | 20+600 | 20+700 | 22.6 |
| 15+000 | 15+100 | 28.0 | 20+700 | 20+800 | 27.4 |
| 15+100 | 15+200 | 26.8 | 20+800 | 20+900 | 22.6 |
| 15+200 | 15+300 | 23.0 | 20+900 | 21+000 | 24.2 |
| 15+300 | 15+400 | 24.0 | 21+000 | 21+100 | 25.4 |
| 15+400 | 15+500 | 29.0 | 21+100 | 21+200 | 26.4 |
| 15+500 | 15+600 | 27.4 | 21+200 | 21+300 | 25.0 |
| 15+600 | 16+200 | 26.0 | 21+300 | 21+500 | 24.0 |
| 16+200 | 16+300 | 25.3 | 21+500 | 21+600 | 23.7 |
| 16+300 | 16+400 | 26.0 | 21+600 | 21+700 | 22.6 |
| 16+400 | 16+500 | 27.6 | 21+700 | 21+800 | 26.6 |
| 16+500 | 16+800 | 29.0 | 21+800 | 21+900 | 28.0 |
| 16+800 | 16+900 | 24.5 | 21+900 | 22+000 | 29.2 |
| 16+900 | 17+000 | 23.7 | 22+000 | 22+100 | 28.7 |
| 17+000 | 17+400 | 22.0 | 22+100 | 22+200 | 23.8 |
| 17+400 | 17+600 | 23.0 | 22+200 | 22+300 | 24.0 |
| 17+600 | 17+700 | 24.0 | 22+300 | 22+400 | 26.0 |
| 17+700 | 17+800 | 25.8 | 22+400 | 22+500 | 25.0 |
| 17+800 | 17+900 | 26.8 | 22+500 | 22+600 | 26.5 |
| 17+900 | 18+000 | 27.8 | 22+600 | 22+700 | 21.1 |
| 18+000 | 18+100 | 26.5 | 22+700 | 22+800 | 22.1 |
| 18+100 | 18+200 | 24.8 | 22+800 | 22+900 | 21.0 |
| 18+200 | 18+300 | 25.0 | 22+900 | 23+000 | 19.6 |
| 18+300 | 18+400 | 28.0 | 23+000 | 23+100 | 20.0 |
| 18+400 | 18+500 | 29.0 | 23+100 | 23+200 | 22.0 |
| 18+500 | 18+600 | 28.7 | 23+200 | 23+300 | 22.8 |
| 18+600 | 18+700 | 28.4 | 23+300 | 23+400 | 21.1 |
| 18+700 | 18+800 | 29.0 | 23+400 | 23+500 | 22.5 |
| 18+800 | 18+900 | 30.7 | 23+500 | 23+600 | 25.05 |
| 18+900 | 19+000 | 31.0 | 23+600 | 23+800 | 22.0 |
| 19+000 | 19+100 | 28.0 | 23+800 | 23+900 | 22.8 |
| 19+100 | 19+200 | 27.4 | 23+900 | 24+000 | 23.0 |
| 19+200 | 19+300 | 27.0 | 24+000 | 24+100 | 27.5 |
| 19+300 | 19+400 | 26.0 | 24+100 | 24+200 | 29.0 |
| 19+400 | 19+500 | 24.0 | 24+200 | 24+500 | 27.5 |

| Chainage (km) | | Average width (m) |
|---|---|---|
| To | From | |
| 19+500 | 19+600 | 25.8 |
| 19+600 | 19+700 | 26.0 |
| 24+700 | 24+800 | 26.7 |
| 24+800 | 24+900 | 27.3 |
| 24+900 | 25+000 | 25.0 |
| 25+000 | 25+100 | 39.5 |
| 25+100 | 25+200 | 32.7 |
| 25+200 | 25+500 | 37.9 |
| 25+500 | 25+600 | 27.1 |
| 25+600 | 25+700 | 25.7 |
| 25+700 | 25+800 | 24.9 |
| 25+800 | 25+900 | 24.9 |
| 25+900 | 26+200 | 23.5 |
| 26+200 | 26+300 | 26.4 |
| 26+300 | 26+500 | 27.4 |
| 26+500 | 26+600 | 26.7 |
| 26+600 | 26+700 | 25.3 |
| 26+700 | 26+800 | 26.6 |
| 26+800 | 26+900 | 23.0 |
| 26+900 | 27+000 | 25.6 |
| 27+000 | 27+100 | 26.8 |
| 27+100 | 27+200 | 27.5 |
| 27+200 | 29+200 | 28.0 |
| 29+300 | 29400 | 31.3 |
| 29+400 | 29+500 | 30.6 |
| 29+500 | 29+600 | 28.6 |
| 29+600 | 29+700 | 32.0 |
| 29+700 | 30+700 | 38.0 |
| 30+700 | 30+800 | 26.9 |
| 30+800 | 30+900 | 22.0 |
| 30+900 | 31+000 | 27.6 |
| 31+000 | 31+100 | 28.0 |
| 31+100 | 31+200 | 19.6 |
| 31+200 | 31+300 | 22.0 |
| 31+300 | 31+400 | 24.7 |
| 31+400 | 31+500 | 26.2 |
| 31+500 | 31+600 | 22.4 |
| 31+600 | 31+700 | 23.4 |
| 31+700 | 31+800 | 25.1 |
| 31+800 | 31+900 | 24.9 |
| 31+900 | 32+000 | 24.9 |
| 32+000 | 32+100 | 24.6 |
| 32+100 | 32+200 | 26.0 |

| Chainage (km) | | Average width (m) |
|---|---|---|
| To | From | |
| 24+500 | 24+600 | 31.2 |
| 24+600 | 24+700 | 27.9 |
| 32+200 | 32+300 | 25.6 |
| 32+300 | 32+400 | 28.7 |
| 32+400 | 32+500 | 26.9 |
| 32+500 | 32+600 | 29.2 |
| 32+600 | 32+700 | 28.1 |
| 32+700 | 32+800 | 28.1 |
| 32+800 | 32+900 | 27.5 |
| 32+900 | 33+000 | 28.4 |
| 33+000 | 33+100 | 29.0 |
| 33+100 | 33+200 | 26.2 |
| 33+200 | 33+300 | 26.2 |
| 33+300 | 33+400 | 25.4 |
| 33+400 | 33+500 | 28.5 |
| 33+500 | 33+600 | 26.6 |
| 33+600 | 36+500 | 25.0 |
| 36+500 | 36+600 | 26.7 |
| 36+600 | 36+700 | 25.0 |
| 36+700 | 36+800 | 28.6 |
| 36+800 | 36+900 | 29.1 |
| 36+900 | 37+100 | 22.3 |
| 37+100 | 37+200 | 23.5 |
| 37+200 | 37+300 | 21.0 |
| 37+300 | 37+400 | 26.2 |
| 37+400 | 37+500 | 25.4 |
| 37+500 | 37+600 | 19.5 |
| 37+600 | 37+700 | 22.8 |
| 37+700 | 37+800 | 23.6 |
| 37+800 | 37+900 | 20.7 |
| 37+900 | 38+000 | 23.4 |
| 38+000 | 38+100 | 16.8 |
| 38+100 | 38+200 | 24.9 |
| 38+200 | 38+300 | 19.7 |
| 38+300 | 38+400 | 20.7 |
| 38+400 | 41+800 | 24.7 |
| 41+800 | 42+200 | 23.2 |
| 42+200 | 42+300 | 25.4 |
| 42+300 | 42+400 | 23.4 |
| 42+400 | 42+500 | 24.3 |
| 42+500 | 42+600 | 30.0 |
| 42+600 | 48+070 | 25.0 |
| | | |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

***Bridges and Culverts:*** There are 2 existing major bridges, 3 existing minor bridges and 39 culverts (25 Hume Pipe culvert & 14 Slab culverts) on the project road.

**Table 1 - 3 Details of Existing Bridges of Balaghat – Gondia Road**

| Sl. No | Existing Ch. | River/ Nalla | Span (m) | Type of Bridge |
|---|---|---|---|---|
| 1 | 19+901 | Ghisari River | 8x25 | RCC T-Beam and slab |
| 2 | 24+359 | Bagh River | 11x25 | RCC Box |
| 3 | 28+498 | Local Stream | 2 X 3.25 | RCC solid slab |
| 4 | 36+300 | Canal | 1x10 | RCC solid slab |
| 5 | 41+071 | Local Stream | 1x8.1 | RCC solid slab |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

**Bridge on Ghisari River at Existing Chainage 19+901**

**Bridge on Bhagh River at Existing Ch.24+359**

**Bridge at Existing Ch.28+498**

**Waterway of Bridge at Existing Ch.41+071**

Following has been observed during the field survey of the existing road:

- Road side land use is predominantly agricultural and barren land;
- In built up sections, due to non-availability of right of way the operating speed reduces and causes accident;
- Present condition of the pavement has deteriorated;
- Edge breaks, undulations, pot holes and patching distress on the existing pavement in some sections due to the recent floods;
- There are about 43 existing junctions (3 major and 40 minor) on the project road. Major settlements en-route is Uchehera and Maihar; and

- Overall Pavement riding quality of the road in the section seems average except few locations where it is found poor. Road roughness (IRI) is varying between 1.5 m/km to 12 m/km.

***Forest along the existing project road:*** There is no forest along the project road in the stretch located in Balaghat District of Madhya Pradesh (Km 0+000 to Km 24+300). Remaining stretch of the project road i.e. Km 24+300 to Km 41+510 is located in Gondia district of Maharashtra. In this stretch, there is no Reserved / Protected forest along the project road. However, Zudpi Jungle is located at four places along the project road (**0.606 km** stretch). Joint site visits were carried out with the forest officials to identify the location of Zudpi Jungle along the project road. Location of Forest along the project road is presented in **Table 1-4**. Apart from these stretches, there may be some forest patches under Revenue Department of Maharashtra Government.

**Joint Site Visit with the Forest Officials**

**Table 1 - 4 Location of Forest along the Existing Project Road**

| Existing Ch. Km | | Length (Km) | Side | Forest Type | Forest Range | Forest Division |
|---|---|---|---|---|---|---|
| From | To | | | | | |
| 25+855 | 26+136 | 0.281 | LHS | Zudpi Jungle, G. No. 391, Village: Satauna | Gondia | Gondia Forest Division |
| 27+670 | 27+900 | 0.230 | LHS | Zudpi Jungle, G. No 293, Village - Changera | Gondia | |
| 29+030 | 29+040 | 0.010 | LHS | Zudpi Jungle, G. No 528, | Gondia | |

| Existing Ch. Km | | Length (Km) | Side | Forest Type | Forest Range | Forest Division |
|---|---|---|---|---|---|---|
| From | To | | | | | |
| | | | | Village - Changera | | |
| 35+270 | 35+355 | 0.085 | RHS | Zudpi Jungle, G. No 510, Village – Sawari Lodhi Tola | Gondia | |
| **Total Length (Km)** | | **0.606** | | | | |

*Source: Field Survey carried out by ICT*

## 4.0 TRAFFIC SURVEY AND ANALYSIS

### 4.1 Planning of the Traffic Survey

During the reconnaissance survey of the project road in April 2017, the possibility of diversion to or from the project road, if there was any, were duly examined while identifying the traffic survey locations. Traffic survey locations were identified in conjunction with the surrounding road network of the project road stretches. The network was also verified by visiting all the associated road junctions and links so as to assess the traffic levels and logistics that will be required for traffic surveys. To capture traffic flow characteristics and travel pattern of users passing through the project road and other characteristics related to miscellaneous requirements of the ToR, the following primary traffic surveys were planned and conducted.

- Automatic Traffic Classified Count / Manual Classified Traffic Volume Count
- Junction Volume or Intersection Turning Movement Count (TMC)
- Origin-Destination and Commodity Movement Survey (OD)
- Speed and Delay Survey
- Pedestrian / Cross Movement Count
- Road Safety Assessment

Traffic survey stations were selected considering the following parameters:

- The station should represent homogeneous traffic section
- The station should be outside urban area and local traffic influence
- The station should be located in a reasonably level section of the road with good visibility (preferably straight section).

The finalized survey location maps are presented in **Figure-2**, schematically shown in line diagrams in **Figure-3** and details are given in **Table 1-5**.

**Table 1 - 5 Locations of Traffic Surveys**

| Sl. No. | Type of Survey | Code | Existing Chainage | Location | No. of Location |
|---|---|---|---|---|---|
| 1 | Turning Movement Count Survey (TMC) | TMC 1 | 0+000 | Rani Avanti Bai Chowk at Balaghat | 5 |
| | | TMC 2 | 1+700 | Hanuman Mandir Chowk at Balaghat | |
| | | TMC 3 | 23+200 | SH-11 & Lanji Road at Rajegaon MP | |
| | | TMC 4 | 33+850 | SH-275 & MDR 42 at Rawanwadi MH | |

| Sl. No. | Type of Survey | Code | Existing Chainage | Location | No. of Location |
|---|---|---|---|---|---|
| | | TMC 5 | 41+550 | SH-275 & SH-249/Tiroda Road at Gondia | |
| 2 | Automatic Classified Traffic Volume Count (7 Days, 24 hours) | ATCC 1 | 22+600 | at Toll Plaza and MP Border Checkpost | 2 |
| | | ATCC 2 | 40+900 | North of SH-249/Tiroda Road at Gondia | |
| 3 | Manual Classified Traffic Volume Count (3 Days, 24 hours) | MCC 1 | 1+200 | West of Hanuman Mandir Chowk at Balaghat | 2 |
| | | MCC 2 | 33+400 | North of MDR 42 at Rawanwadi | |
| 4 | Origin Destination (OD) | OD 1 | 22+600 | at Toll Plaza and MP Border Checkpost | 2 |
| | | OD 2 | 40+900 | North of SH-249/Tiroda Road at Gondia | |
| 5 | Axle Load Survey (AL) | AL 1 | 22+600 | at Toll Plaza and MP Border Checkpost | 2 |
| | | AL 2 | 40+900 | North of SH-249/Tiroda Road at Gondia | |
| 6 | Pedestrian Volume Count (PC) | PC 1 | 0+000 | near Avanti Bai Chowk at Balaghat | 6 |
| | | PC 2 | 1+700 | near Hanuman Mandir Chowk at Balaghat | |
| | | PC 3 | 2+400 | at Railway Level Crossing | |
| | | PC 4 | 23+200 | near SH-11 & Lanji Road at Rajegaon MP | |
| | | PC 5 | 33+850 | near SH-275 & MDR 42 at Rawanwadi MH | |
| | | PC 6 | 41+550 | near SH-275 & SH-249/Tiroda Road at Gondia | |
| 7 | Number Plate Survey | NP 1 | 22+600 | at Toll Plaza and MP Border Checkpost | 2 |
| | | NP 2 | 40+900 | North of SH-249/Tiroda Road at Gondia | |
| 8 | Speed and Delay | | Full Stretch | | |

## 4.2 Identification of Homogeneous Sections

Balaghat-Gondia section of NH-543, having a total existing length of 41.550 km, have been divided into two homogeneous road sections on the basis of traffic generation and dispersal nodes located along the alignment as seen during the reconnaissance carried out as well as the observed traffic flows. Homogeneous sections have been identified for road section for the purpose of traffic analysis, presentation of traffic, traffic forecast and also to examine different strategies for tolling**. Table 1-6** gives the details of the homogeneous sections defined for the study

**Table 1 - 6 Homogeneous Sections of Project Highway**

| Homogeneous Section (HS) | Existing Chainage (km) | | Design Chainage (km) | | Length (km) | AADT (PCUs) in 2017 |
|---|---|---|---|---|---|---|
| | From | To | From | To | | |
| HS-1 | km 0+000 (Rani Avanti Bai Chowk, Balaghat) | km 24+300 (Near M.P –Maha Border) | km 0+000 | km 29+600 | 29.60 | 5540 |
| HS-2 | km 24+300 (near MP-Maha Border) | km 41+550 (near SH-249/Tiroda Road junction at Gondia) | km 29+600 | km 48+070 | 18.47 | 13239 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

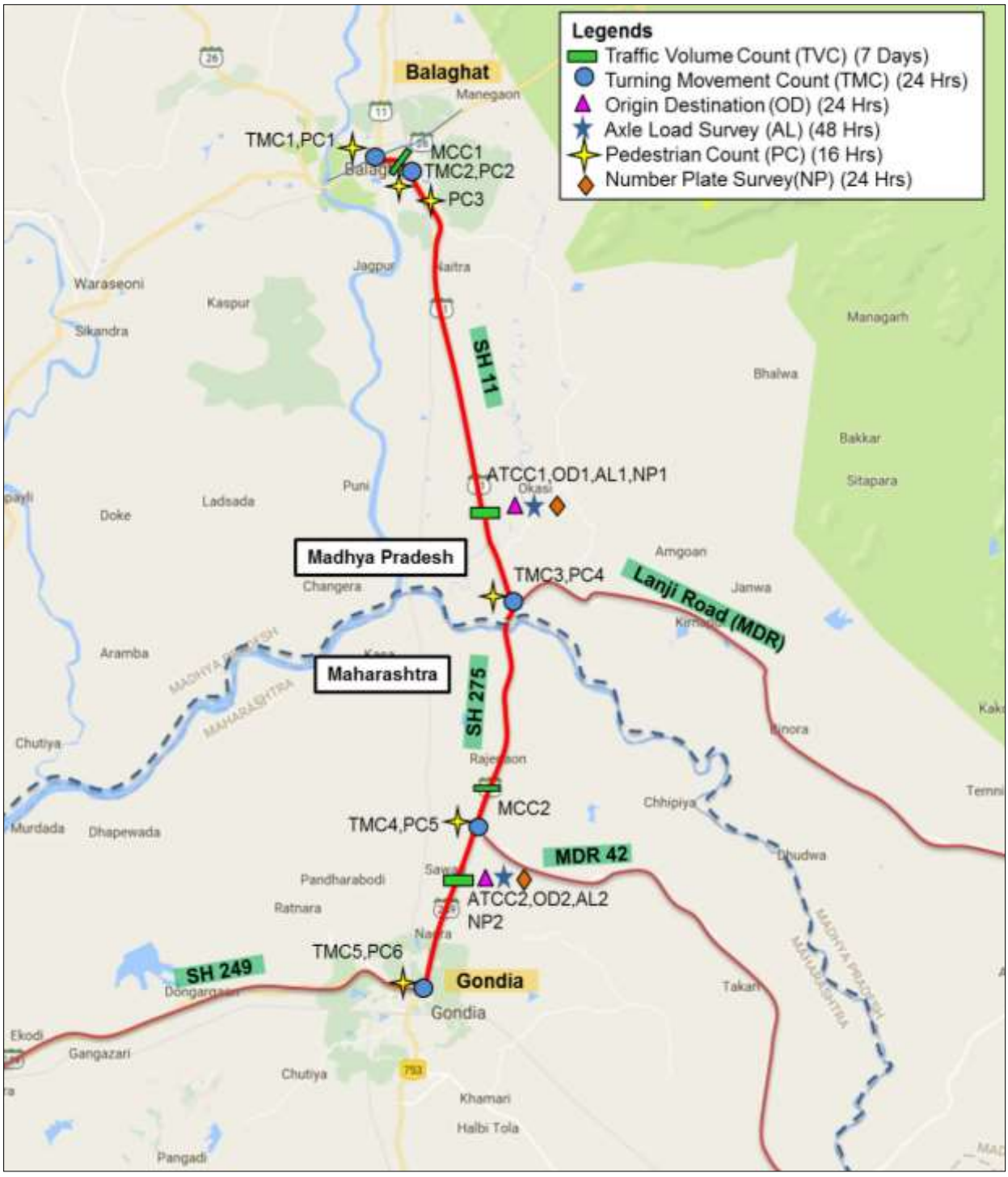



**Figure-2 Map Showing Traffic Survey locations**

## 4.3 Turning Movement Survey

The daily total approach volumes for Balaghat-Gondia road section of project road vary from 8967 PCUs (10567 vehicles) to 30923 PCUs (49052 vehicles). The highest total approach volume along this Corridor, in terms of PCUs has been observed Hanuman Mandir Chowk (km 1+800). The lowest total approach volume is found at junction of SH 11 and Lanji Road (km 23+200).

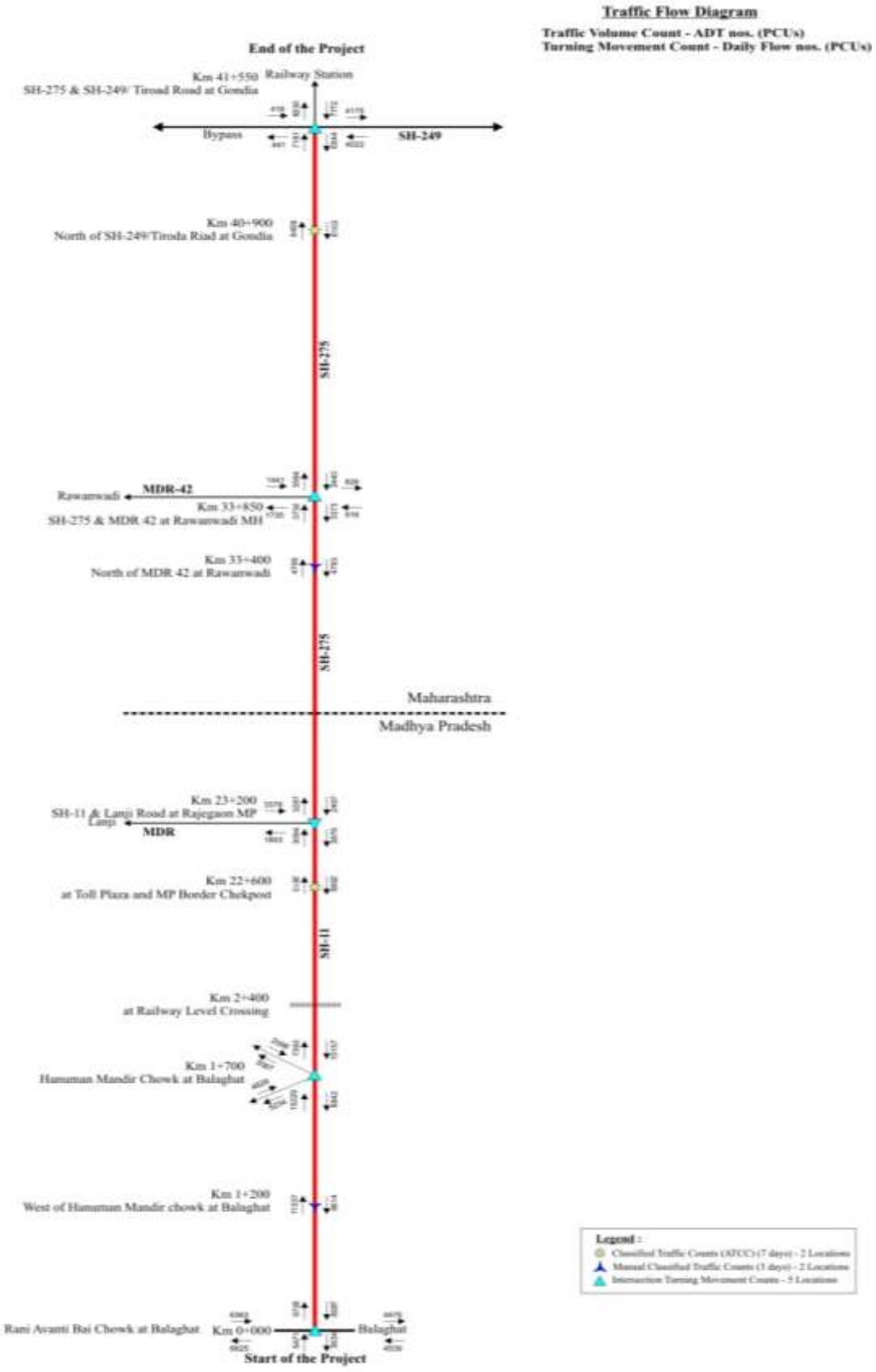



**Figure-3 Line Diagram for Traffic Survey Locations (Existing chainage)**

## 4.4 Origin Destination and Commodity Movement Survey

In order to assess the movement pattern in the project influence area the zoning system was developed keeping in view the major generation and attraction points in the influence area. 50 internal and external zones were developed.

The average trip lengths along Balaghat-Gondia road section of project road, for car/jeeps vary from 46.4-83 km, for taxi from 14.5-46 km, whereas for bus and mini bus it varies from 44.4-54 km and 16-42 km respectively. The average trip length for LGV-4W varies from 21.6-67 whereas the average trip length for 2 axle truck varies from 45-152 km. For 3 axle truck trip length ranges from 174-490 km and MAV average trip length varies from 57.5-545 km.

The average trip length amongst goods vehicles is higher for the heavier vehicle classes across all locations. This is because the heavier goods vehicles are used for transporting goods to longer distances while smaller goods vehicles like LGV and 2 axle trucks are being used for local distribution of goods.

## 4.5 Axle Load Survey

Based on the survey, the VDF for 2-axle trucks has been computed in the range 0.51 to 1.88 while the VDF for 3-axle truck lies in the range 1.61 to 3.76. The VDF for multi-axle vehicle has been calculated to be in the range 4.13 to 8.26.

## 4.6 Speed and Delay Survey

A speed and delay survey using the moving car observer method was carried out by dividing the Balaghat-Gondia road section of project road in to different section**.** This survey provides data for assessing running speed, journey speeds signifying any unreasonable congestion levels. Journey speed is the effective speed of a vehicle between two points. It is determined by the distance between two points divided by the total time taken by the vehicle to complete the journey, including all delays incurred en-route. Running speed is the average speed maintained by a vehicle over given course while the vehicle is in motion. The summary of the speed and delay analysis is given in **Table 1-7.** The results for Balaghat-Gondia road section of project road indicate that average journey speed at Balaghat Gondia Corridor ranges from **29.63 kmph to 63.82 kmph**.

**Table 1 - 7 Summary of Speed and Delay Analysis**

| Stretch No. | Existing Chainage | | Stretch Name | Average Running Speed (kmph) | Average Journey Speed (kmph) |
|---|---|---|---|---|---|
| | From | To | | | |
| 1 | 0+000 | 1+700 | Avanti Bai Chowk to Hanuman Chowk (Balaghat) | 35.47 | 29.63 |
| 2 | 1+700 | 23+100 | Hanuman Chowk, Balaghat to Gandhi Chowk, Rajegaon | 63.82 | 63.82 |
| 3 | 23+100 | 33+800 | Gandhi Chowk, Rajegaon to | 56.49 | 56.49 |

| Stretch No. | Existing Chainage | | Stretch Name | Average Running Speed (kmph) | Average Journey Speed (kmph) |
|---|---|---|---|---|---|
| | From | To | | | |
| | | | Ravanwadi Chowk, Maharashtra | | |
| 4 | 33+800 | 41+500 | Ravanvadi Chowk to Bypass Road, Maharashtra | 65.99 | 59.89 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 4.7 Pedestrian Count Survey

Pedestrian Count Survey was carried out for 12 hours (8:00 AM to 8:00 PM) at various major intersections and railway crossings, where considerable pedestrian movements were observed. For each approach road of an intersection, along and across movements were counted as per the need of the existing situation. The corresponding total daily pedestrian flows and peak hour pedestrian flows in the junction are presented in **Table 1-8**.

**Table 1 - 8 Pedestrian Flows per Day at Major Intersections**

| Existing Chainage | Location | Arm | Daily Flow | | Peak Hour Flow | |
|---|---|---|---|---|---|---|
| | | | Across | Along | Along | Across |
| Km 0+000 | Avanti Bai Chowk at Balaghat | Baihar Side | 2963 | 6548 | 419 | 1077 |
| | | Sivni Side | 1428 | 3734 | 196 | 457 |
| | | Gondia Side | 3627 | 4377 | 576 | 614 |
| | | Kumhari Side | 1120 | 4050 | 287 | 719 |
| Km 1+700 | Hanuman Mandir Chowk at Balaghat | Guzri Chowk Side | 1255 | 4884 | 195 | 685 |
| | | Balaghat Side | 1118 | 2564 | 168 | 446 |
| | | Gondia Side | 749 | 1996 | 102 | 474 |
| | | Railway Station Side | 692 | 1523 | 90 | 199 |
| Km 2+400 | Railway Fatak Crossing Side | Railway Fatak Crossing Side | 386 | 1281 | 87 | 147 |
| Km 23+200 | SH 11 & Lanji Road Intersection at Rajegaon | Balaghat Side | 974 | 1008 | 136 | 169 |
| | | Gondia Side | 794 | 656 | 123 | 106 |
| | | Lanji Side | 376 | 1327 | 72 | 243 |
| Km 33+850 | SH 275 & MDR 42 | Balaghat Road Side | 396 | 547 | 67 | 96 |
| | | Gondia Tola Road Side | 606 | 973 | 126 | 124 |
| | | Gondia Road Side | 523 | 656 | 78 | 105 |
| | | Birchi Airport Road Side | 686 | 471 | 100 | 58 |
| Km 41+550 | SH 275 & SH 249 at Gondia | Balaghat Side | 451 | 587 | 147 | 188 |
| | | Tiroda Side | 189 | 213 | 26 | 52 |
| | | Gondia Side | 204 | 547 | 35 | 95 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 4.8 Traffic Forecast

Elasticity of Transport Demand (ETD) technique is used in traffic forecast, which is based on historical growth in vehicle registration and trend of the economy in the area. Traffic growth rate is estimated for different modes of traffic that are likely to use the project road in future. The likely diverted, induced and generated traffic has been added to arrive at the future traffic for each of the homogeneous sections. The projected traffic for each of the homogeneous sections is presented in **Table 1-9**.

**Table 1 - 9 Projected Annual Average Daily Traffic on NH 135BG**

| Year | Total Tollable Vehicles | Total Tollable PCUs | Total PCUs | Total Vehicles |
|---|---|---|---|---|
| **Annual Average Daily Traffic on HS 1 (Km 0+000 to 29+600)** | | | | |
| 2017 | 1861 | 3424 | 5540 | 5953 |
| 2021 | 2555 | 4642 | 7538 | 8179 |
| 2025 | 4055 | 7286 | 11734 | 12747 |
| 2030 | 5847 | 10364 | 16740 | 18345 |
| 2035 | 7892 | 13847 | 22455 | 24800 |
| 2040 | 10083 | 17550 | 28573 | 31766 |
| 2045 | 12268 | 21189 | 34651 | 38776 |
| 2050 | 14785 | 25337 | 41618 | 46894 |
| **Annual Average Daily Traffic on HS 2 (Km 29+600 to 48+070)** | | | | |
| 2017 | 2777 | 4416 | 13239 | 19253 |
| 2021 | 3833 | 6032 | 17676 | 25740 |
| 2025 | 6094 | 9496 | 26777 | 38829 |
| 2030 | 8803 | 13561 | 37667 | 54804 |
| 2035 | 11895 | 18162 | 50098 | 73199 |
| 2040 | 15211 | 23065 | 63472 | 93083 |
| 2045 | 18538 | 27935 | 76946 | 113204 |
| 2050 | 22391 | 33537 | 92530 | 136553 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 4.9 Capacity and Level of Service Analysis

Homogenous sections 1 of Balaghat to Gondia Stretch require to be widened to 2 lane with paved shoulder configuration from the year 2023. Homogenous Sections 1 and 2 would require to be widened to four lane with paved shoulder configurations from the year 2031, 2021 respectively. The widening proposals based on the IRC: SP: 73-2015 and IRC: SP: 84-2014 are given in **Table 1-10** below.

**Table 1 - 10 Year-wise Improvement Proposal Based on IRC Codes**

| Homogeneous Section | Recommendations | | |
|---|---|---|---|
| | 2–lane with paved shoulder | 4–lane with paved shoulder | 6–lane with paved shoulder |
| HS 1 | 2023 | 2031 | |
| HS 2 | | 2021 | 2038 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

*Further, as per the circular issued by Ministry of Road Transport and Highways SR&T (Roads), RW/NH-33044/37/2015/S&R(R) dated 26th May 2016; all the roads with traffic more than 10000 PCUs are to be proposed for four laning.*

Homogenous section 1 and 2 of Balaghat to Gondia Stretch would require 4 laning from the year 2023 and 2017 respectively. Therefore the entire project road stretch from **Balaghat to Gondia may be improved to four lane with paved shoulder configuration from opening year 2021** (as per the circular issued by Ministry of Road Transport and Highways SR&T (Roads), dated 26th May 2016). Moreover, the project road is classified as a feeder road under Bharat Mala Phase 1. So the project road will be developed and widened to 4 lane as per MoRTH memorandum dated 3rd May 2018.

In the meeting held under the Chairmanship of Member (A) on 14th July 2018, the project was discussed in details and it was decided that as per direction of Circular dated 3rd May 2018 and considering the connectivity of both National Highways as well as two states, the project road has to be developed to four lane standard at the opening year with right of way of 70m in general.

**Table 1 - 11 Proposed Improvement Proposal**

| Road name | Improvement type in the opening year |
|---|---|
| Balaghat –Gondia (NH 543) | 4 lane with paved shoulder |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.0 ALIGNMENT IMPROVEMENT PROPOSAL

During the course of the detailed site investigations, the Consultant examined both the option of improvement & widening of the existing road and also the possibility of Re-alignments / Bypasses for some built up stretches which are difficult to widen due to Engineering and other constraints and the collective details are explained below.

### 5.1 Improvement and Widening of Existing Road

The consultants have carried out detailed topographic survey of the existing alignment along with other engineering investigations. As enumerated in Section 3.0 of this report, the existing road is deficient in geometrics and improving the geometrics will involve higher social unrest due to dismantling of road side structures. Further, there are some major bottlenecks for widening and improvement of existing road.

The project road is carrying medium to heavy traffic and become eligible for capacity augmentation to four lanes. With existing geometrics, terrain and involvement of R&R constraints, it is not feasible to widen the existing road to four lanes.

Considering the above facts, it is apparent that improvement & widening the existing road will be possible for some length and not for the entire length. Hence some alternative proposals of Re-alignments / Bypasses have been explored. The Consultant

has accordingly worked out the alternative proposals and is described in the following sections:
The evaluation criterion for widening proposals is as follows:

- ***Technical Considerations*** – Geometric, movement of traffic during construction, earthwork, cross drainage works, junction layout, relocation of existing utilities, bypasses, construction costs, and maintenance costs.
- ***Environmental Consideration*** – land use change, location of water bodies, river / canal / stream crossing, location of protected areas / critically polluted areas / eco-sensitive areas / forest etc.
- ***Social Consideration*** - Area of land acquisition, type of land acquisition, location of religious places / educational institutions / medical amenities / drinking water sources, resettlement and rehabilitation problems and costs.

## 5.2 Possible Re-alignments / Bypasses

Based on the site condition, IRC guidelines, MoRT&H circulars the project road has been designed with design speed of 100kmph.

The project starts from Balaghat district head quarter within the congested area having very less right of way. Improvements along existing will involve large scale demolition of structures. The clearance between the building lines is about 25m. There are also sub-standard geometries with right angle turning. Widening along existing will involve large scale demolition and will create social unrest .Improvement along existing as per IRC codal provision will involve large scale demolition of structures. Hence to avoid above hindrances for improvement to 4 lane standards, a bypass (**Balaghat Bypass**) on western side for a length of 14.40km has been proposed.

Further the alignment follows the existing road up to **Rajegaon**. In Rajegaon the existing geometries are not conforming to IRC standard and the clearance between building line is about 17m. Hence improvement inside the market area will involve large scale demolition of private structures. Therefore, to avoid these hindrances for improvement a bypass (Rajegaon Bypass) option has been proposed.

In **Ravanwadi** (Maharashtra) the clearance between building line is about 22m. Hence improvement inside the market area will involve large scale demolition of private structures. Therefore, to avoid these hindrances for improvement a **bypass** option has been proposed.

In addition to above bypasses, **realignments** have been proposed **at 3 locations** to improve the road geometry and to avoid habitation. The details of bypass and realignment are tabulated in **Table 1-12** below:

**Table 1 - 12 Possible Locations of Realignments / Bypasses**

| Sl. No. | Name | Existing Chainage | | | Design Chainage | | |
|---|---|---|---|---|---|---|---|
| | | From | To | Length (Km) | From | To | Length (Km) |
| 1 | Balaghat Bypass | 0+000 | 9+110 | 9.110 | 0+000 | 14+400 | 14.400 |
| 2 | Rajegaon Bypass in MP | 21+980 | 23+880 | 1.900 | 27+270 | 29+200 | 1.930 |
| 3 | Rajegaon Bypass in MH | 28+420 | 31+075 | 2.655 | 33+755 | 36+570 | 2.815 |
| 4 | Rawanwadi Bypass | 33+000 | 36+000 | 3.000 | 38+500 | 41+690 | 3.190 |
| 5 | Vijaynagar Bypass | 36+915 | 41+550 | 4.635 | 42+600 | 47+500 | 4.900 |
| **Total Length of Bypass (Km)** | | | | | | | **27.235** |
| 1 | Realignment | 24+520 | 25+460 | 0.940 | 29+860 | 30+780 | 0.920 |
| **Total Length of Realignment (Km)** | | | | | | | **0.920** |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.3 Recommended Alignment

Taking into account the above major improvements, the recommended improvement proposal for the project highway is indicated in **Table 1-13** below. A key plan showing the recommended alignment from Balaghat to Gondia (Km 0+000 to Km 48+070) is given in **Figure-4**.

**Table 1 - 13 Recommended Improvement Proposal for the Project Highway**

| Sl. No. | Existing Alignment (Km) | | | Design Alignment (Km) | | |
|---|---|---|---|---|---|---|
| | From | To | Length | From | To | Length |
| 1 | 0+0 | 41+550 | 41.55 | 0+0 | 48+070 | 48.07 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

Out of 48.070 km stretch, 29.700 km stretch is in the State of Madhya Pradesh (Package-1A) and 18.370 km s in the State of Maharashtra (Package-1B).

## 5.4 Proposed RoW and Widening Details

In reference to the MoRT&H office memorandum dated 3rd May 2018 and further discussion on 14th July 2018 in NHAI HQ, the width of Proposed Right of Way (PROW) outside forest area has been kept as **70 m** in general. At location of major & minor junction, bus bays, truck lay bye, toll plaza, way side amenities, entry exit of VUP / Flyovers and interchange extra land to be provided in addition to above mentioned ROW as per the actual Design requirement.

Considering the need to minimize land acquisition in majority section eccentric widening has been adopted. A summary of widening details is given in **Table 1-14** below and chainage wise widening scheme has been presented in **Table 1-15**.

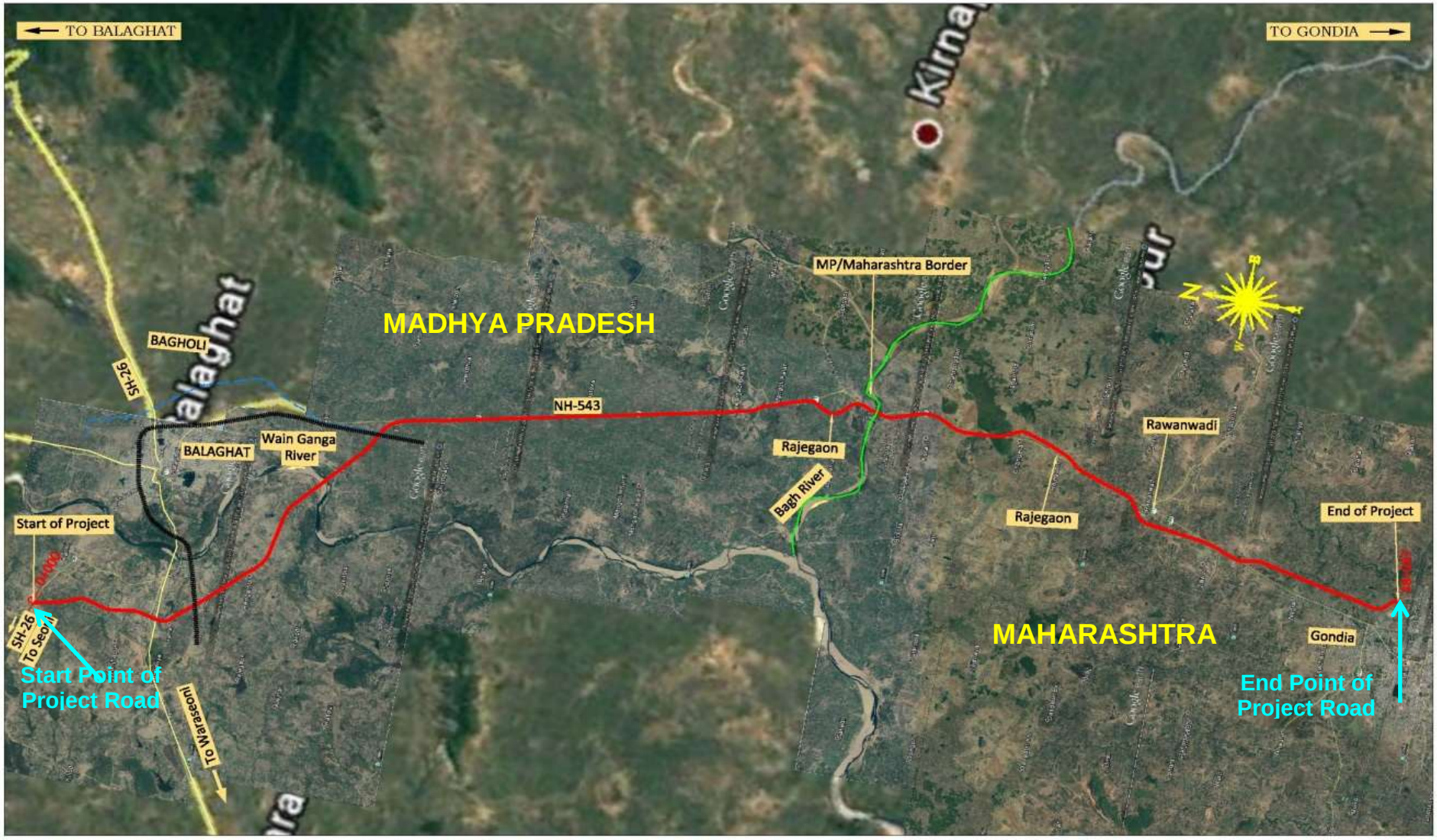



**Figure-4 Recommended Alignment of Balaghat - Gondia Section**

**Table 1 - 14 Summary of Proposed Widening Scheme**

| Widening Length (Km) | | | Bypass (Km) | Realignment (Km) | Total Length (Km) |
|---|---|---|---|---|---|
| Concentric | Eccentric Left | Eccentric Right | | | |
| 0.970 | 2.470 | 16.475 | 27.235 | 0.920 | **48.070** |

**Table 1 - 15 Details of Proposed Widening Scheme**

| SL No | Design Chainage (km) | | Length (m) | Widening / Construction Scheme |
|---|---|---|---|---|
| | From | To | | |
| 1. | 0+000 | 14+400 | 14.400 | Balaghat Bypass |
| 2. | 14+400 | 15+300 | 0.900 | Eccentric Left Widening |
| 3. | 15+300 | 24+800 | 9.500 | Eccentric Right Widening |
| 4. | 24+800 | 25+600 | 0.800 | Eccentric Left Widening |
| 5. | 25+600 | 26+500 | 0.900 | Eccentric Right Widening |
| 6. | 26+500 | 27+270 | 0.770 | Eccentric Left Widening |
| 7. | 27+270 | 29+200 | 1.930 | Rajegaon Bypass in MP |
| 8. | 29+200 | 29+860 | 0.660 | Eccentric Right Widening |
| 9. | 29+860 | 30+780 | 0.920 | Realignment |
| 10. | 30+780 | 33+755 | 2.975 | Eccentric Right Widening |
| 11. | 33+755 | 36+570 | 2.815 | Rajegaon Bypass in MH |
| 12. | 36+570 | 38+100 | 1.530 | Eccentric Right Widening |
| 13. | 38+100 | 38+500 | 0.400 | Concentric Widening |
| 14. | 38+500 | 41+690 | 3.190 | Rawanwadi Bypass |
| 15. | 41+690 | 42+600 | 0.910 | Eccentric Right Widening |
| 16. | 42+600 | 47+500 | 4.900 | Vijaynagar Bypass |
| 17. | 47+500 | 48+070 | 0.570 | Concentric Widening |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.5 Typical Cross Sections

Based on the traffic projection, capacity and the design standards, typical cross-sections applicable for various sections of the project road have been prepared. These typical sections have been prepared separately for various alternatives like reconstruction, rehabilitation, Built-up areas, Bypasses / realignments and Grade separated sections etc. (**Table 1-16**). Typical cross sections are given at the end of this Feasibility Report.

**Table 1 - 16 Details of Typical Cross Sections**

| Sl. No. | Description | TCS No. |
|---|---|---|
| 1 | 4 lane divided carriageway (rural section - bypass / realignment/curve improvement) | TCS - 1 |
| 2 | 4 lane divided carriageway (Reconstruction - Left side widening) | TCS - 2 |
| 3 | 4 lane divided carriageway (Reconstruction - Right side widening) | TCS - 3 |
| 4 | 4 lane divided carriageway (Reconstruction - Concentric widening) | TCS - 4 |

| Sl. No. | Description | TCS No. |
|---|---|---|
| 5 | 4 lane divided carriageway (Overlay - Right side widening) | TCS - 5 |
| 6 | 4 lane divided carriageway with both side slip road (Grade separated approaches) | TCS - 6 |
| 7 | 4 lane divided carriageway with both side slip road (Built-up section) | TCS - 7 |
| 8 | 4 lane elevated divided carriageway (ROB approaches) | TCS - 8 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.6 Geometric Design Standards

*General Considerations*

a) This section lays down the standards for Geometric Design and general features for upgrading the existing roads to 2 lane and 4 laning divided carriageway configuration.
b) The Geometric Design of the Project Highway shall conform to the standards set out in this chapter as a minimum.
c) The uniformity of the Design Standards shall be maintained throughout the length.
d) Existing Horizontal Curves, which are found deficient in radius, layout, transition lengths or super-elevation shall be corrected to the specified standards. Similarly deficiencies in the vertical alignment shall also be addressed.

Geometric Design Standards for the Project Road have been drafted based on the following Guidelines:

- Manual of Specification and Standards for Two Laning of Highways with Paved Shoulder (IRC:SP:73-2015)
- Manual for safety in Road Design by Government of India, Ministry of Road Transport & Highways (Road Wing –September 1998)
- Manual of Specification & Standards for Four Laning of Highways Through Public Private Partnership (IRC:SP:84-2014)
- Manual on Road Safety Audit (IRC:SP:88-2010)
- NHAI circular No. 11014/11/2016-HR-I dated 12.06.2017.
- Other IRC Guidelines/Manuals and
- All notations, abbreviations and symbols used in the reports, documents and drawings shall be as per IRC: 71.

The Design Standards for the 2 lane/4 lane Highway Alignment Design are broadly drawn up in **Table 1-17** below. The horizontal and vertical Alignment Design for the improvement of the Project Highway has been done keeping these Standards in view.

**Table 1 - 17 Design Standards for 4 Lane Highway**

| S. No. | Design Specification | Unit | Proposed Design Standards | | |
|---|---|---|---|---|---|
| 1 | Design Speed | Km/hr | Plain & Rolling | | Mountainous& Steep |
| | Ruling | | 100 | | 60 |
| | Minimum | | 80 | | 40 |
| 2. | ROW | M | 4- Lane- 70m | | |
| 3. | Lane Width (for Multilane Highway) | M | 3.50 | | |
| 4 | Median Width (4 Lane Highways) | M | Plain & Rolling Terrain | | Mountainous & Steep Terrain |
| | | | Raised | Depressed | Raised |
| | (a) Open Country | | 5.0 | 7.0 | 2.5 |
| | (b) Built Up Area | | 2.5 | NA | 2.5 |
| | (c) Approach to Grade Separated Structures | | 5.0 | NA | 2.5 |
| 5(a) | Shoulder Width (Plain & Rolling Terrain) | M | Paved | | Earthen |
| | (a) Open Country | | 1.5 | | 2.0 |
| | (b) Built Up Area | | 4-Lane-2.0m | | - |
| | (c) Approaches to Grade Separators | | 2.0 | | - |
| | (d) Approaches to Bridges | | 1.5 | | 2.0 |
| 5(b) | Shoulder Width (Mountainous and Steep Terrain (Hilly Area) (a) Open Country | M | Paved | | Earthen |
| | (i) Hill Side | | 1.5 | | - |
| | (ii) Valley Side | | 1.5 | | 1.0 |
| | (b) Built Up Area & Approaches to Grade Separators/Bridges | | Paved | | Earthen |
| | (i) Hill Side | | 0.25+1.5 (Raised) | | - |
| | (ii) Valley Side | | 0.25+1.5 (Raised) | | - |
| 6. | Camber | % | | | |
| | Carriageway | | 2.5 | | |
| | Paved Shoulders<br>Earthen Shoulder | | 2.5<br>3.0 | | |
| 7. | Gradients<br>a) Plain and Rolling | % | Ruling | | Limiting |
| | | | 2.5 | | 3.3 |
| | b) Mountainous and Steep | | 5.0 | | 6.0 |
| 8. | Super elevation<br>a) For radius of curvature 400m/250m and above for 100kmph/80kmph<br>b) For radius of curvature less than 400m/250m for 100kmph/80kmph | % | 5.0<br>7.0 | | |

| S. No. | Design Specification | Unit | Proposed Design Standards | |
|---|---|---|---|---|
| 9. | Minimum Horizontal Curve Radius | M | Plain & Rolling | Mountainous & Steep |
| | Desirable | | 400 | 250 |
| | Absolute | | 150 | 75 |
| 10. | Sight Distance | M | 100 km /hr | 80km / hr |
| | Stopping Sight Distance | | 180 | 130 |
| | Intermediate Sight Distance | | 360 | 260 |
| 11. | Minimum Vertical Curve Length (SSD case)<br>Crest<br>Sag | | 73.6A<br>41.5A | |
| 12. | Widening at curve locations | M | | |
| | 75-100 m | | 0.9 | |
| | 101-300 m | | 0.6 | |

*Note: A in the above table is the algebraic difference in grades expressed as percentage*

## 5.7 Pavement Design

The pavement design has been carried out using various IRC publications. Different options of flexible pavement such as CTB, RAP and conventional along with rigid option of pavement design had been evaluated. 30 year design life for rigid pavement and 15 year for flexible pavement has been considered. As per MoRT&H circular RW/NH-35072/05/2018 – S&R (P&B) dated 24th August, 2018, VG -40 Bitumen has been considered for DBM and BC.

Based on the LCCA, **rigid pavement has been recommended for main carriageway** in case of new construction and reconstruction including toll plaza location. As per IRC: SP 84, flexible pavement of 10 MSA has been considered for slip roads. The recommended pavement structure for new construction / reconstruction and overlay is presented in **Table 1-18**.

**Table 1 - 18 Recommended Pavement Structure for New Construction / Reconstruction and Overlay**

| Design Chainage (km) | | Design Traffic for Flexible | Design Traffic for Rigid* | Design CBR (%) | Recommended pavement structures for new construction of eccentrically placed additional 2-lanes, new bypasses/ realignments and full depth reconstruction stretches | | | | Recommended overlay on existing flexible pavement | | Flexible Pavement Composition for Widening of Existing Carriageway | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | | | | BC(mm) | DBM (mm) | WMM (mm) | GSB (mm) | BC (mm) | DBM (mm) | BC (mm) | DBM (mm) | WMM (mm) | GSB Drainage Layer (mm) | GSB Separation Layer (mm) |
| 0+000 | 29+600 | 10 | 1,61,50,766 | 13 | 40 | 50 | 250 | 250 | 50 | - | 50 | 50 | 250 | 100 | 150 |
| 29+600 | 35+100 | 20 | 2,71,98,626 | 11 | 40 | 50 | 250 | 250 | 50 | - | 50 | 50 | 250 | 100 | 150 |
| 35+100 | 45+300 | 20 | 2,71,98,626 | 11 | 40 | 50 | 250 | 250 | Reconstruction** | | 40 | 50 | 250 | 100 | 150 |
| 45+300 | 48+070 | 20 | 2,71,98,626 | 11 | 40 | 50 | 250 | 250 | 40 | 80 | 40 | 50 | 250 | 100 | 150 |

*Note:– DBM (VG-40 Bitumen), BC – (VG-40 Bitumen) (as per MORTH circular RW/NH-35072/05/2018 – S&R (P&B) dated 24th August, 2018) is used in main carriageway*

***Reconstruction shall be from upper GSB layer onwards by considering the existing pavement layer as lower GSB separation layer*

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.8 Hydrological Design and Recommendations

Data collected from the site were collated and studied along with the Google Earth Imageries. The Design Approach has been formulated through careful examination of the field data collected and the following additional pieces of data:

- Local inquiries, road / culvert inventory, HFL, history of flooding/ overtopping, mean annual rainfall, regional runoff coefficient,
- Survey of India Toposheets – land use, soil type, cover condition and slope
- 30m, SRTM Digital Elevation Model (DEM) to analyze the river catchment characteristics in GIS platform.
- Rainfall / runoff data published in "Flood Estimation Report for Subzones 1(c), 1(d) and 3(f)"– Isopluvial maps for design storms of 24 hour duration with 25 year and 100 year return period.
- Visual inspection – bed level, clearance, HFL, Overtopping, vegetation cover, flood plain, blockage/sedimentation, flow direction, terrain, embankment height, scour.

***Hydro-Meteorologically Homogenous Sub zones:*** For estimation of Design Flood, The Central Water Commission (CWC) has divided the whole Geographical Territory of India into 26 distinct hydro-meteorologically homogenous Subzones. The proposed project area comes under three Subzones 3(f).

**Table 1 - 19 Subzone for Project Section**

| Project Road | CWC Subzone |
|---|---|
| Balaghat – Gondia Road | Subzone 3(f) |

***Design Rainfall:*** Relevant data have been taken from the Flood Estimation Reports of concern subzones of CWC. The **Tables 1-20** shows the 24-hr maximum point rainfall values (from Isopluvial Maps of different Return Periods) generally adopted for the study area:

**Table 1 - 20 Adopted Rainfall Data for Rewa –Shahdol Road**

| Chainage Km | | 100 Yr. 24 hr. Rainfall (mm) | 25 Yr. 24 hr. Rainfall (mm) |
|---|---|---|---|
| 0+000 | 30+500 | 320 | 240 |
| 30+500 | 48+070 | 360 | 280 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

***Basin Parameters:*** The watersheds of the rivers / streams at the proposed crossing points have been delineated with the help of Google Earth Imagery and ArcGIS 10 Software. The watershed area, fall in height, total and segmental stream lengths and corresponding elevations have also be determined with the help of GIS Software.

***Estimation of Design Flood***

- Determination of Design Discharges have been done in line with the stipulations of IRC-5:2015, IRC-SP:13-2004 and standard engineering practices.

- For streams having catchment areas more than 25 sq. km, SUH Method as stipulated in the Flood Estimation Report of CWC has been followed.
- For catchment areas less than 25 Sq. Km, Rational Method in general has been followed. Empirical Methods (Catchment Area Method using Dicken's Formula), without any assigned return period, has been used as a check for the adopted Design Flood.
- For catchment area more than 5000 Sq. Km. is divided into sub basin areas and SUH method has been applied to calculate design flood of each sub basin. The estimated design flood of each individual sub basin is then routed to bridge location by Muskingum channel routing method.
- Slope Area Method demands accurate information regarding HFL at the particular crossing point. During site visit, sincere efforts were made to collect reliable information regarding Highest Flood Levels (at proposed crossing point) of memorable past.
- However, HFL information received from local enquiries are not reliable enough to be used for determination of design discharges for the bridges. Therefore, the design discharge has not been estimated using slope area method.

***Design Return Period:*** The following table summarizes the return period to be adopted for design of bridges:

**Table 1 - 21 Summary of the Return Period adopted for Bridge Design**

| Sl. No. | Design Parameter | Adopted Return Period Flood |
|---|---|---|
| 1. | Waterway for Bridges | 100 Years |
| 2. | HFL for Bridges | 100 Years |
| 3. | Scour for foundation design | 100 Year Flood multiplied by suitable factor, based on catchment area. |
| 4. | Design of Roadside Drains / Culverts | 25 Years (both for rural and urban areas) and checked for 50 year Return Period Flood. |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

The information about the catchment characteristics, river behaviour, morphology and other hydraulic data for bridges have been collected from the site visit and have been analysed and studied to determine the adequacy of waterway of existing bridges proposed to be retained and/or new bridges to be constructed as per provisions of IRC: 5-2015 and IRC: SP-13 - 2004. The hydrological details of all existing bridges are summarized and given in **Table 1-22.**

**Table 1 - 22 Hydrological and Hydraulic Calculation summary of Bridges**

| S. No. | Design Chainage | Catchment Area (sq.km) | 100 Yr. 24 hr. rainfall (mm) | Discharge (Cumec) | Clear waterway Provided (m) | HFL (m) | Retain/ New/ Replaced | Recommendation as per Hydrological Study |
|---|---|---|---|---|---|---|---|---|
| 1 | 1+175 | 4.11 | 320 | 64 | 20 | 306.939 | New | New Bridge |
| 2 | 2+440 | 6.6 | 320 | 96 | 30 | 305.629 | New | New Bridge |
| 3 | 3+420 | | | 0.38* | 4.65 (Top Width) * | | New/ Canal /Bypass | New Canal bridge |

| S. No. | Design Chainage | Catchment Area (sq.km) | 100 Yr. 24 hr. rainfall (mm) | Discharge (Cumec) | Clear waterway Provided (m) | HFL (m) | Retain/ New/ Replaced | Recommendation as per Hydrological Study |
|---|---|---|---|---|---|---|---|---|
| 4 | 6+300 | | | 0.48* | 4.52 (Top Width) * | | New/ Canal /Bypass | New Canal bridge |
| 5 | 11+300 | 8524 | 320 | 17928 | 380 | 295.707 | New | New Bridge |
| 6 | 12+253 | | | 0.484* | 5.58 (Top Width) * | | New/ Canal /Bypass | New Canal bridge |
| 7 | 12+612 | | | 0.26* | 5.55 (Top Width) * | | New/ Canal /Bypass | New Canal bridge |
| 8 | 15+650 | 2.05 | 320 | 32 | 14 | 295.925 | New | New Bridge |
| 9 | 25+265 | 308.27 | 320 | 1927 | 185 | 283.135 | Retained | Hydrologically Adequate |
| 10 | 28+450 | 1.68 | 320 | 30 | 10 | 281.596 | New/ Realignment | New Bridge |
| 11 | 29+675 | 5411 | 320 | 11114 | 252 | 285.031 | Retained | Hydrologically Adequate |
| 12 | 33+850 | 2.15 | 360 | 29 | 5.5 | 290.891 | Retained | Hydrologically Adequate |
| 13 | 34+235 | | | 7.2* | 12.65 (Top Width) * | | Canal/ New | Canal bridge |
| 14 | 41+975 | | | 7.5* | 23.00 (Top Width) * | | Canal | Canal bridge |
| 15 | 46+265 | 17.2 | 360 | 137 | 20 | 299.237 | New/ Realignment | New Bridge |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.9 Recommendation for Check Dam cum Bridges

The Ministry of Road Transport & Highways recently advised through a letter no. RW-NH-34066/59/2015-S&R (B) dated 18th April, 2017 to save and optimally utilize scarce natural resources like water to cater for drinking (human/animals) and irrigation needs besides other purposes, the bridge sites for all new bridge structures and old abandoned bridge structures having total length 100m or less can be used for tapping of water for serving multipurpose, provided they are technically feasible.

Accordingly, a study has been done to check feasibility of Check Dam / Bandhara cum bridges for project road and the same is presented in **Table 1-23**.

**Table 1 - 23 Proposed Check Dam cum Bridges**

| Sl. No. | Design Chainage | Catchment Area (sq.km) | 100 yr. 24 hr. Rainfall (mm) | Discharge (Cumec) | Retain/ New/ Replaced | Check Dam / Bandhara |
|---|---|---|---|---|---|---|
| 1. | 1+175 | 4.11 | 320 | 64 | New | Check Dam may be provided with 0.5m Depth |
| 2. | 2+440 | 6.6 | 320 | 96 | New | Check Dam may be provided with 0.5m Depth |
| 3. | 11+300 | 8524 | 320 | 17928 | New | Waterway more than 100m / Not in Scope |

| Sl. No. | Design Chainage | Catchment Area (sq.km) | 100 yr. 24 hr. Rainfall (mm) | Discharge (Cumec) | Retain/ New/ Replaced | Check Dam / Bandhara |
|---|---|---|---|---|---|---|
| 4. | 15+650 | 2.04 | 320 | 32 | New | Not Feasible / not defined stream / u/s Agricultural Land |
| 5. | 25+265 | 308.27 | 320 | 1927 | Retained | Waterway more than 100m / Not in Scope |
| 6. | 28+450 | 1.68 | 320 | 30 | Replaced | Check Dam may be provided with 0.5m Depth |
| 7. | 29+675 | 5411 | 320 | 11114 | Retained | Waterway more than 100m / Not in Scope |
| 8. | 33+850 | 2.15 | 360 | 29 | Retained | Bridge Retained |
| 9. | 46+265 | 17.2 | 360 | 137 | Replaced | Urban Area / Not Feasible |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.10 Improvement Proposals for Bridges and Structures

***Bridge:*** Out of existing 5 bridges, 2 existing bridges are proposed to be replaced with new 4-lane bridges, 1 existing bridge is falling in the VUPs approach and remaining 3 existing bridges are proposed to be retained with additional 2-lane bridges. Further, on the bypasses and realigned stretches of project road, 4 new 4-lane bridges and 6 new 4-lane bridges with bridges on both side service roads are proposed. Thus the **total numbers of bridges** on the project road are **15** as detailed below:

**Table 1 - 24 Details of Existing Bridges to be retained and additional 2 lane bridges to be provided**

| Sl. No. | Existing Chainage | Design Chainage | Total Length (m) | Carriageway Width (m) | Total Deck Width (m) | Remarks |
|---|---|---|---|---|---|---|
| 1 | 19+901 | 25+265 | 200.04 | 1 x 8.5 | 1 x 12.5 | Existing bridge is retained without widening and New 2-lane bridge for other carriageway on LHS proposed. |
| 2 | 24+359 | 29+675 | 275.04 | 1 x 8.5 | 1 x 12.5 | Existing bridge is retained without widening and New 2-lane bridge for other carriageway on RHS proposed. |
| 3 | 36+282 | 41+975 | 10.94 | 1 x 8.5 | 1 x 12.5 | Existing bridge is to be retained and Add. New 2-lane bridge proposed |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

**Table 1 - 25 Details of New 4 lane Bridges with Service Road Bridges**

| Sl. No. | Existing Chainage | Design Chainage | Total Length (m) | Carriageway Width (m) | Total Deck Width (m) | Remarks |
|---|---|---|---|---|---|---|
| 1 | 28+498 | 33+850 | 8.9 | 2 x 8.5 | 2 x 11.5 | New 4-lane bridge with bridges on both side service road |
| 2 | 41+687 | 46+265 | 27.029 | 2 x 9.0 | 2 x 11 | New 4-lane bridge with bridges on both side service roads |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

**Table 1 - 26 Details of New 4 lane Bridges on bypass or realigned stretches**

| Sl. No. | Design Chainage | Total Length (m) | Carriageway Width (m) | Total Deck Width (m) | Remarks |
|---|---|---|---|---|---|
| 1 | 1+175 | 22.48 | 2 x 8.5 | 2 x 12.5 | New 4-lane bridge |
| 2 | 2+440 | 34.24 | 2 x 8.5 | 2 x 12.5 | New 4-lane bridge |
| 3 | 6+300 | 18.445 | 2 x 8.5 | 2 x 12.5 | New 4-lane bridge |
| 4 | 11+300 | 422.05 | 2 x 8.5 | 2 x 12.5 | New 4-lane bridge |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

**Table 1 - 27 Details of New 4 lane Bridges with Bridges on Service Road on Bypass**

| Sl. No. | Design Chainage | Total Length (m) | Carriageway Width (m) | Total Deck Width (m) | Remarks |
|---|---|---|---|---|---|
| 1. | 3+420 | 12.376 | 2 x 8.5 | 2 x 11.5 | New 4-lane bridge with bridges on both side service road |
| 2. | 12+253 | 9.0 | 2 x 8.5 | 2 x 11 | New 4-lane bridge with bridges on both side service road |
| 3. | 12+612 | 9.0 | 2 x 8.5 | 2 x 11 | New 4-lane bridge with bridges on both side service road |
| 4. | 15+650 | 17.48 | 2 x 9.5 | 2 x 11.5 | New 4-lane bridge with bridges on both side service road |
| 5. | 28+450 | 11.6 | 2 x 8.5 | 2 x 11.5 | New 4-lane bridge with bridges on both side service road |
| 6. | 34+235 | 14.08 | 2 x 8.5 | 2 x 11.5 | New 4-lane bridge with bridges on both side service road |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

***Rail Over Bridge:*** The project road crosses south east central railway at 2 locations (Ch. 5+360 and Ch. 13+574). ROB has been proposed.

**Table 1 - 28 Details of Rail Over Bridges (ROBs)**

| Sl. No. | Type of Structure | Design Chainage | Total Length (m) | Type of Superstructure | Remarks |
|---|---|---|---|---|---|
| 1 | ROB | 5+360 | 668.243 | Steel composite Girder, PSC Girder with slab and RCC Girder with slab | New 4-lane ROB |
| 2 | ROB | 13+574 | 409.639 | | |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

***Grade Separated Structures:*** The project road starts from the existing NH 35. A trumpet interchange has been proposed. In addition to above major crossing, there are some village roads and MDR connects /crosses the project road, where flyover has been proposed (**Table 1-29**).

Apart from above, 3 Vehicular Underpasses, 12 Light Vehicular Underpasses and 8 Small Vehicular Underpasses are proposed on project road as shown in **Table 1-30**.

**Table 1 - 29 Details of Interchange and Flyover**

| Sl. No. | Design Chainage | Total Length (m) | Carriageway Width (m) | Total Deck Width (m) | Remarks |
|---|---|---|---|---|---|
| 1 | 0+000 | 32.25 | 2x9 | 2x11 | Interchange |
| 2 | 3+800 | 32.25 | 2x9 | 2x11 | New 4-LaneFlyover |
| 3 | 47+315 | 32.25 | 2x9 | 2x11 | New 4-LaneFlyover |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

**Table 1 - 30 Details of VUPs, LVUPs, SVUPS & VOP**

| Sl. No. | Type of Structure | Design Chainage | Total Length (m) | Carriageway Width (m) | Total Deck Width (m) |
|---|---|---|---|---|---|
| 1 | SVUP | 1+265 | 8.4 | 2 x 8.5 | 2 x 11 |
| 2 | SVUP | 2+293 | 8.4 | 2 x 8.5 | 2 x 11 |
| 3 | LVUP | 7+100 | 13.6 | 2 x 8.5 | 2 x 11 |
| 4 | SVUP | 8+570 | 8.4 | 2 x 8.5 | 2 x 11 |
| 5 | SVUP | 10+780 | 8.4 | 2 x 8.5 | 2 x 11 |
| 6 | SVUP | 11+780 | 8.4 | 2 x 8.5 | 2 x 11 |
| 7 | LVUP | 12+420 | 13.6 | 2 x 8.5 | 2 x 11 |
| 8 | VUP | 14+160 | 22.04 | 2 x 8.5 | 2 x 11 |
| 9 | LVUP | 15+290 | 13.6 | 2 x 8.5 | 2 x 11 |
| 10 | LVUP | 18+175 | 13.6 | 2 x 8.5 | 2 x 11 |
| 11 | LVUP | 19+790 | 13.6 | 2 x 8.5 | 2 x 11 |
| 12 | LVUP | 23+680 | 13.6 | 2 x 8.5 | 2 x 11 |
| 13 | LVUP | 25+940 | 13.6 | 2 x 8.5 | 2 x 11 |
| 14 | LVUP | 28+095 | 13.6 | 2 x 8.5 | 2 x 11 |
| 15 | SVUP | 29+935 | 8.4 | 2 x 8.5 | 2 x 11 |
| 16 | LVUP | 30+445 | 13.6 | 2 x 8.5 | 2 x 11 |
| 17 | LVUP | 34+365 | 13.6 | 2 x 8.5 | 2 x 11 |
| 18 | LVUP | 35+715 | 13.6 | 2 x 8.5 | 2 x 11 |
| 19 | LVUP | 38+615 | 13.6 | 2 x 8.5 | 2 x 11 |
| 20 | SVUP | 39+688 | 8.4 | 2 x 8.5 | 2 x 11 |
| 21 | LVUP | 41+265 | 13.6 | 2 x 8.5 | 2 x 11 |
| 22 | VUP | 42+705 | 22.04 | 2 x 8.5 | 2 x 11 |
| 23 | VUP | 46+105 | 22.04 | 2 x 8.5 | 2 x 11 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

***At grade Intersection / Grade Separated Intersection:*** In addition to above grade separated intersections, for smooth merging & diverging of cross road traffic, at grade intersections have been proposed at 25 locations.

## 5.11 Proposed Culvert

Based on the hydrological assessment, existing minor cross drainage structures, canal crossings and drainage flow, 115 culverts (includes 2 RCC portal) have been proposed. The summary of recommended culverts for the project road is presented in **Table 1-31**.

**Table 1 - 31 Summary of Recommended Culverts**

| Description | Type of Culverts | | |
|---|---|---|---|
| | Hume Pipe | Slab | Box |
| New Culvert | 0 | 0 | 98 |
| Widening of existing culverts | 5 | 2 | 0 |
| Reconstruction of existing culverts | 0 | 0 | 10 |
| **Total** | **5** | **2** | **108** |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

In addition to above 70 HP Culverts are proposed for cross drainage at junction locations.

## 5.12 Major & Minor Junctions

In addition to VUPs and LVUPs, for smooth merging & diverging of cross road traffic, at grade intersections has been proposed at other locations. The details of Major & Minor Junction for improvement have been given in **Table 1-32** and **Table 1-33**.

**Table 1 - 32 Details of Major Junction for Improvement**

| Sl. No. | Design Chainage | Junction Type | Road leading to | |
|---|---|---|---|---|
| | | | Left | Right |
| 1 | 0+000 | T | -- | Gondia |
| 2 | 3+792 | + | Balaghat | Waraseoni |
| 3 | 7+100 | + | Rengatola | Alejhari |
| 4 | 12+420 | + | Gonglai | Bhamodi |
| 5 | 14+160 | T | -- | - |
| 6 | 15+290 | + | -- | Kanhadgaon Station Road |
| 7 | 18+175 | + | Sihora | Chikhla |
| 8 | 19+790 | + | Hatta Road Station Road | Hatta Road Station Road |
| 9 | 23+680 | + | -- | Khara Station Road |
| 10 | 25+940 | T | Dhadi | - |
| 11 | 28+095 | + | Rajegaon | Bagadmara |
| 12 | 30+445 | + | SH-11 | Jirutola |
| 13 | 34+365 | + | Dhamangaon | Changera |
| 14 | 38+615 | T | Rawanwadi | -- |
| 15 | 41+265 | T | Murpar | -- |
| 16 | 42+705 | + | Halbi Tola | SH-11 |

| Sl. No. | Design Chainage | Junction Type | Road leading to | |
|---|---|---|---|---|
| | | | Left | Right |
| 17 | 46+105 | + | Pemni | Katangi |
| 18 | 47+315 | T | -- | Gondia |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

**Table 1 - 33 Details of Minor Junction for Improvement**

| Sl. No. | Design Chainage | Junction Type | Road leading to | |
|---|---|---|---|---|
| | | | Left | Right |
| 1 | 1+265 | + | Garra | Kanki |
| 2 | 2+293 | + | -- | -- |
| 3 | 8+570 | + | -- | -- |
| 4 | 10+780 | + | -- | Jagpur |
| 5 | 11+780 | + | -- | -- |
| 6 | 17+552 | T | -- | -- |
| 7 | 20+945 | T | Newargaon | -- |
| 8 | 21+490 | T | Digoda | -- |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.13 Toll Plaza

The site for toll plaza location was carefully selected based on guidelines laid out in IRC standards. As per the guidelines given in MCA and toll policy, the distance between two toll plazas shall be at least 60 km apart and in reference with NHAI Circular dated 12th June 2017, minimum 8 lane (i.e. 7+1 on both side) configure of toll plaza has been proposed. Based on these criteria **one toll plaza** (2 x 8 lane) has been proposed at **Km 21+935 (Village Khara)**. General Layout of Toll Plaza is given below:

- Lane Width = 3.2 m in general and 4.5 m for oversize vehicles.
- Booth Island (a) Width = 1.9 m (b) minimum Length = 35m.
- Transition – 1 in 10 has been provided from two-lane section/four lane section to the widened width at Toll Plaza on either side.
- Provision of Future expansion: The office building shall be located taking into consideration of future expansion

## 5.14 Passenger Wayside Amenity

As per MoRTH Guidelines dated 12th December 2012 for providing **"Research and Test (ResT) reaches along National Highways"**, 1 passenger wayside amenity at every 50 km, will be established. Rest area provides useful services to the road user. These facilities provide services to the users who desire to stop for rest, refreshment, information and fuelling or for some emergency requirement. **Since the improvement length is less than 50 km, amenity has not been proposed.**

## 5.15 Truck Lay Bye

Based on site observations of existing informal truck laybyes, the following locations are considered for proposed truck laybys. It is presented in **Table 1-34**.

**Table 1 - 34 Location of Truck Lay bye**

| Design Chainage (Km) | Side | Village |
|---|---|---|
| 20+530 | LHS | Digoda |
| 22+900 | RHS | Newargaon |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.16 Bus Byes

**26 Bus bays** (13 Locations) on this package are identified to address the need of people living for boarding and alighting of passengers along the project roads as detailed below.

**Table 1 - 35 Location of Bus Byes**

| S. No | Chainage | Side |
|---|---|---|
| 1 | 3+650 | Both Sides on Service Road |
| 2 | 7+380 | Both Sides on Service Road |
| 3 | 15+050 | LHS on Service Road |
| 4 | 15+500 | RHS on Service Road |
| 5 | 17+950 | LHS on Service Road |
| 6 | 18+400 | RHS on Service Road |
| 7 | 19+550 | LHS on Service Road |
| 8 | 20+000 | RHS on Service Road |
| 9 | 23+500 | LHS on Service Road |
| 10 | 23+900 | RHS on Service Road |
| 11 | 26+240 | Both Sides on Service Road |
| 12 | 27+850 | Both Sides on Service Road |
| 13 | 31+350 | LHS |
| 14 | 31+550 | RHS |
| 15 | 34+600 | Both Sides on Service Road |
| 16 | 35+950 | Both Sides |
| 17 | 38+800 | Both Sides on Service Road |
| 18 | 45+850 | Both Sides on Service Road |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.17 Slip Roads

The project road is passing through number of ribbon developments / urban settlements which contribute heavy movements of local and non-motorized traffic along with the long distance (through) traffic. The profile of speed along the project road has shown reductions in speed levels in such locations. To address the need of the local habitants and to maintain the uniform speed profile of straight traffic after segregation of local traffic underpasses have been proposed to cross and access the National Highway. At

underpass locations, slip road has been proposed. In accordance to the MoRT&H memorandum dated 3rd May 2018, the width of slip road / service road has been kept as 10m (Carriageway 9m with 1m shoulder). The details locations of the proposed slip roads (14.91 km on both sides) are given in **Table 1-36**.

**Table 1 - 36 Location of Slip Roads**

| S. No | From | To | Length (km) | Side |
|---|---|---|---|---|
| 1 | 0+200 | 0+650 | 0.450 | Both |
| 2 | 3+350 | 4+300 | 0.950 | Both |
| 3 | 6+800 | 7+565 | 0.765 | Both |
| 4 | 12+000 | 12+775 | 0.775 | Both |
| 5 | 13+925 | 15+700 | 1.775 | Both |
| 6 | 17+800 | 18+600 | 0.800 | Both |
| 7 | 19+400 | 20+150 | 0.750 | Both |
| 8 | 23+275 | 24+050 | 0.775 | Both |
| 9 | 25+575 | 26+350 | 0.775 | Both |
| 10 | 27+800 | 28+600 | 0.800 | Both |
| 11 | 30+100 | 30+750 | 0.650 | Both |
| 12 | 33+810 | 34+700 | 0.890 | Both |
| 13 | 38+325 | 38+900 | 0.575 | Both |
| 14 | 40+900 | 41+540 | 0.640 | Both |
| 15 | 42+100 | 43+250 | 1.150 | Both |
| 16 | 45+350 | 47+740 | 2.390 | Both |
| **Total Length of Slip Road** | | | **14.91** | |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 5.18 Street Lighting

Street Lighting shall be provided at the following locations conforming to IRC:SP:73-2015 (Manual of Specifications & Standards for Two Laning of Highways with Paved Shoulder) and IRC: SP:84-2014 (Manual of Specifications & Standards for Four Laning of Highways through Public Private Partnership).

- Toll Plaza Area
- Way Side Amenities
- Truck Lay byes
- Bus Bays and Bus Shelters
- Grade Separated structures, Interchanges, Flyovers, Underpasses and Overpasses.
- Built-up Sections on the Project Highway both in the median of the main carriageway and on the service road on either side.

## 5.19 Traffic Control Devices and Road Safety Works

**Road Signs:**

- Three types of road signs shall generally be provided (such as Mandatory / Regulatory, Cautionary / Warnings, and informatory signs.

- Locations of Signs shall conform to IRC:67-2012, Section 800 of MOR&TH Specifications, and IRC: SP:84-2014 (Manual of Specifications & Standards for Four Laning of Highways through Public Private Partnership) and Manual of Specification & Standards for Expressways (IRC:SP:99-2013)
- Proper signs shall be provided for main carriageway, service and slip roads, toll plaza and other project highway facilities. Clustering and proliferation of road signs shall be avoided for enhancing their effectiveness.

**Road Markings:**

- Road Markings shall be of hot applied thermoplastic materials with glass reflectorizing beads.
- Road markings shall conform to IRC:35-1977 and IRC: SP:84-2014 (Manual of Specifications & Standards for Four Laning of Highways through Public Private Partnership) and Manual of Specification & Standards for Expressways (IRC:SP:99-2013)

**Road Delineators:** These are roadway indicators, hazard markers and object markers and shall conform to IRC 79-1981.

**Reflective Pavement Markers (Road Studs)** shall be provided to improve the visibility in night time and wet weather conditions. The locations and details of road studs shall conform to IRC:SP:73-2015 (Manual of Specifications & Standards for Two Laning of Highways with Paved Shoulder) and IRC: SP:84-2014 (Manual of Specifications & Standards for Four Laning of Highways through Public Private Partnership).

**Roadside and Median Safety Barriers:**

a) Semi-rigid type barrier at the edge of formation shall be provided at all embankments with height 3.0m or more with delineating reflectors fitted on them. These barriers shall also be provided along all curves having radii up to 450m for complete length of curves including transitions and 20m further before and after the curve.
b) Semi rigid barrier and flexible barrier shall not be installed upon a structure.
c) Steel barriers shall be provided in non-built-up sections, whereas concrete barriers shall be provided in built up sections.
d) Rigid barriers shall also be provided at the following locations:
    - Where embankment is retained by a retaining structure
    - On valley side of highway in mountainous and steep terrain.
    - Between main carriageway and footpath in bridges.

## 6.0 LAND ACQUISITION

The Existing ROW varies from 25m to 30 m. In reference to the MoRT&H office memorandum dated 3rd May 2018 and further discussion on 14th July 2018 in NHAI HQ, the width of Proposed Right of Way (PROW) has been kept as 70m in general. In forest area, a minimum 32m and maximum 40m right of way has been adopted. Additional

land has been considered for junction improvement, Way side amenities, Toll plaza, and Interchanges. Summary of land acquisition are given in **Table 1-37**.

**Table 1 - 37 Summary of Land Acquisition**

| Sl. No. | Type of Land | Area (in Ha) |
|---|---|---|
| 1 | Private | 268.98 |
| 2 | Govt. | 36.656 |
| **Total** | | **305.636** |

*Source: preliminary assessment of land acquisition*

## 7.0 INITIAL SOCIAL IMPACT ASSESSMENT

Assessment of social impact and preliminary land acquisition aims to identify impact of properties, impact on land, congested areas, impacts on the community and settlement to provide the basic information to the Engineering Design team to make any changes in the initial technical design. The thrust of this integration is to minimize the adverse impacts, if any, with the best possible engineering solutions at the most appropriate cost. It defines the magnitude of social impact on properties and households including PAPs. The main features of the impact assessment on the population and properties along the project roads are summarized here as follows.

- Enumeration of properties reveals an impact on total of **205 properties** (Private, Religious, Community and Government) in project roads due to the implement of project section.
- The total number of private properties to be affected due to the project is estimated to be 170 in number. Out of these private properties, 95 are commercial properties, 14 are res-cum-commercial, 49 are residential, and 8 are others type of properties and 4 are boundary wall.
- As per the initial census survey of affected properties as many as **170 households** will be affected
- The analysis of the census survey shows that all the affected 170 households comprise of **1083 PAPs**, who will be affected directly or indirectly by the project within the corridor of impact.
- Out of total PAHs (170), 4.12% belong to Schedule Caste (SC), 1.18% belongs to Schedule Tribe (ST), 79.41% belongs to Other Backward Class, 8.24% belongs to General category followed by 7.06% which belongs to (NA).
- The project will effect on the source of income of project affected households who are mainly involved agriculture and business activities.
- Total 305.636 hectares land to be acquired in which 268.98 hectares are private.

The R&R budget for the widening of existing road worked out approximately is **Rs. 316.99 Crores** which includes the cost of land and structures, relocation or enhancement of religious, government and community structures and R& R Assistance given to affected people.

**Table 1 - 38 Summary of Social Impacts**

| Sl. No. | Impacts | Number |
|---|---|---|
| 1 | Total land acquisition including Govt. Land (in hectare) | 36.656 |
| 2 | Total private land acquisition requirements (in hectare) | 268.980 |
| 3 | Total number of structures affected of all categories ( Private+ Government.+ Religious + Community) | 205 |
| 4 | Total Number of SC(7) /ST (2) households affected | 9 |
| 5 | Total number of Affected persons (APs) | 1083 |
| 6 | Total number of private structures affected [TH(114) +NTH (56)] | 170 |
| 7 | Total number of Govt. properties | 21 |
| 8 | Total number of CPRs including Religious properties affected | 11 |
| 9 | Fully Displaced | 170 |
| 10 | Losing Primary source of Income (Land Owner) 0 + Commercial structure owner (TH) | 72 |
| 11 | Losing Residential Structures (TH) | 31 |

*Source: Census Survey, ICT New Delhi 2018*

## 8.0 DIVERSION OF FOREST LAND

Total Forest land required to be diverted for the proposed project is approx. **10.889 ha, out of which 1.9093 ha is located in Balaghat District of Madhya Pradesh and 8.9797 ha land is located in Gondia district of Maharashtra**. Total length of forest in Madhya Pradesh is 0.500 km and length of forest in Maharashtra is 1.885 km. Details of forest land to be diverted is presented in **Table 1-39**.

**Table 1 - 39 Details of Forest Land to be diverted in Madhya Pradesh and Maharashtra**

| Package | District | Tehsil | Village | Area (Ha) | Status | Division | Chainage From | Chainage To | Length (m) |
|---|---|---|---|---|---|---|---|---|---|
| **Forest land to be diverted in the State of Madhya Pradesh** | | | | | | | | | |
| Package 1A | Balaghat | Lalbarra | Manjhapur | 0.1357 | RF | South Balaghat | 02+282 | 02+412 | 130 |
| | | | Garra | 0.0496 | RF | | 02+412 | 02+467 | 55 |
| | | | Garra | 0.7497 | Forest | | 05+491 | 05+600 | 109 |
| | | | Garra | 0.9264 | Forest | | 05+600 | 05+748 | 148 |
| | | Waraseoni | Jagpur | 0.0479 | RF | | 09+068 | 09+126 | 58 |
| | | | ***Sub Total (A)*** | ***1.9093*** | | | | | ***500*** |
| **Forest land to be diverted in the State of Maharashtra** | | | | | | | | | |
| Package 1B | Gondia | Gondia | Changera | 0.5651 | Zupdi Jungle | Gondia | 32+976 | 33+116 | 140 |
| | | | | 0.8758 | | | 33+116 | 33+318 | 202 |
| | | | | 0.0184 | | | 33+100 | 33+228 | 128 |
| | | | | 0.9675 | | | 34+240 | 34+356 | 116 |
| | | | | 1.8886 | | | 34+365 | 34+713 | 348 |
| | | | | 0.2607 | | | 34+447 | 34+547 | 100 |
| | | | | 0.0137 | | | 34+528 | 34+547 | 19 |

| Package | District | Tehsil | Village | Area (Ha) | Status | Division | Chainage From | Chainage To | Length (m) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 0.3978 | | | 34+547 | 34+629 | 82 |
| | | | | 0.1836 | | | 34+629 | 34+713 | 84 |
| | | | Murpur | 0.1251 | | | 38+349 | 38+424 | 75 |
| | | | | 0.1137 | | | 38+782 | 38+794 | 12 |
| | | | | 0.2177 | | | 39+408 | 39+441 | 33 |
| | | | Rawanwadi | 1.6377 | | | 39+441 | 39+673 | 232 |
| | | | | 0.9848 | | | 39+700 | 39+885 | 185 |
| | | | | 0.2896 | | | 39+770 | 39+838 | 68 |
| | | | Lodhitola | 0.4399 | | | 40+924 | 40+985 | 61 |
| | | | | ***Sub Total (B)*** | ***8.9797*** | | | | ***1885*** |
| | | | | **Grand Total (A + B)** | **10.889** | | | | **2385** |

*Note: * area has been calculated based on available Land Acquisition Plan (LAP); may get changed after physical demarcation of forest land during joint survey.*

## 9.0 COST ESTIMATE

Total project cost is **Rs. 1,099.22 Crore** and total cost includes contingencies, supervision charges, administrative charges, cost of resettlement and rehabilitation, land acquisition cost, environmental cost and shifting of utilities. The Civil Cost and Total Project Cost are presented in **Table 1-40**.

**Table 1 - 40 Package wise Civil Cost and Total Project Cost**

| Sl. No. | Description | Part-I MP Section (Km 0+000 to 29+600) | Part-II MH Section (Km 29+600 to 48+070) | Total (MP+MH) 48.070 Km |
|---|---|---|---|---|
| | | **Amount (Rs.)** | **Amount (Rs.)** | **Amount (Rs.)** |
| A) | **Total Civil Cost** | 4,572,693,238.00 | 2,491,902,679.00 | 7,064,595,917.00 |
| B) | Add Contingencies @ 3% on (A) | 137,180,797.00 | 74,757,080.00 | 211,937,878.00 |
| C) | Construction Supervision Charges @ 3% on (A) | 137,180,797.00 | 74,757,080.00 | 211,937,878.00 |
| | **Sub Total (A+B+C)** | 4,847,054,832.00 | 2,641,416,839.00 | 7,488,471,673.00 |
| D) | Resettlement and Rehabilitation costs I/C Land | 1,951,925,109.22 | 1,217,974,890.78 | 3,169,900,000.00 |
| E) | Environment cost | 71,742,000.00 | 50,181,400.00 | 121,923,400.00 |
| F) | Shifting of utilities | 137,180,797.00 | 74,757,080.00 | 211,937,878.00 |
| | **GRAND TOTAL (A+B+C+D+E+F)** | **7,007,902,738.22** | **3,984,330,209.78** | **10,992,232,951.00** |
| | | ***Rs. 700.79 Crore*** | ***Rs. 398.43 Crore*** | ***Rs. 1099.22 Crore*** |
| | **Per km Cost in Crores** | **23.68** | **21.57** | **22.87** |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

## 10.0 ECONOMIC AND SENSITIVITY ANALYSIS

The **Economic Analysis** has been carried out for appreciating the viability of proposed investment in the improvement of the project road and are presented in **Table 1-41.**

**Table 1 - 41 Results of Economic Analysis**

| Project Name | EIRR (%) | NPV (Rs. in million) |
|---|---|---|
| Balaghat Gondia Section of NH-543 | 5.77 | -2503.29 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

**Sensitivity Analysis:** Sensitivity Analysis or 'What if Analysis' is done to check the robustness of the project under various adverse conditions and its effect on economic viability of the project due to change in the level of the key input factors, including construction cost, variation in traffic etc. The sensitivity of the EIRR and NPV has been studied under the following change in conditions are presented in **Table 1-42.**

Scenario – I : Base Costs + 15% and Base Benefits
Scenario – II : Base Costs + Base Benefits - 15%
Scenario – III : Base Costs + 15% and Base Benefits - 15%

**Table 1 - 42 Results of Sensitivity Analysis**

| Description | EIRR (%) |
|---|---|
| Scenario – I | 4.28 |
| Scenario – II | 4.10 |
| Scenario – III | 2.73 |

*Source: Feasibility Study carried out by ICT Pvt. Ltd., New Delhi*

***Conclusion:*** From the above tabulated results of economic and Sensitivity analysis, it can be observed that, the project is not economically viable considering the tangible benefits of savings in Vehicle Operating Cost and Travel Time. This is due to low volume of initial traffic as it reaches the Design Service Volume of 4-lane only by 2031 i.e. after 10 years of opening in the first homogenous section. In the second homogeneous section though the initial volume is about 13,000PCUs but in terms of absolute numbers about 75% of it is two wheelers which have short trip length and hence do not contribute significantly to the tangible benefits of the project.
However, the Implementation of the project road is highly desirable for the economic development of the region considering the stretch as feeder route for the economic corridor and macro level as well. Hence, development of the project roads should be taken up for implementation without any delay in view of full realization of benefits to the road users and the community along the Project influence area.

## 11.0 FINANCIAL ANALYSIS

Financial Analysis of the project road has been carried out for concession period of 15 years on Hybrid Annuity mode. The results of analysis are given in **Table 1-43**.

**Table 1 - 43 Results of Financial Analysis**

| | |
|---|---|
| Base Civil Construction Cost | Rs. 706.46 Crore |
| Civil Construction Cost escalated upto bid due date | Rs. 706.46 Crore |
| Estimated Project Cost | Rs. 746.22 Crore |

| | |
|---|---|
| % of basic CCC to EPC | 5.63% |
| Estimated Bid Project Cost | Rs. 881.15 Crore |
| Estimated Project Life Cycle Cost | Rs. 872.67 Crore |
| Variation in Estimated Project Cost | 18.08% |
| Equity IRR | 15.00% |
| Project IRR | 12.90% |
| NPV of Equity IRR | Rs. 23.60 Crore |
| NPV of Project IRR | Rs. 15.30 Crore |
| NPV of Gross Revenue of the Concessionaire (Annuity + O&M) | Rs. 508.83 Crore |
| Average Debt Service Coverage Ratio | 1.46 |
| First Year O&M Cost | 10.74 |

Based on the Financial Analysis carried out, the following conclusion can be made:

- The Estimated Bid Project Cost as per HAM Mode of Implementation would be **Rs. 881.15 Crore** with a construction period of **24 months** and concession period of 15 years (excluding construction period). The project IRR is about 12.90% in hybrid annuity mode with concession period of 15 years. Hence, the Project is viable as per HAM).

## 12.0 PROJECT BENEFIT

Direct Benefits: Major benefits that are likely to accrue from the project road include:

- Stimulus for further development in the region along with increase in employment opportunities;
- Improved road network benefiting the local people including businessmen, traders, merchant, tourists and long distance motorists;
- Reduction in travel time, distance as well as transportation cost will be reduced;
- Boost for socio-economic and tourism development along the project road;
- Income of vulnerable and poor people will be increased;
- Facilitate the provision of extension and social services by the government, NGOs and other voluntary institutions;
- Possible employment of semi-skilled and unskilled people living along the project road alignment and its adjoining villages during the construction and operational period; and
- Better driving conditions and road safety.

***Indirect Benefits:*** As quantified above, the most direct beneficiaries of this project roads are road users, i.e., the population living along project road, vehicle owners, as well as passengers traveling in private and public transport etc.. There will be benefit from reduced transportation costs and travel times between the connected cities and regions, and much improved traveling comfort. However, the communities located along the project corridor will also get economic benefit indirectly mainly because of two main reasons;

a) During the construction period a large number of skilled and unskilled workers will be employed by private contractors, resulting in important income generation. Unskilled workers will be recruited from the area for physical works, resulting in direct income generation for this group in the area of the project road.

b) Private contractors and consultants will get benefit from the contracts that will arise from project execution and from the subsequent operation and maintenance of these roads. Both women and men are expected to benefit from the improved mobility, safety and access to markets and services along the project corridor. However, in terms of safety benefits women and children will be benefitted from the increased pedestrian safety generated by the project, since they tend to constitute the majority of pedestrians in settlements along the project road, in order to access social services, markets and shopping stores. On the other hand, men will mostly benefit from those road safety improvements that address safety risks for drivers and vehicle occupants, which in their majority are men.

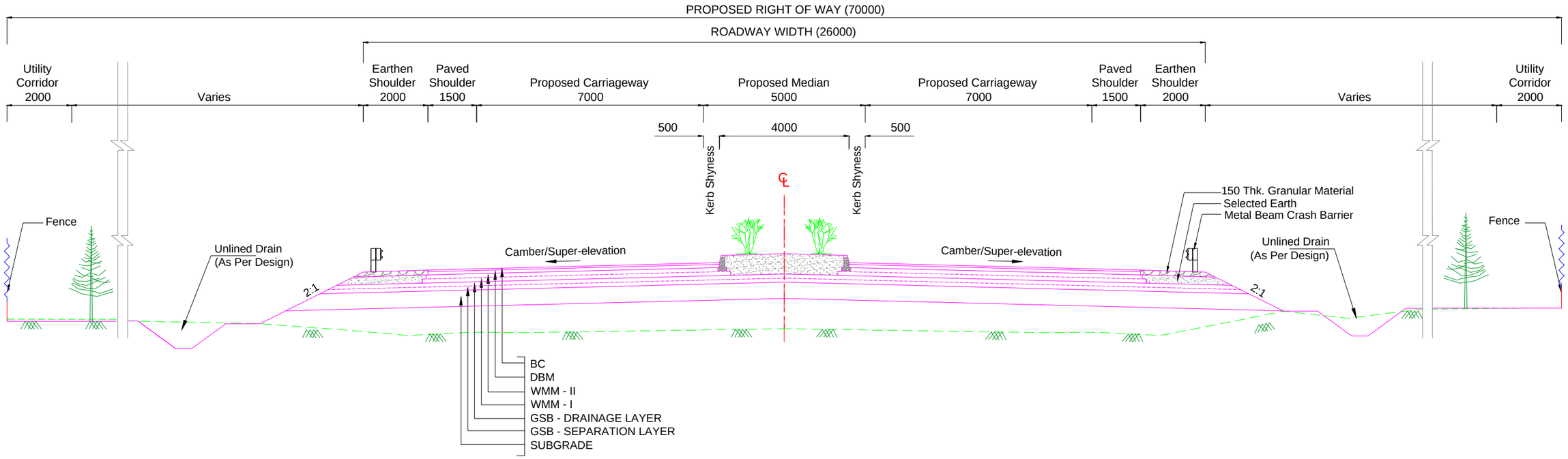
Finally, specific beneficiaries will include the rural and urban poor, unemployed, small and petty traders, shop owners, chemists, medical practitioners, fertilizer agents, fruit and vegetable sellers, tea stalls, hotels, restaurants, Dhabas, tyre repairing and mechanics shops, garages, godowns, vendors, hawkers, kiosks, rural artisans, farmers, cultivators, industrial workers and women etc.

## 13.0 CONCLUSIONS AND RECOMMENDATION

Based on the findings of this study the following recommendations are made:

- Due to presence of ribbon development along existing road improvement will involve large scale demolition of private as well as religious and government structures. Considering this facts, a total length of 28.155 km bypass and realignment has been recommended.
- The projected traffic is connecting National Highways as well as two states. Considering the existing Industries and their growth trend, the project road has been recommended for up-gradation to 4 lane standards at the opening year.
- Based on the LCCA flexible pavement has been recommended.
- A conventional pavement material of BC, DBM, WMM and GSB is recommended on slip road.
- 26 Bus bays (13 Locations) on the project road has been recommended to address the need of the people living along the stretch.
- To facilitate the truck traffic truck lay bye near proposed toll plaza is necessary for this industrial area and two lay byes have been proposed.
- The project road is recommended to be implemented under Hybrid Annuity Mode (HAM) mode under Govt. of India funding.

**********

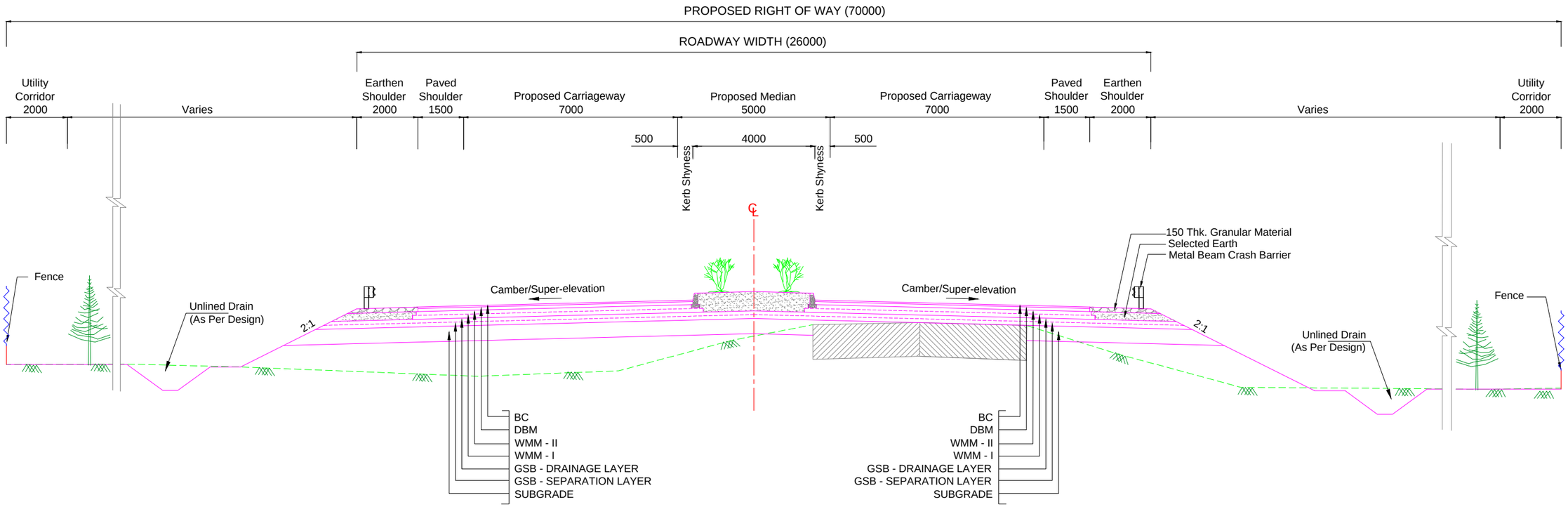



# TCS - 1
## 4 LANE DIVIDED CARRIAGEWAY (RURAL SECTION - BYPASS / REALIGNMENT / CURVE IMPROVEMENT)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NATIONAL HIGHWAYS AUTHORITY OF INDIA | Scale:- Not to Scale | Project Title :- Four Laning of Balaghat - Gondia section of NH-543 from km 0.000 to km 48.070 (Package-1A & 1B) Under Bharatmala Pariyojana in the State of Madhya Pradesh & Maharashtra (Lot-1/Madhya Pradesh/Package -6) | PACKAGE - I (NH 543) (BALAGHAT - GONDIA) | Drawing Name :- Feasibility Report TYPICAL CROSS SECTION | Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 | HBisht (Prepared by) | Jogesh (Designed by) | B.K.Swain (Checked by) | Sanjay Singh (Approved by) | R0 \| November - 2018 \| Initial Drawing<br>Revisions \| Date \| Description \| Checked by<br>Revisions Rev. R0<br>DRAWING No: NHAI/LEEP/MP-6/BAL-GON/TCS/ 01<br>Paper Size A2 Sheet |



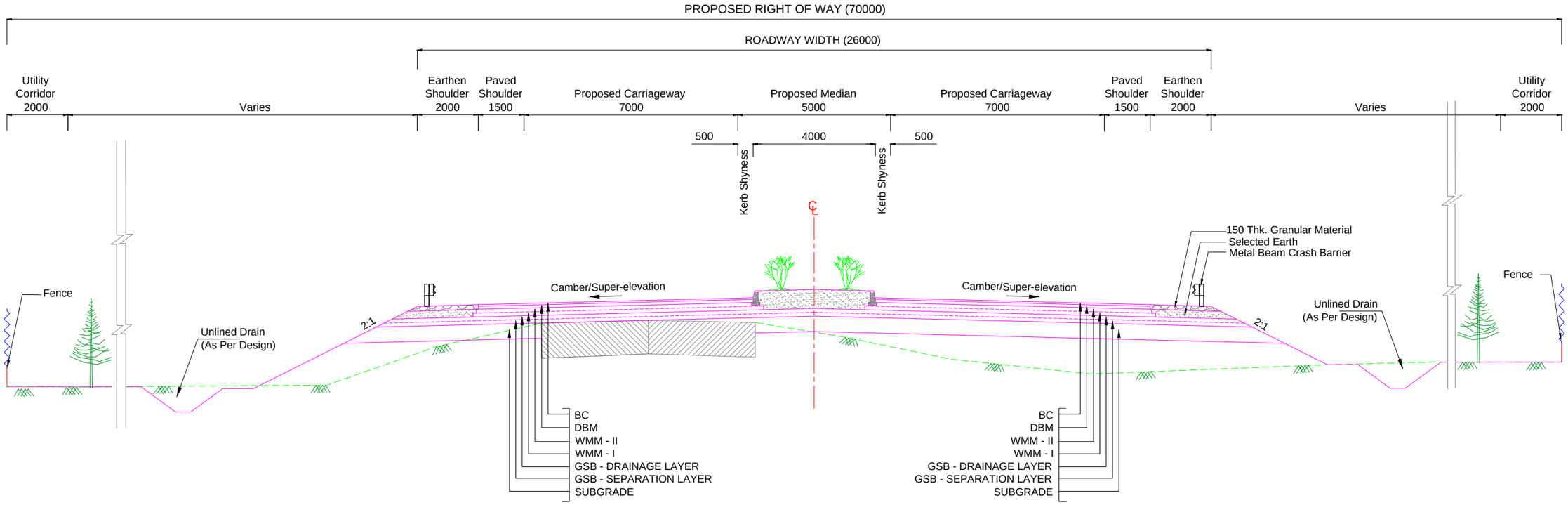

TCS - 2

4 LANE DIVIDED CARRIAGEWAY (RECONSTRUCTION - LEFT SIDE WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NATIONAL HIGHWAYS AUTHORITY OF INDIA | Scale:- Not to Scale | Project Title :- Four Laning of Balaghat - Gondia section of NH-543 from km 0.000 to km 48.070 (Package-1A & 1B) Under Bharatmala Pariyojana in the State of Madhya Pradesh & Maharashtra (Lot-1/Madhya Pradesh/Package -6) | PACKAGE - I (NH 543) (BALAGHAT - GONDIA) | Drawing Name :- Feasibility Report TYPICAL CROSS SECTION | Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 | HBisht (Prepared by) | Jogesh (Designed by) | B.K.Swain (Checked by) | Sanjay Singh (Approved by) | R0 \| November - 2018 \| Initial Drawing<br>Revisions \| Date \| Description \| Checked by<br>Revisions Rev. R0<br>DRAWING No: NHAI/LEEP/MP-6/BAL-GON/TCS/ 02<br>Paper Size A2 Sheet |




TCS - 3

4 LANE DIVIDED CARRIAGEWAY (RECONSTRUCTION - RIGHT SIDE WIDENING)

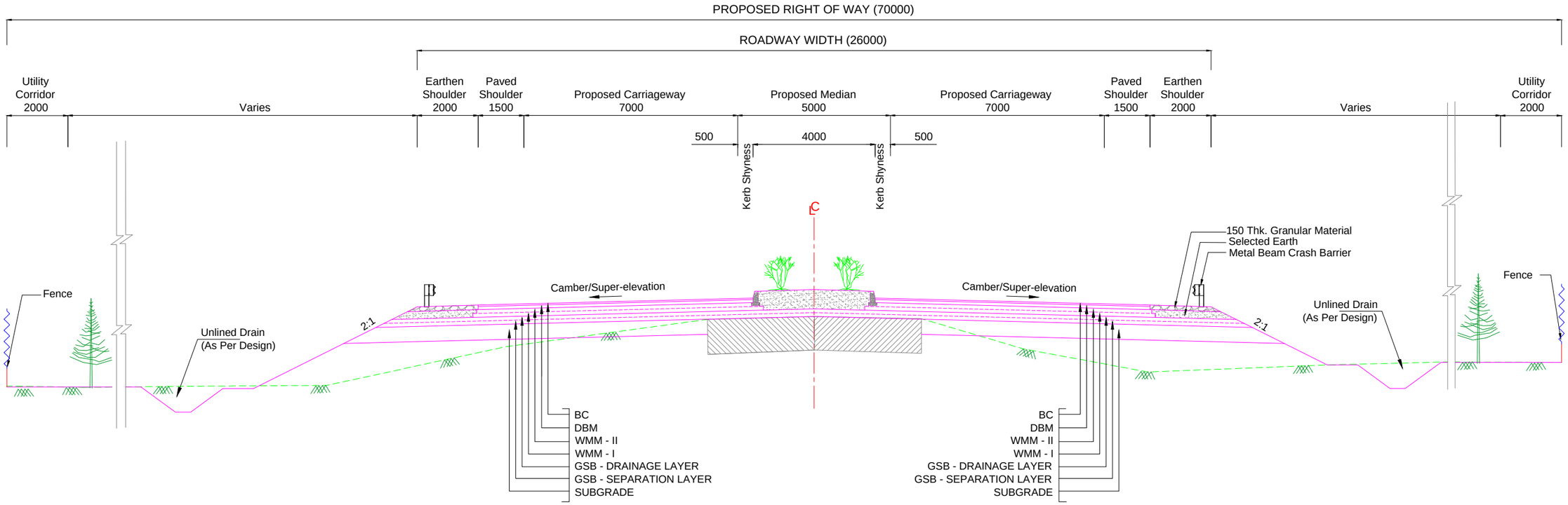
Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be Provided as per Design.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NATIONAL HIGHWAYS AUTHORITY OF INDIA | Scale:- Not to Scale | Project Title :- Four Laning of Balaghat - Gondia section of NH-543 from km 0.000 to km 48.070 (Package-1A & 1B) Under Bharatmala Pariyojana in the State of Madhya Pradesh & Maharashtra (Lot-1/Madhya Pradesh/Package -6) | PACKAGE - I (NH 543) (BALAGHAT - GONDIA) | Drawing Name :- Feasibility Report TYPICAL CROSS SECTION | Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 | HBisht (Prepared by) | Jogesh (Designed by) | B.K.Swain (Checked by) | Sanjay Singh (Approved by) |

| R0 | November - 2018 | Initial Drawing | |
|---|---|---|---|
| Revisions | Date | Description | Checked by |

| Revisions | Rev. |
|---|---|
| DRAWING No: NHAI/LEEP/MP-6/BAL-GON/TCS/ 03 | R0 |
| Paper Size A2 Sheet | |



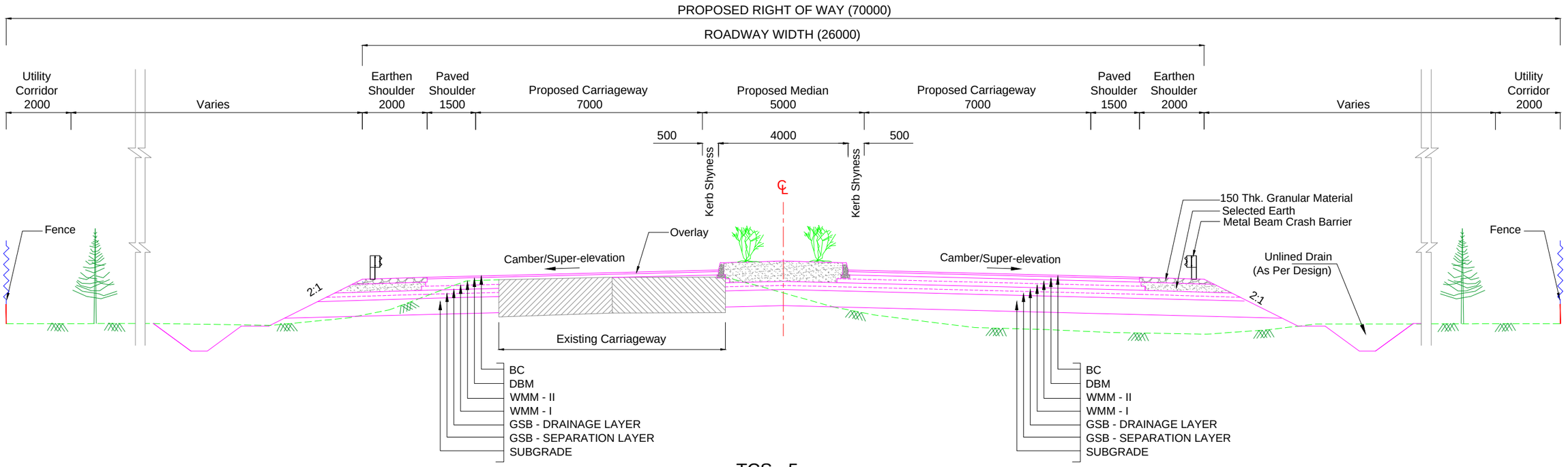

TCS - 4

4 LANE DIVIDED CARRIAGEWAY (RECONSTRUCTION - CONCENTRIC WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NATIONAL HIGHWAYS AUTHORITY OF INDIA | Scale:- Not to Scale | Project Title :- Four Laning of Balaghat - Gondia section of NH-543 from km 0.000 to km 48.070 (Package-1A & 1B) Under Bharatmala Pariyojana in the State of Madhya Pradesh & Maharashtra (Lot-1/Madhya Pradesh/Package -6) | PACKAGE - I (NH 543) (BALAGHAT - GONDIA) | Drawing Name :- Feasibility Report TYPICAL CROSS SECTION | Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 | HBisht Prepared by | Jogesh Designed by | B.K.Swain Checked by | Sanjay Singh Approved by | R0 \| November - 2018 \| Initial Drawing<br>Revisions \| Date \| Description \| Checked by<br>Revisions Rev. R0<br>DRAWING No: NHAI/LEEP/MP-6/BAL-GON/TCS/ 04<br>Paper Size A2 Sheet |



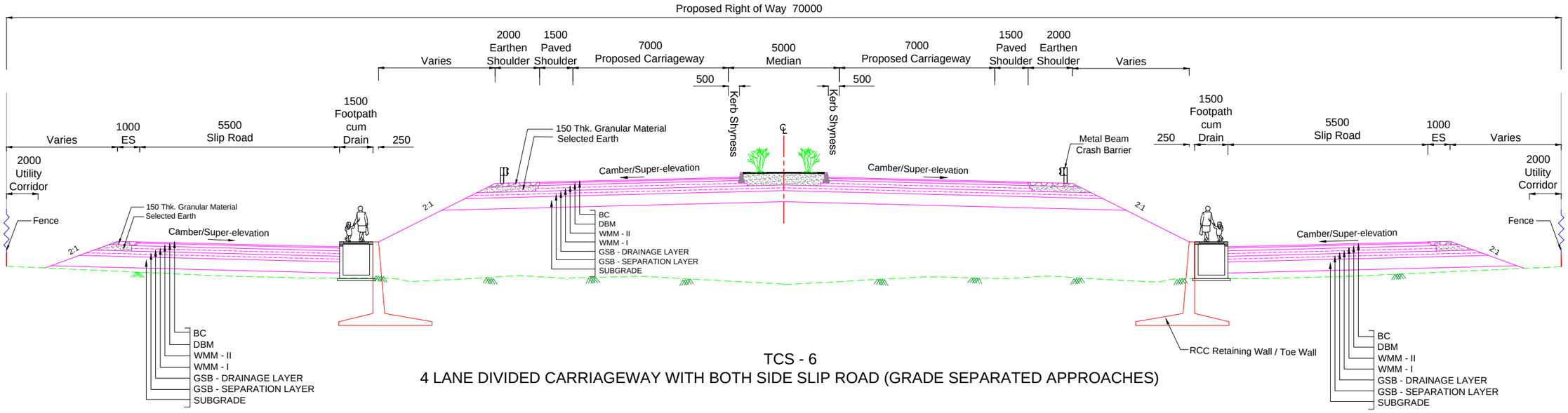

# TCS - 5

## 4 LANE DIVIDED CARRIAGEWAY (OVERLAY - RIGHT SIDE WIDENING)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NATIONAL HIGHWAYS AUTHORITY OF INDIA | Scale:- Not to Scale | Project Title :- Four Laning of Balaghat - Gondia section of NH-543 from km 0.000 to km 48.070 (Package-1A & 1B) Under Bharatmala Pariyojana in the State of Madhya Pradesh & Maharashtra (Lot-1/Madhya Pradesh/Package -6) | PACKAGE - I (NH 543) (BALAGHAT - GONDIA) | Drawing Name :- Feasibility Report TYPICAL CROSS SECTION | Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 | HBisht (Prepared by) | Jogesh (Designed by) | B.K.Swain (Checked by) | Sanjay Singh (Approved by) | R0 \| November - 2018 \| Initial Drawing<br>Revisions \| Date \| Description \| Checked by<br>Revisions Rev. R0<br>DRAWING No: NHAI/LEEP/MP-6/BAL-GON/TCS/ 05<br>Paper Size A2 Sheet |




TCS - 6

4 LANE DIVIDED CARRIAGEWAY WITH BOTH SIDE SLIP ROAD (GRADE SEPARATED APPROACHES)

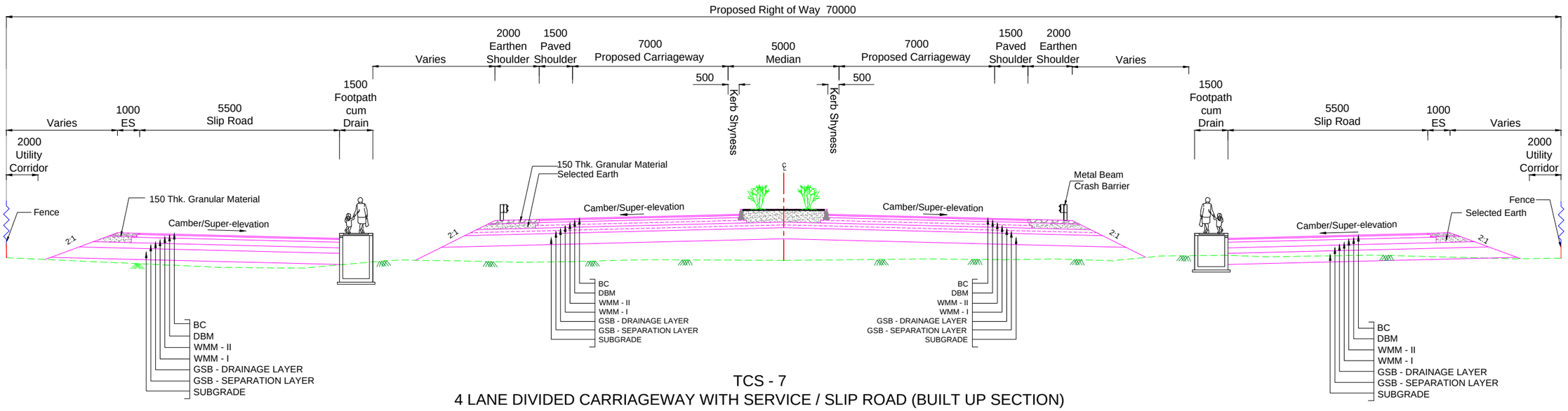
Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be Provided as per Design.
4. Toe Wall/ Retaining wall shall be provided as per Design.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NATIONAL HIGHWAYS AUTHORITY OF INDIA | Scale:- Not to Scale | Project Title :- Four Laning of Balaghat - Gondia section of NH-543 from km 0.000 to km 48.070 (Package-1A & 1B) Under Bharatmala Pariyojana in the State of Madhya Pradesh & Maharashtra (Lot-1/Madhya Pradesh/Package -6) | PACKAGE - I (NH 543) (BALAGHAT - GONDIA) | Drawing Name :- Feasibility Report TYPICAL CROSS SECTION | Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 | | | |
| | | | | | HBisht | Jogesh | B.K.Swain | Sanjay Singh |
| | | | | | Prepared by | Designed by | Checked by | Approved by |

| Revisions | Date | Description | Checked by |
|---|---|---|---|
| R0 | November - 2018 | Initial Drawing | |

| Revisions | Rev. |
|---|---|
| DRAWING No: NHAI/LEEP/MP-6/BAL-GON/TCS/ 06 | R0 |
| Paper Size A2 Sheet | |




TCS - 7

4 LANE DIVIDED CARRIAGEWAY WITH SERVICE / SLIP ROAD (BUILT UP SECTION)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provide as per Design.

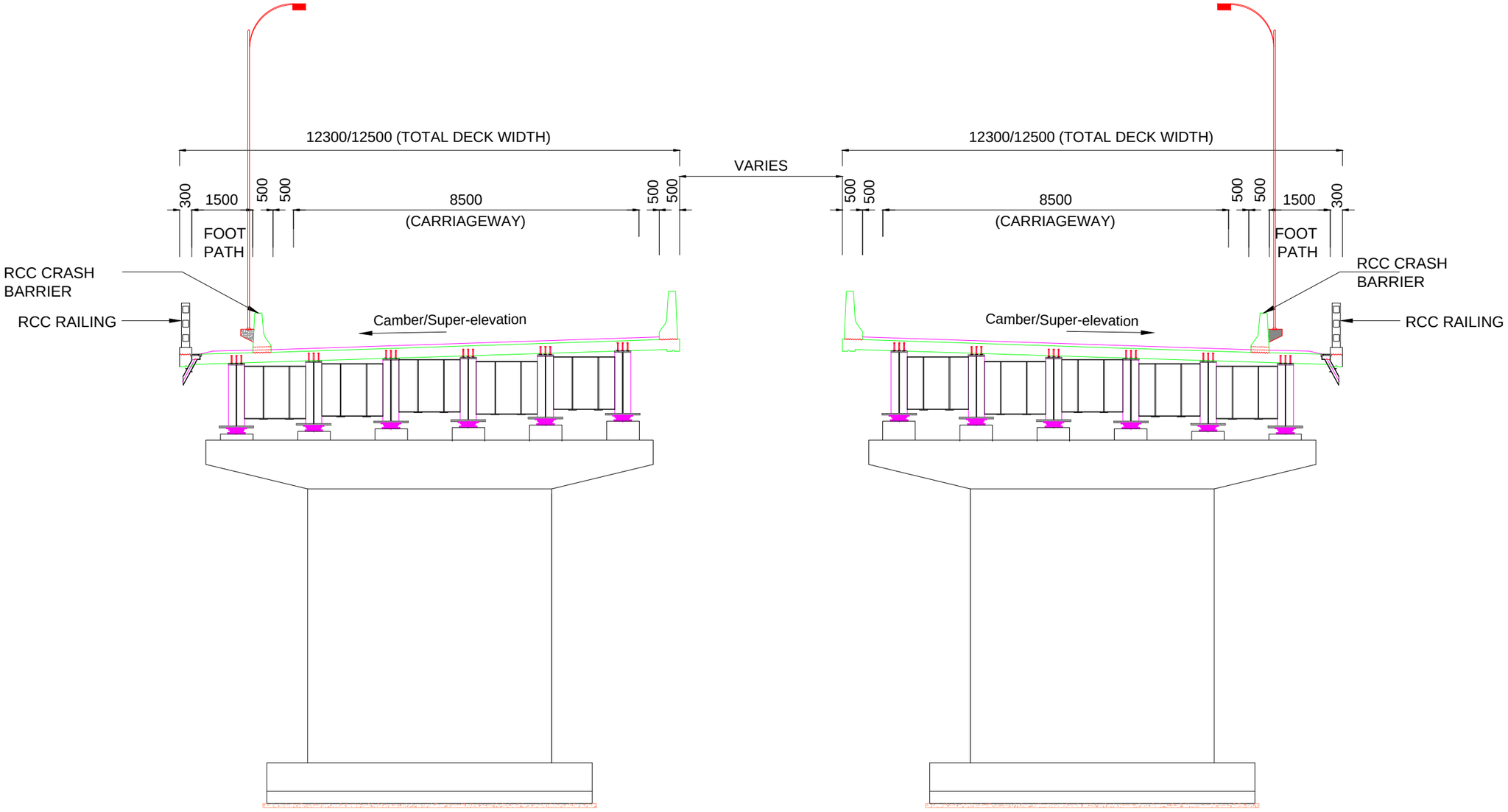
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NATIONAL HIGHWAYS AUTHORITY OF INDIA | Scale:- Not to Scale | Project Title :- Four Laning of Balaghat - Gondia section of NH-543 from km 0.000 to km 48.070 (Package-1A & 1B) Under Bharatmala Pariyojana in the State of Madhya Pradesh & Maharashtra (Lot-1/Madhya Pradesh/Package -6) | PACKAGE - I (NH 543) (BALAGHAT - GONDIA) | Drawing Name :- Feasibility Report TYPICAL CROSS SECTION | Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 | HBisht (Prepared by) | Jogesh (Designed by) | B.K.Swain (Checked by) | Sanjay Singh (Approved by) |

| Revisions | Date | Description | Checked by |
|---|---|---|---|
| R0 | November - 2018 | Initial Drawing | |

Revisions Rev. R0

DRAWING No: NHAI/LEEP/MP-6/BAL-GON/TCS/ 07

Paper Size A2 Sheet

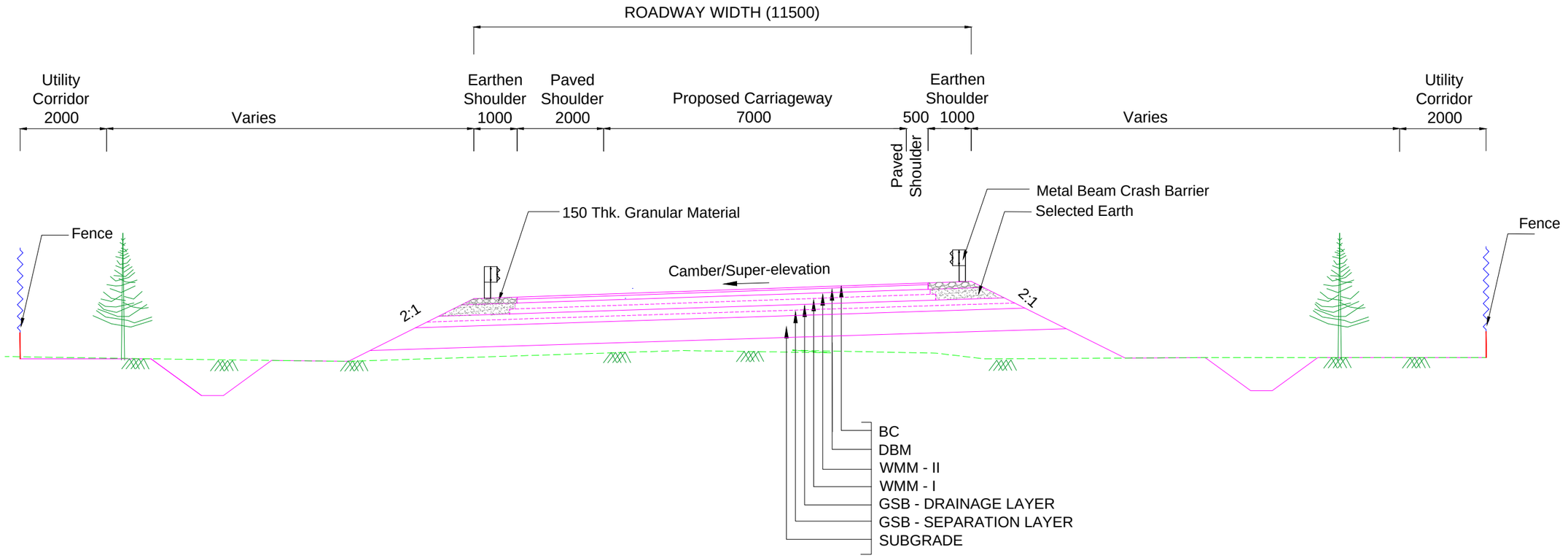



# TCS - 8
# 4 LANE DIVIDED CARRIAGEWAY (ROB)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NATIONAL HIGHWAYS AUTHORITY OF INDIA | Scale:- Not to Scale | Project Title :- Four Laning of Balaghat - Gondia section of NH-543 from km 0.000 to km 48.070 (Package-1A & 1B) Under Bharatmala Pariyojana in the State of Madhya Pradesh & Maharashtra (Lot-1/Madhya Pradesh/Package -6) | PACKAGE - I (NH 543) (BALAGHAT - GONDIA) | Drawing Name :- Feasibility Report TYPICAL CROSS SECTION | Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 | HBisht Prepared by | Jogesh Designed by | B.K.Swain Checked by | Sanjay Singh Approved by | R0 \| November - 2018 \| Initial Drawing<br>Revisions \| Date \| Description \| Checked by<br>Revisions \| Rev.<br>DRAWING No: NHAI/LEEP/MP-6/BAL-GON/TCS/ 08 \| R0<br>Paper Size A2 Sheet |

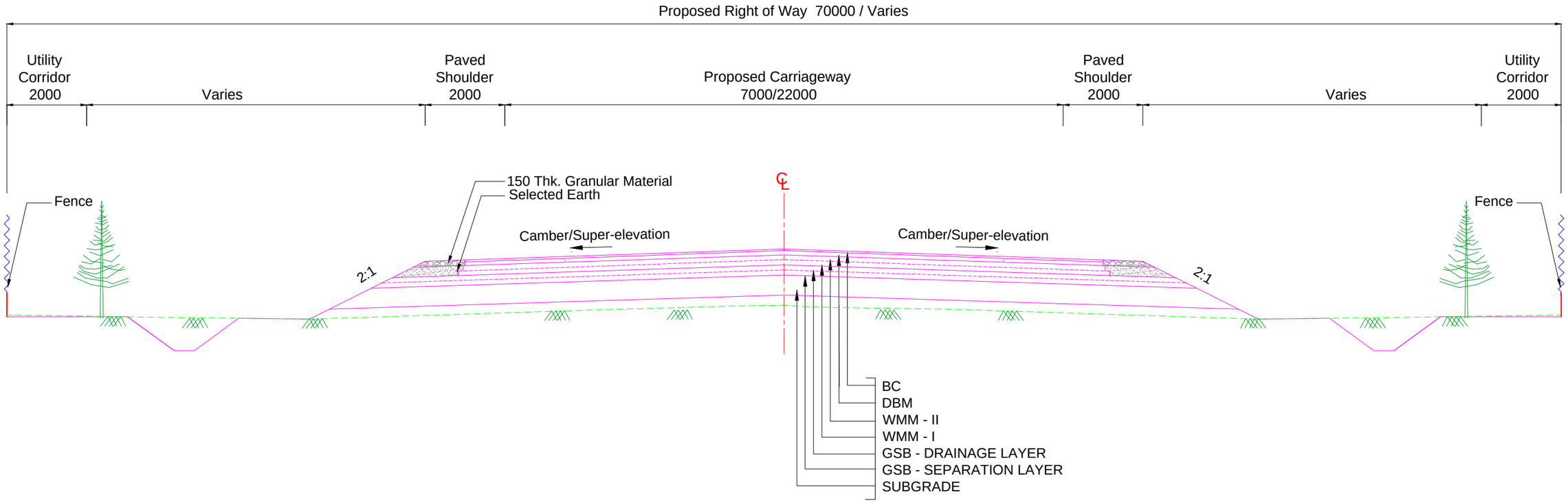



# TCS -9
# 2 LANE SINGLE CARRIAGEWAY (LOOP / RAMP)

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NATIONAL HIGHWAYS AUTHORITY OF INDIA | Scale:- Not to Scale | Project Title :- Four Laning of Balaghat - Gondia section of NH-543 from km 0.000 to km 48.070 (Package-1A & 1B) Under Bharatmala Pariyojana in the State of Madhya Pradesh & Maharashtra (Lot-1/Madhya Pradesh/Package -6) | PACKAGE - I (NH 543) (BALAGHAT - GONDIA) | Drawing Name :- Feasibility Report TYPICAL CROSS SECTION | Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 | | | |
| | | | | | HBisht (Prepared by) | Jogesh (Designed by) | B.K.Swain (Checked by) | Sanjay Singh (Approved by) |
| | | | | | R0 \| November - 2018 \| Initial Drawing | | | |
| | | | | | Revisions \| Date \| Description \| Checked by | | | |
| | | | | | Revisions | | | Rev. |
| | | | | | DRAWING No: NHAI/LEEP/MP-6/BAL-GON/TCS/ 09 | | | R0 |
| | | | | | Paper Size A2 Sheet | | | |




# TCS -10
# MERGING SECTION

Notes :-

1. All Dimension Are In mm, Unless Otherwise Specified.
2. At Super Elevation Section, The Value of "e" Shall be As Per Design.
3. Metal Beam Crash Barrier shall be provided as per Design.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NATIONAL HIGHWAYS AUTHORITY OF INDIA | Scale:- Not to Scale | Project Title :- Four Laning of Balaghat - Gondia section of NH-543 from km 0.000 to km 48.070 (Package-1A & 1B) Under Bharatmala Pariyojana in the State of Madhya Pradesh & Maharashtra (Lot-1/Madhya Pradesh/Package -6) | PACKAGE - I (NH 543) (BALAGHAT - GONDIA) | Drawing Name :- Feasibility Report TYPICAL CROSS SECTION | Intercontinental Consultants & Technocrats Pvt Ltd, A-8, Green Park, New Delhi - 110016 Ph : 4086-3000, Fax 2685-5252 | | | |
| | | | | | HBisht | Jogesh | B.K.Swain | Sanjay Singh |
| | | | | | Prepared by | Designed by | Checked by | Approved by |

| Revisions | Date | Description | Checked by |
|---|---|---|---|
| R0 | November - 2018 | Initial Drawing | |

Revisions Rev. R0

DRAWING No: NHAI/LEEP/MP-6/BAL-GON/TCS/ 10

Paper Size A2 Sheet