Compliances to the Comments

- Submit detailed list of all prior online / offline forest diversion proposal of RCD, Jharkhand in the State mentioning proposal no. and area involved.

  Attached Herewith as annexure-1

- This proposal for diversion has been submitted from 8.0 to 34.700 Km. for 20.695 ha. area. Whereas in justification D.(i) it is mentioned that project is sanctioned from 0.00 to 46.600 km – 26.9246 ha. The guideline prescribes that in case of linear projects the proposal should be processed in their entirety.

  The project length is from Km 0.00 to Km 46.600, road length

  From Km 0.00 to Km 8.200 falls under the Chatra South Forest division falls under the jurisdiction of Chatra Road Construction Division Chatra, Proposal for part 1 already submitted (Proposal No. FP/JH/ROAD/8477/2014)

  From Km 8.200 to Km 34.700 falls under the Hazaribagh Wildlife Division under the jurisdiction of Chatra Road Construction Division Chatra, the present proposal submitted for this section

  From Km 34.700 to Km 46.600 falls under the Medininnagar Forest Division under the jurisdiction of Medininagar Road Construction Division Medininagar, Proposal for part 3 already submitted (Proposal No. FP/JH/ROAD/8650/2014)

- Please, submit a map indicating alignment of the entire project and highlight / mark the portions passing through forest land.

  Attached as annexure-2

- A write-up on salient feature of the entire project and details of approval already obtained or sought under the project.

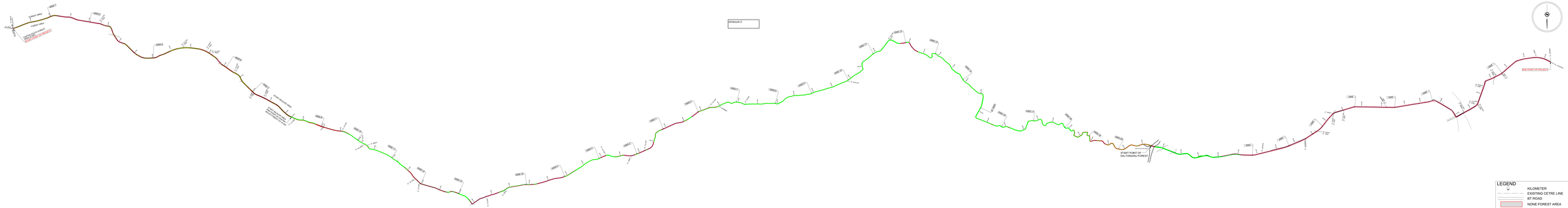
  Attached as annexure-3

  After receipt of the above, this proposal will be scrutinized for

Annexure-1

Proposal submitted by SHAJ			
Sr. No.	**Road Name**	**User Agency**	Proposal No.
1	Deoghar Madhupr Via Maohanpur Road	SHAJ	FP/JH/Road/20472/2016
2	Deoghar Satsangnagar Bhirkhibad Bengabad Road	SHAJ	FP/JH/ROAD/20658/2016
3	Chhatarpur Japla Road	SHAJ	FP/JH/ROAD/8432/2014
4	Bagramore to Panki Road (Section Km 0/000 to Km 8/200)	SHAJ	FP/JH/ROAD/8477/2014
	Bagramore to Panki Road (Section m 8/200 to 34/700)		FP/JH/ROAD/20565/2016
5	Bagramore to Panki Road (Section Km 34/700 to Km 46/600)	SHAJ	FP/JH/ROAD/8650/2014
6	Khaga Digri Road	SHAJ	FP/JH/ROAD/18350/2016
7	MalicDangal to Upperbandha Road	SHAJ	FP/JH/ROAD/18355/2016
8	Girdhi Gandey Pandedih Road (Section in Giridih District)	SHAJ	FP/JH/ROAD/18301/2016
9	Girdhi Gandey Pandedih Road (Section in Jamtara District)	SHAJ	FP/JH/ROAD/18203/2016
10	Girdhi Gandey Pandedih Road (Section in Deoghar District)	SHAJ	FP/JH/ROAD/18324/2016
13	MDR-86& 83 (Pachamba-JamuaSarwan)\	SHAJ	FP/JH/ROAD/14559/2015

9.9.16


Annexure-2
START POINT OF
GALTHGANJ FOREST
END POINT OF PROJECTS
LEGEND
KILOMETER
EXISTING CETRE LINE
BT ROAD
NONE FOREST AREA
FOREST AREA
PROPOSED ROW

Annexure-3

0.0 Executive Summary

0.1 Prelude

State Highway Authority of Jharkhand, Government of Jharkhand has decided to upgrade the entire single and intermediate lane sections of MDR/SH to two lane/two lane with paved shoulder. The work would be taken up for up gradation on corridor concept. Therefore, corridors include strengthening (in adjoining stretches) in addition to widening to 2 lane / 2 lane with paved shoulder standards in order to have a better facility in a long continuous stretch.

0.2 Scope of Study

The Project has to be completed in three stages as described herein below:

Stage	**Report and Deliverables**	
1	QAP and Inception Report (IR)	Submitted on 29th April 2013 vide letter no SAI/TAD213002/HO/1587/2013
2	Feasibility Report (FR)	
	• Draft Feasibility Report	Submitted on 27th May 2013 vide letter no SAI/TAD213002/HO/2067/2013
	• Final Feasibility Report	Submitted on 28th June 2013 vide letter no SAI/TAD213002/HO/2559/2013
3	Draft Detailed Project Report (DDPR)	Submitted on 21st August 2013 vide letter no SAI/TAD213002/HO/3265/2013

0.3 Socio - Economic Profile

Jharkhand is a state in eastern India. It was carved out of the southern part of Bihar on 15 November 2000. It lies between latitude $22^0$00' and $24^0$37' North and longitude $83^0$15' and $87^0$01' East. Jharkhand shares its boundaries with the states of Bihar to the north, Uttar Pradesh and Chhattisgarh to the west, Odisha to the south, and West Bengal to the east. The geographical area of the state is 30,778 sq mi (79,710 km2) which is 2.4% of the country's total geographic area. It includes the region which is predominately tribal populous.

The industrial city of Ranchi is its capital and Dumka is sub capital while Jamshedpur is the largest and the biggest industrial city of the state. Some of the other major cities and industrial centres are Dhanbad, Bokaro and Hazaribagh. Project road passes through Chatra and palamu districts.

Chatra

Chatra district is located in the Hazaribag plateau. It is bounded by the district of Gaya of Bihar state in the north, Palamu district in the west and Latehar in the South and Koderma and Hazaribag district in the East. It has an area of 3706 sq. km and population of 7,90,680 persons (Census of India, 2001). The district comprises one subdivision and ten development blocks viz. Chatra, Simaria, Patrappur, Huntergunj, Itkhori, Tandwa, Kunda, Lawalong, Giddhor and Pratapgarha.

According to the 2011 census Chatra district has a population of 1,042,304, roughly equal to the nation of Cyprus or the US state of Rhode Island. This gives it a ranking of 434rd in India (out of a total of 640). The district has a population density of 275 inhabitants per square kilometre (710 /sq mi) . Its population growth rate over the decade 2001-2011 was 28.98 %.Chatra has a sex ratio of 951 females for every 1000 males,[6] and a literacy rate of 62.14 %.; The district shares its boundary in north by Aurangabad district(Bihar) and the river son which separates it from the district of Rohat on the east.

Palamu

Palamu district is located in the north-western parts of the state. It Total geographic area of the district is 5044 sq. kms. It has 3 subdivisions viz. Daltonganj Sadar, Hussainabad and Chattarpur. There are ten development blocks in the district.

The District of Palamu lies between $23^0$50' and $24^0$8' north latitude and between $83^0$55' and $84^0$30' east longitude. The altitude of the district is 222.00 mm above mean sea level. . The administrative head quarter is Daltonganj situated on Koel River in east.

Palamu district is primarily rural with the large population still residing in the villages. Agriculture is the main source of economy for the rural people of the district. However, agriculture is mainly for subsistence and is yet to be taken up on a commercial basis due to lack of adequate assured irrigation facility and other infrastructure bottlenecks. The total population of the district as per the 1991 Census has been recorded as 1192801. The total population of the district has increased to 15,33,173 as per 2001 census of which 794880 are male and 738293 are female. Of this, the rural population was recorded at 1434504 and the urban population of 98669. The urban population is mainly concentrated in the two blocks of Daltonganj and Hussainabad and has recorded a population of 94490 and 30013 respectively. The percentage of decadal growth (1991-2001) of the district is 28.52 %. Out of total population of the district, Scheduled Caste consist 27.31% and Scheduled Tribe consist 9.28%. Palamu has a sex ratio of 937:1000. In the rural areas it is 935 females against 1000 males and in the urban areas it is relatively better at 949 females to 1000 males.

0.4 Project Description

Bagramore - Panki ("**Project Road**") is situated at northwestern part of Jharkhand and is a section of **PMGSY and MDR**, having total length of **46.60 Kilometer**. The project road lies between 24°02'N (E) to 84°51' (E) longitude and 24°02' (N) to 84°28' (N) latitude.

There are three well-defined seasons in Jharkhand. The cold-weather season, from November to February, is the most pleasant part of the year. High temperatures in Ranchi in December usually rise from about 70 °F (20 °C) into the low 50^o F (low 10^o C) daily. The hot-weather season lasts from March to mid-June. May, the hottest month, is characterized by daily high temperatures in the upper 90^o F (about 37 °C) and low temperatures in the mid-70^o F (mid-20^o C). Maximum rainfall takes place during the months from July to September that accounts for more than 90% of total rainfall in the state.

The existing carriageway is a generally single-lane bituminous road having 3.0m – 3.5m width with 15 Km of gravel road of intermediate lane width. The existing road has earthen shoulder of about 0.5 m to 1.5 m on either sides of the project road. hence embankment toe and built-up edge has been taken as existing ROW reference.

Table 0.1: Project Road Characteristics

Existing Chainage		Carriageway Width	Surface Type	Shoulder Width	Shoulder Type
Start	End				
0/000	19/900	3.2m to 3.5m	BT	0.5m to 1.5m	ES
19/900	35/400	5.0m to 7.0m	NBT	0.5m to 1.5m	ES
35/400	46/000	2.5m to 3.5m	BT	0.5m to 1.5m	ES
46/000	46/600	7.0m	BT	1.0m	ES

Right of Way boundary pillars were not found during reconnaissance survey on the project road at many locations. As per reconnaissance survey average 10 m ROW available for the entire road except few location i.e. Lowalong due to ribbon development / encroachments along the project road. ROW at these locations varies from 6 to 10 m

During detailed investigation it is observed that Electric power supply line and Telephone line is running parallel and crossing the project road at built-up locations.

0.4.1 Road Junctions

All intersections falling on the project corridor have been studied for the improvement to allow a safe connection to the corridor and minimum interference to the through traffic. The traffic on the connected road for major intersections have been studied and projections have been made for its future development. Before recommending the improvement, all available options in order of their importance as enumerated ahead have been considered:

- At grade Intersections
  - Major junction with channelization of traffic;
  - Minor Junction as 'Left In & Left Out'

Two Major and Sixty minor intersections are proposed to be improved on the project corridor. The details of major intersections are as shown in **Table 0.2**.

Table 0.2: Details of Major Junctions

Sr. No.	Design Chainage	Left / Right / Both Side	Type of Road	Connecting to	Improvement
1	0+000	Both	NH-99	L-Chandva. R-Gaya	Channelized **+**
2	46+187	Both	SH-10	L-Balumath. R-Daltonganj	Channelized **Y**

0.4.2 Bridge & Cross Drainage Structures

There is one major bridge along the dam alignment, four minor bridges and ninety four culverts exist on the project road section.

Table 0.3: Summary of Bridges and CD Woks

Sr. No.	Type	Nos.
1	Major Bridges	01
2	Minor Bridges	04
3	Culverts	94
3.1	Pipe Culverts	56
3.2	Slab Culverts	24
3.3	Buried Culverts	14
	Total	**99**

0.5 Traffic Survey Analysis and Forecast

It is very important, that the existing information on traffic flow, commodity movement and traffic pattern is required in order to assess the traffic behaviour on a project road. To collect such information and to satisfy the Terms of Reference (TOR) and project requirements, following various types of traffic surveys were carried out:

- Classified Traffic Volume Count Survey
- Origin – Destination (OD) Survey and commodity movement Surveys
- Axle Load Spectrum Survey
- Intersection Volume Count Survey
- Speed and Delay Survey

0.5.1 Classified Continuous Volume Count Survey

The objective of classified traffic volume count survey is to estimate traffic intensity on the project road. Classified volume count survey has been carried out at one location.

The traffic is counted in number of vehicles by vehicle category-wise in each direction in a 15-minute interval over 24 Hrs a day for 7 Days. The counts were recorded in the formats as per IRC specifications.

Table 0.4: Summary of Classified Volume Count Survey at all count stations

Sr. No.	Location	ADT (No.)	ADT (PCU)	Directional Distribution (%)		Peak No.	Peak Traffic (Hour)	Peak Traffic (%)
				Up	Dn			
1	Near Lawalong Village (km 13/600)	1440	1309	51.8	48.2	164	09:00-10:00	11.29

0.5.2 Annual Average Daily Traffic (AADT)

The seasonal correction factors are used to convert Average Daily Traffic (ADT) to Annual Average Daily Traffic (AADT). The Annual Average Daily Traffic is presented vide Table below:

Table 0.5: Summary of Annual Average Daily Traffic (AADT)

Sr. No.	Location	Fast Moving Vehicles	Slow Moving Vehicles	Total AADT in Nos.	Total PCU
1	Near Lawalong Village (km 13/600)	1112	443	1556	1338

0.5.3 Turning Movement Count

The intersection volume count surveys at two major intersections have been carried out during identified peak periods for 24 hours. The category-wise traffic is counted for all direction in a 15 - minute interval. The counts were recorded in the specified survey formats.

The survey data have been analysed to obtain the morning and evening peak hours with flow of vehicles in each direction. The summary of peak hour traffic flow through intersections is given in Table below

Table 0.6: Peak Hour Traffic at Intersections

Sr. No.	Name	Chainage (km)	Type of Intersection	Peak Hour	Peak Hour Flow (PCU)		
					Fast	Slow	Total
1	Bagramore Junction	0/000	**+**	08:00-09:00	1658	117	**1775**
2	Panki Junction	46/600	**Y**	10:30-11:30	578	197	**774**

0.5.4 Axle Load Survey

In order to estimate vehicle loading spectrum on project road, and to determine vehicle damage factor for the commercial vehicles, the axle load surveys have been carried out at one identified location. The data collected from the Axle Load Survey has been compiled and analyzed through “Fourth power” pavement damage rule to arrive at the vehicles damage factor (VDF). The survey is analyzed to obtain Vehicle Damage Factor (VDF) and is presented below:

Table 0.7: Adopted VDF by Homogeneous Sections

Sr. No.	To (km)	From (Km)	Adopted VDF				
			LCV (4 tyres)	LCV (6 tyres)	2-Axle	3-Axle	MAV
1	0/000	46/600	0.50	1.50	3.50	3.51	3.50

The cumulative numbers of standard axles have been calculated assuming that the project road will be opened to traffic in the year 2016. Since project road is of two lane carriageway width, for all Homogenous sections. Lane Distribution Factor 0.5 is used for determination of MSA. Design traffic in terms of MSA for 15 year is given in **Table 0.8**.

Table 0.8 : Million Standard Axles (MSA) for New Carriageway Pavement Design

Year	Bagramore to Panki
	Km0/000 - Km 46/600
15 Year	10**

**As per axle load survey, MSA worked out for 15 year is 1. The project road has existing

connectivity with NH-99 and SH-10 which in turns connects to NH-98. Also project road is to be upgraded and developed to State highway/Major District road configuration. Considering above parameters and future importance of the road, minimum **10 MSA** has been adopted for pavement design.

0.5.5 Speed-Delay Survey

Speed and delay survey was carried out to obtain the information on the average journey time, journey speed and running speed of the project road.

Round trip was made on entire project road during identified peak period using new technology vehicle. The survey vehicle was kept to maintain the speed of existing traffic flow. Start time, delay occurred, distance covered and end time were recorded on the specified survey format. The data thus obtained is analyzed and presented below:

Table 0.9 : Summary of Speed-Delay Survey

Direction	**Bagramore to Panki (Km 00/000 to km 46/600)**
Distance Covered (km)	46.60
Average Journey Speed (kmph)	41.05
Average Running Speed (kmph)	44.35
Journey Time (minutes)	62.23
Direction	**Panki to Bagramore (km 46/600 to km 00/000)**
Distance Covered (km)	46.60
Average Journey Speed (kmph)	38.44
Average Running Speed (kmph)	40.12
Journey Time (minutes)	71.80

0.5.6 Growth Rate

The various methods specified vide IRC 108: 1996 are taken in to consideration for arriving at reasonable growth rate for traffic in future. The results of such methods along with proposed growth rate for each type of vehicle are presented vide Table below:

Table 0.10 : Comparative Analysis and Adopted of Growth Rates

Sr. No.	**Method/Model**	**2-Wheelers**	**Car/ Taxi**	**Jeep**	**Bus**	**Trucks**	**Tractor**
		Growth Rate (%)					
1	**Vehicle Registration Method**	10.9	15.7	14.4	4.5	18.3	14.7
2	**Econometric Model IRC-108 (NSDP) Method**	9.3	12.9	12.0	4.4	16.1	12.8
3	**Road Development Plan Vision 2021**						
	India (1981-1996)	-	8.7	-	7.4	8.5	-
Adopted Growth Rate (%)		**9.3**	**12.9**	**12.0**	**5.0***	**16.1**	**12.8**

The comparison of vehicle growth rates by vehicle registration and econometric model is as shown in above table. It is appropriate to use the growth pattern that has emerged out of the economic model. Minimum 5.0%growth rate adopted for all type of vehicles. Hence adopted growth rate for project road is shown in above table**.** Summary of projected traffic based on adopted growth rate is provided in Table given below;

Table 0.11 : Summary of Projected Traffic Volume for Total and Tollable Traffic (Normal Traffic + Diverted traffic + Induced Traffic)

Year	Total Traffic		Tollable Traffic	
	Bagarmore to Panki			
	Km0/000 - Km 46/600			
	(Nos.)	(PCU)	(Nos.)	(PCU)
2013	1715	1735	388	733
2014	1851	1906	439	829
2015	2002	2099	496	940
2016	2170	2317	563	1067
2017	2405	2654	689	1304
2018	2618	2943	783	1483
2019	2838	3249	883	1677
2020	3082	3592	998	1897
2021	3352	3977	1129	2149
2022	3652	4412	1278	2437
2023	3985	4902	1448	2767
2024	4326	5413	1629	3117
2025	4703	5986	1833	3515
2026	5119	6628	2064	3966
2027	5580	7347	2325	4477
2028	6090	8154	2622	5058
2029	6609	8988	2932	5669
2030	7180	9916	3281	6355
2031	7808	10951	3672	7129
2032	8501	12104	4113	7999
2033	9266	13389	4607	8979
2034	10034	14701	5118	9994
2035	10876	16152	5687	11128
2036	11800	17759	6321	12392
2037	12814	19538	7028	13805
2038	13927	21510	7816	15382
2039	15032	23491	8617	16989
2040	16236	25668	9503	18768
2041	17551	28062	10481	20736
2042	18986	30694	11562	22915

0.5.7 Capacity Analysis

For the purpose of augmentation of the facilities and up gradation of the project highway, the design service volume for the plain terrain condition and level of Service B & C is shown in **Table 0.12**.

Table 0.12 : Design Service Volume for Different Lane Configurations

Lane Configuration	Design Service Volume (PCUs per day) *Level of Service B*	Design Service Volume (PCUs per day) *Level of Service C*
Intermediate Lane	6000	8400
2-Lane with 1.5m Earthen Shoulder	15000	21000
2-Lane with 1.5m Paved Shoulder	18000	25200
4-Lane with 1.5m Earthen Shoulder	35000	49000
4-Lane with 1.5m Paved Shoulder	40000	60000

0.6 Lane Requirements

Based on the assessment of the traffic demand on the various homogeneous sections of the Project Highway, the Consultant have carried out detailed option analysis for Two-laning earthen or Two- laning with paved shoulders or four lanning. Based on the estimated Capacity & Design Service Volume, the number of lanes required for the project road is worked out for LOS B & LOS C which is presented in **Table** below.

Table 0.13 : Lanning Requirement for the Project Corridor

Homogeneous Section	Km	Lanning Requirements Year				
		Intermediate lane (LOS B)	2-Lane with Earthen Shoulder (LOS B)	2-Lane with Earthen Shoulder (LOSC)	2-Lane with Paved Shoulder (LOS B)	2-Lane with Paved Shoulder (LOS C)
Bagarmore to Panki	**Km 0/000 - Km 46/600**	Immediate	2026	2029	2035	2038

0.7 Results of Engineering Surveys and Investigations

0.7.1 Pavement Condition

The condition survey of existing pavement includes the assessment of pavement, shoulder, embankment and drainage condition. In pavement condition data regarding pavement distress like cracking, ravelling, potholes are recorded in terms of % of pavement affected. The edge break is measured in length and rutting is measured in mm depth. Shoulder Condition is assessed as a paved/unpaved shoulder, corrugation or ruts development in mm and shoulder edge drop in mm.

Distresses like ravelling, potholes and cracks are found during the investigation along the project road. Fatigue and Sub grade failure are root cause for Cracks and Ruts. Aging of Bitumen and insufficient Bitumen are causes for ravelling. The overall pavement is in fair condition. From km 15/000 to 19/300, the pavement condition is fair with some scattered cracking, potholes and ravelling. From km 19/300 to km36/000 project road is non-bituminous section. From km 36/000 to 46/600 pavement condition is generally fair to poor. Between chainages km 36/000 to km 38/000 and km 43/000 to 44/000, settlement was observed at few locations.

0.7.2 Benkelman Beam Deflection

Structural strength of existing pavement has been assessed by conducting Benkelman beam test as per procedure specified vide IRC 81: 1997 and in accordance with TOR set-forth vide consultancy agreement as well as for identified control sections. On an average, characteristic deflection were noticed in the range of 0.42 to 1.21 mm for the project stretch.

0.7.3 Road Roughness

Roughness test was carried out by a vehicle fitted with ROMDAS. For both up and down directions of existing carriageway the vehicle was driven at 32±1 kmph speed. The readings were recorded at 100 m intervals and then cumulated for every kilometre to obtain IRI. The minimum and maximum RI noticed for each section is presented in Table provided below.

Table 0.14 : Summary of Roughness (mm/km)

Section	Chainage		
	From	To	Average Roughness
1	0/000	20/000	6575
2	20/000	36/000	NBT Section
3	36/000	43/000	8371
4	43/000	46/600	12672

0.7.4 Pavement Investigation

Summary of the existing layer thickness as recorded from test pits are as under:

Table 0.15 : Summary of Crust Thickness in mm

Type of Layer	Range of Pavement Thickness (mm)	
	Maximum	Minimum
Bituminous Top	50	NBT
Base Course	250	170
Total thickness	300	200

0.8 Proposed Design Standards

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

Table 0.16 : Summary of Recommended Design Standard

(i)	Design Speed (Km/hr)		
	Plain /Rolling Terrain Mountainous/Steep Terrain	: :	65 (Ruling), 50(Minimum) 40 (Ruling), 30(Minimum)
(ii)	Level of Service	:	B
(iii)	Roadway Widths (m)	:	12.0m for 2-lanes with Granular Shoulder 13m for 2 lane paved shoulder/drain (inbuilt up areas) 10.0 m for Hilly areas 9.0 m for Wild Life Portion
(iv)	Roadway Elements		

		:	Carriageway • 2-lane- 2X3.5m Paved Shoulder • 2X1.5m in built up areas Paved Shoulder • 2X1.5m in built up areas Unpaved Shoulder- • 2X2.5 m Plain and Rolling terrain • 2X 1.0 m on Hill Side and 2X2.0m on Valley side
(v)	Camber	:	Carriageway/Paved Shoulder- 2.50% Unpaved Shoulder- 3.50%
(vi)	Right of Way	:	30m in general 18m forest areas 12m Wild Life Portion
(vii)	Embankment/ Cutting Slope	:	In filling- 1V: 2 H In cutting- 1V:1H
(viii)	Stopping Sight Distance Intermediate Sight Distance	:	180m for design speed of 100km/hr 120m for design speed of 80 km/hr 90m for design speed of 65 Km /hr 50m for design speed of 50 Km /hr 45m for design speed of 40 Km /hr 30m for design speed of 30 Km /hr 360m for design speed of 100km/hr 240m for design speed of 80 km/hr 180m for design speed of 65 Km /hr 120m for design speed of 50 Km /hr 90m for design speed of 40 Km /hr 60 m for design speed of 30 Km /hr
(ix)	Super-elevation	:	Maximum 5%
(x)	Radii for Horizontal Curves	:	**For Plan and Rolling** Ruling Minimum 155 m Absolute minimum 90 m **For Mountainous and Steep** Ruling Minimum 60 m Absolute minimum 30 m
(xi)	Ruling Gradient	:	3.3% for plain and rolling terrain 7% for hilly terrain
(xii)	Minimum K- factor		
	Summit Curve	:	75 for Design speed of 100 km/hr 35 for Design speed of 80 km/hr 20 for design speed of 65 km/hr 15 for Design speed of 60 km/hr 10 for Design speed of 50 km/hr 5 for Design speed of 40 km/hr 3 for Design speed of 30 km/hr

	Valley Curve	:	42 for Design speed of 100 km/hr 30 for Design speed of 80 km/hr 20 for Design speed of 65 km/hr 15 for Design speed of 60 km/hr 10 for Design speed of 50 km/hr 8 for Design speed of 40 km/hr 5 for Design speed of 30 km/hr
(xiii)	Bridge Clearance		
	Vehicular underpass	:	5.5 m
	Cattle (Camel) and Pedestrian underpass	:	3.0m
(xiv)	Design Flood Frequency		
	Bridges	:	50 years
	Sewers and Ditches	:	10 years
(xv)	Minimum Drainage Channel Width	:	0.60 m

0.9 Improvement Proposals

The improvement proposals for proposed widening include the provisions for the following major items:

a) Widening Proposal
b) Requirement of bypasses and realignment
c) Geometric Improvement Design
d) Proposed Pavement Design & Overlay Design
e) Traffic Control and Safety Measures
f) Bridge and Cross Drainage Structures

0.9.1 Widening Proposal

In order to meet future traffic requirement **(chapter5)** the existing carriageway is proposed to upgrade to achieve high speed of travel with comfort and safety. Concentric widening scheme is followed to minimise land acquisition issues and to ensure maximum utilisation of existing carriageway.

Table 0.17 : Proposed Improvement

Sr. No.	Section (Design Chainage)	Improvement Proposed
1	Bagramore (Ch. 0+000)–Sehda (Ch.8+177)	Two lane with earthen shoulder
2	Km 8+177 to Km 34+815	Two lane with 1.0m earthen shoulder(Wild Life Portion)
3	Km 34+815 to Km 42+400	Two lane with earthen shoulder
4	Barrage (Ch. 42+400 to Ch.43+000)	Existing provisions needs to be retain as Barrage section
5	Barrage to Panki Outskirt (Ch. 43+000) – (Ch.45+750)	Two lane with earthen shoulder
6	Panki Village (Ch. 45+825) –(Ch. 46+187)	Built-up section Two Lane with rigid pavement

0.9.1.1 Typical Cross-sections

Proposed cross-sections along with widening schedule is shown in **Table 0.18** below.

Table 0.18 : Widening Proposal

Sr. No.	Existing Chainage		Design Chainage		Length	Cross Section	Widening	Remarks
	Start	End	Start	End				
1	0/000	1/050	0+000	1+050	1.050	TCS 1	Concentric	
2	1/050	1/150	1+050	1+150	0.100	TCS 2	Eccentric Right	Curve Improvement
3	1/150	2/490	1+150	2+490	1.340	TCS 1	Concentric	
4	2/490	2/600	2+490	2+600	0.110	TCS 4	New Construction	Realignment Curve Improvement
5	2/600	3/020	2+600	3+020	0.420	TCS 3	Reconstruction	Reconstruction from WMM
6	3/020	3/115	3+020	3+115	0.095	TCS 2	Eccentric Right	
7	3/115	3/220	3+115	3+220	0.105	TCS 3	Reconstruction	Reconstruction from WMM
8	3/220	3/300	3+220	3+300	0.080	TCS 2	Eccentric Left	
9	3/300	3/760	3+300	3+760	0.460	TCS 3	Reconstruction	Reconstruction from WMM
10	3/760	4/560	3+760	4+560	0.800	TCS 1	Concentric	
11	4/560	4/680	4+560	4+680	0.120	TCS 2	Eccentric Right	Curve Improvement
12	4/680	4/880	4+680	4+880	0.200	TCS 2	Eccentric Left	Curve Improvement
13	4/880	5/135	4+880	5+135	0.255	TCS 1	Concentric	
14	5/135	5/280	5+135	5+280	0.145	TCS 2	Eccentric Left	Curve Improvement
15	5/280	5/740	5+280	5+740	0.460	TCS 1	Concentric	
16	5/740	5/950	5+740	5+950	0.210	TCS 4	New Construction	Realignment
17	5/950	6/500	5+950	6+500	0.550	TCS 1	Concentric	
18	6/500	6/715	6+500	6+715	0.215	TCS 3	Reconstruction	Reconstruction from WMM
19	6/715	7/020	6+715	7+020	0.305	TCS 1	Concentric	
20	7/020	7/335	7+020	7+335	0.315	TCS 3	Reconstruction	Reconstruction from WMM
21	7/335	7/460	7+335	7+460	0.125	TCS 1	Concentric	
22	7/460	7/610	7+460	7+610	0.150	TCS 4	New Construction	Realignment
23	7/610	7/900	7+610	7+900	0.290	TCS 3	Reconstruction	Cutting
24	7/900	8/177	7+900	8+177	0.277	TCS 1	Concentric	
25	8/177	20/000	8+177	20+000	11.823	TCS-11	Concentric	
26	20/000	30/200	20+000	30+200	10.200	TCS-10	Reconstruction	
27	30/200	32/325	30+200	32+325	2.125	TCS-7	Reconstruction	
28	32/325	32/850	32+325	32+850	0.525	TCS-8	Reconstruction	Cutting
29	32/850	33/200	32+850	33+200	0.350	TCS-9	Reconstruction	Filling
30	33/200	34/500	33+200	34+500	1.300	TCS-10	Reconstruction	
31	34/500	35/000	34+500	35+000	0.500	TCS 4	New Construction	Realignment New Major

Sr. No.	Existing Chainage		Design Chainage		Length	Cross Section	Widening	Remarks
	Start	End	Start	End				
								Bridge on Chako River
32	35/000	35/150	35+000	35+150	0.150	TCS 1	Concentric	
33	35/150	35/535	35+150	35+535	0.385	TCS 3	Reconstruction	Minor Bridge Reconstruction
34	35/535	35/675	35+535	35+675	0.140	TCS 2	Eccentric Right	Curve Improvement
35	35/675	35/950	35+675	35+950	0.275	TCS 3	Reconstruction	Cutting
36	35/950	36/275	35+950	36+275	0.325	TCS 4	New Construction	Realignment
37	36/275	36/370	36+275	36+370	0.095	TCS 1	Concentric	
38	36/370	36/530	36+370	36+530	0.160	TCS 4	New Construction	Realignment
39	36/530	36/680	36+530	36+680	0.150	TCS 2	Eccentric Left	
40	36/680	36/750	36+680	36+750	0.070	TCS 3	Reconstruction	Minor Bridge Reconstruction
41	36/750	37/030	36+750	37+030	0.280	TCS 2	Eccentric Right	
42	37/030	37/130	37+030	37+130	0.100	TCS 3	Reconstruction	Minor Bridge Reconstruction
43	37/130	37/240	37+130	37+240	0.110	TCS 1	Concentric	
44	37/240	37/340	37+240	37+340	0.100	TCS 3	Reconstruction	Minor Bridge Reconstruction
45	37/340	37/800	37+340	37+800	0.460	TCS 2	Eccentric Right	
46	37/800	38/800	37+800	38+800	1.000	TCS 1	Concentric	
47	38/800	38/925	38+800	38+925	0.125	TCS 2	Eccentric Right	
48	38/925	39/150	38+925	39+150	0.225	TCS 1	Concentric	
49	39/150	39/300	39+150	39+300	0.150	TCS 2	Eccentric Left	
50	39/300	39/650	39+300	39+650	0.350	TCS 1	Concentric	
51	39/650	39/715	39+650	39+715	0.065	TCS 3	Reconstruction	Minor Bridge Reconstruction
52	39/715	39/900	39+715	39+900	0.185	TCS 2	Eccentric Right	
53	39/900	42/215	39+900	42+215	2.315	TCS 1	Concentric	
54	42/215	42/430	42+215	42+430	0.215	TCS 4	New Construction	Realignment
55	42/430	43/475	42+430	43+000	0.570	TCS 6	Eccentric Right	High Embankment Section
56	43/475	43/975	43+000	43+500	0.500	TCS 1	Concentric	
57	43/975	46/290	43+500	45+825	2.315	TCS 3	Reconstruction	Reconstruction From GSB
58	46/290	46/662	45+825	46+187	0.372	TCS 5	Concentric	2 Lane CC Pavement in urban area

0.9.2 Requirement of Bypasses and Realignment

The concept of alignment design is to upgrade the project highway within the existing right of way minimise land acquisition, except for locations having inadequate width and where provision of short bypass, alignment corrections, improvement of intersection are considered necessary, practicable and cost effective. These improvement proposals are based on the findings from various engineering features carried out on the project roads such as Reconnaissance Survey, Future traffic requirement, Inventory Data and Pavement Investigations. Bypasses/realignment proposals are also considered, wherever in urban/rural areas, improvement to two lanes of existing road is not possible.
Alignment options are basically divided into two parts:

A. Bypass
B. Realignment

0.9.2.1 Proposals for Bypasses

Consultant has explored the feasibility of the bypass requirement and based on the current traffic and site situation, it is observed that major towns Lowalong & Panki does not warrant for any bypasses. Since project corridor serves connectivity to small agricultural towns, having scattered settlements & forest areas along the corridor and having traffic of about 1440 Nos, hence no bypass is recommended based on techno-economic feasibility.

0.9.2.2 Proposal for Realignments

Consultant has proposed the realignment at following locations to improve the design speed as per proposed design standard.

Sr. No.	Existing Chainage		Design Chainage		Length	Cross Section	Widening	Remarks
	Start	End	Start	End				
1	2/490	2/600	2+490	2+600	0.110	TCS 4	New Construction	Realignment Curve Improvement
2	5/740	5/950	5+740	5+950	0.210	TCS 4		Realignment
3	7/460	7/610	7+460	7+610	0.150	TCS 4		Realignment
4	34/500	35/000	34+500	35+000	0.500	TCS 4		Realignment New Major Bridge on Chako River
5	35/950	36/275	35+950	36+275	0.325	TCS 4		Realignment
6	36/370	36/530	36+370	36+530	0.160	TCS 4		Realignment
7	42/215	42/430	42+215	42+430	0.215	TCS 4		Realignment

0.9.3 Speed Restrictions

As per the proposed design standards project highway should be design with 65km/hr ruling speed and minimum speed of 50km/hr for plain and rolling terrain and 40km/hr ruling speed and minimum speed of 30km/hr in mountainous and steep terrain. Existing geometry of the project highway has been improved to achieve the minimum design speed as per proposed standards except with following locations which are proposed as “Speed

Restriction Zone" and improved with design speed of 50km/hr to 65 km/hr to utilise existing roadway and , to reduce land acquisitions and R&R in the project.

Table 0.19 : Speed Restriction Zone

Design Chainage		Design Speed	Remarks
From	To	Km/hr	
8+200	35+000	20 to 30	Lowalong Wild Life Sanctuary
42+800	43+600	25	Existing Barrage- Junction

0.9.4 Pavement Design

The flexible pavement is adopted for proposed new carriageway, widening and reconstruction. Design period of 15 years considered for new carriageway as well as overlay design. The Pavement improvements proposal for entire project road is presented in **Table**.

Table 0.20 : Improvement Proposal for Pavement

Sr. No.	Homogeneous Section				Improvement Proposal	New Pavement Design					Overlay		Matching of Layers for						
													Widening					Overlay	
	Existing Chainage		Design Chainage																
	From	To	From	To		BC (mm)	DBM (mm)	WMM (mm)	GSB (mm)	SG (mm)	BC (mm)	DBM (mm)	BC (mm)	DBM (mm)	WMM (mm)	GSB (mm)	SG (mm)	BC (mm)	DBM (mm)
1	0/000	1/050	0+000	1+050	Concentric	50	50	250	230	500	50		50	50	250	230		50	
2	1/050	1/150	1+050	1+150	Eccentric Right	50	50	250	230	500	50		50	50	250	230		50	
3	1/150	2/490	1+150	2+490	Concentric	50	50	250	230	500	50		50	50	250	230		50	
4	2/490	2/600	2+490	2+600	New Construction	50	50	250	230	500			50	50	250	230	500		
5	2/600	3/020	2+600	3+020	Reconstruction	50	50	250	230	500			50	50	250	230	500		
6	3/020	3/115	3+020	3+115	Eccentric Right	50	50	250	230	500	50		50	50	250	230		50	
7	3/115	3/220	3+115	3+220	Reconstruction	50	50	250	230	500			50	50	250	230	500		
8	3/220	3/300	3+220	3+300	Eccentric Left	50	50	250	230	500	50		50	50	250	230		50	
9	3/300	3/760	3+300	3+760	Reconstruction	50	50	250	230	500			50	50	250	230	500		
10	3/760	4/560	3+760	4+560	Concentric	50	50	250	230	500	50		50	50	250	230		50	
11	4/560	4/680	4+560	4+680	Eccentric Right	50	50	250	230	500	50		50	50	250	230		50	
12	4/680	4/880	4+680	4+880	Eccentric Left	50	50	250	230	500	50		50	50	250	230		50	
13	4/880	5/135	4+880	5+135	Concentric	50	50	250	230	500	50		50	50	250	230		50	
14	5/135	5/280	5+135	5+280	Eccentric Left	50	50	250	230	500	50		50	50	250	230		50	
15	5/280	5/740	5+280	5+740	Concentric	50	50	250	230	500	50		50	50	250	230		50	
16	5/740	5/950	5+740	5+950	New Construction	50	50	250	230	500			50	50	250	230	500		
17	5/950	6/500	5+950	6+500	Concentric	50	50	250	230	500	50		50	50	250	230		50	
18	6/500	6/715	6+500	6+715	Reconstruction	50	50	250	230	500			50	50	250	230	500		
19	6/715	7/020	6+715	7+020	Concentric	50	50	250	230	500	50		50	50	250	230		50	
20	7/020	7/335	7+020	7+335	Reconstruction	50	50	250	230	500			50	50	250	230	500		
21	7/335	7/460	7+335	7+460	Concentric	50	50	250	230	500	50		50	50	250	230		50	
22	7/460	7/610	7+460	7+610	New Construction	50	50	250	230	500			50	50	250	230	500		
23	7/610	7/900	7+610	7+900	Reconstruction	50	50	250	230	500			50	50	250	230	500		
24	7/900	8/177	7+900	8+177	Concentric	50	50	250	230	500	50		50	50	250	230		50	
25	8/177	20/000	8+177	20+000	Concentric	50	50	250	230	500	50		50	50	250	230		50	
26	20/000	30/200	20+000	30+200	Reconstruction	50	50	250	230	500			50	50	250	230			
27	30/200	32/325	30+200	32+325	Reconstruction	50	50	250	230	500			50	50	250	230			
28	32/325	32/850	32+325	32+850	Reconstruction	50	50	250	230	500			50	50	250	230			
29	32/850	33/200	32+850	33+200	Reconstruction	50	50	250	230	500			50	50	250	230			
30	33/200	34/500	33+200	34+500	Reconstruction	50	50	250	230	500			50	50	250	230			

Sr. No.	Homogeneous Section				Improvement Proposal	New Pavement Design					Overlay		Matching of Layers for						
													Widening					Overlay	
	Existing Chainage		Design Chainage																
	From	To	From	To		BC (mm)	DBM (mm)	WMM (mm)	GSB (mm)	SG (mm)	BC (mm)	DBM (mm)	BC (mm)	DBM (mm)	WMM (mm)	GSB (mm)	SG (mm)	BC (mm)	DBM (mm)
31	34/500	35/000	34+500	35+000	New Construction	50	50	250	230	500			50	50	250	230	500		
32	35/000	35/150	35+000	35+150	Concentric	50	50	250	230	500	50		50	50	250	230		50	
33	35/150	35/535	35+150	35+535	Reconstruction	50	50	250	230	500			50	50	250	230	500		
34	35/535	35/675	35+535	35+675	Eccentric Right	50	50	250	230	500	50		50	50	250	230		50	
35	35/675	35/950	35+675	35+950	Reconstruction	50	50	250	230	500			50	50	250	230	500		
36	35/950	36/275	35+950	36+275	New Construction	50	50	250	230	500			50	50	250	230	500		
37	36/275	36/370	36+275	36+370	Concentric	50	50	250	230	500	50		50	50	250	230		50	
38	36/370	36/530	36+370	36+530	New Construction	50	50	250	230	500			50	50	250	230	500		
39	36/530	36/680	36+530	36+680	Eccentric Left	50	50	250	230	500	50		50	50	250	230		50	
40	36/680	36/750	36+680	36+750	Reconstruction	50	50	250	230	500			50	50	250	230	500		
41	36/750	37/030	36+750	37+030	Eccentric Right	50	50	250	230	500	50		50	50	250	230		50	
42	37/030	37/130	37+030	37+130	Reconstruction	50	50	250	230	500			50	50	250	230	500		
43	37/130	37/240	37+130	37+240	Concentric	50	50	250	230	500	50		50	50	250	230		50	
44	37/240	37/340	37+240	37+340	Reconstruction	50	50	250	230	500			50	50	250	230	500		
45	37/340	37/800	37+340	37+800	Eccentric Right	50	50	250	230	500	50		50	50	250	230		50	
46	37/800	38/800	37+800	38+800	Concentric	50	50	250	230	500	50		50	50	250	230		50	
47	38/800	38/925	38+800	38+925	Eccentric Right	50	50	250	230	500	50		50	50	250	230		50	
48	38/925	39/150	38+925	39+150	Concentric	50	50	250	230	500	50		50	50	250	230		50	
49	39/150	39/300	39+150	39+300	Eccentric Left	50	50	250	230	500	50		50	50	250	230		50	
50	39/300	39/650	39+300	39+650	Concentric	50	50	250	230	500	50		50	50	250	230		50	
51	39/650	39/715	39+650	39+715	Reconstruction	50	50	250	230	500			50	50	250	230	500		
52	39/715	39/900	39+715	39+900	Eccentric Right	50	50	250	230	500	50		50	50	250	230		50	
53	39/900	42/215	39+900	42+215	Concentric	50	50	250	230	500	50		50	50	250	230		50	
54	42/215	42/430	42+215	42+430	New Construction	50	50	250	230	500			50	50	250	230	500		
55	42/430	43/475	42+430	43+000	Eccentric Right	50	50	250	230	500	50		50	50	250	230		50	
56	43/475	43/975	43+000	43+500	Concentric	50	50	250	230	500	50		50	50	250	230		50	
57	43/975	46/290	43+500	45+815	Reconstruction	50	50	250	230	500			50	50	250	230	500		
58	46/290	46/662	45+815	46+187	Concentric	50	50	250	230	500	50		50	50	250	230		50	

0.9.5 Traffic Control and Safety Measures

0.9.5.1 Road Marking & Traffic Signs

Pavement markings are proposed as per IRC: 35-1997, "Code of Practice for Road Marking" with centre-line, edge line, continuity line, stop line, give way lines, diagonal/chevron markings and zebra crossings. The pavement marking shall be of hot applied thermoplastic paint with glass beads as per the MORT&H specification for Road and Bridge Works, 2001(4th Revision, latest reprint).

Appropriate road safety measures are provided with stop signs, give-way signs, traffic merging and diverging signs, lane closure signs, compulsory keep left/right signs or any other signs as per IRC-67. Advance cautionary signs are proposed for sharp curves along with chevron signs at the outer edge of the curves. Over head gantry signs have been proposed at start at the end points of the project road.

0.9.6 Major Bridge/ Minor Bridge & Cross Drainage Structures

0.9.6.1 Bridges

There is one existing Major bridge and four existing minor bridges. During inventory and Condition survey, it was found that Major Bridge is high level. Based on Local depression, few bridges are overtopped and proposed as high level bridges. Along the Project road, to cross of River Chako, CD structures are not present to crossing the River. Hence one major bridge is proposed in River Chako as per hydraulics requirements. The major bridge in river Chako is also falling in Lowalong Wild Life Sanctuary.

The Brief details of improvement proposal for existing bridges are as under:

Table 0.21 : Improvement Proposal for Major CD Structures

Sr. No.	Bridge	Description	No
1	Major	Retained	01
		Reconstruction Proposed	-
		Widening Proposed	-
		New major bridge proposed	01
		Total after improvement	02
2	Minor	Retained	00
		Reconstruction Proposed	02
		Repair and Widening Proposed	02
		Total after improvement	04
		Total Major and Minor Bridges	**06**

All the bridges which are proposed to be widen or reconstructed, will have crash barriers instead of railings / parapets.

0.9.6.2 Culverts

Fully buried culverts are replaced by new box culverts. Pipe culverts having less than 0.9 m dia. of pipe is replaced with pipe culverts having higher diameter. Slab culverts reconstructed with new box culvert with higher vent width for proper clear water way. More

no's of new box culverts are proposed instead of pipe culverts due to clear vent way. Out of 109 total culverts 69 culverts are falling in Lowalong Wild Life Sanctuary, hence total width of these CD structures falling in Lowalong Wild Life Sanctuary, are restricted to 9.0m.

The brief details of Improvement Proposal of Culverts are as under:

Table 0.22 : Improvement Proposal for Culverts

Sr. No.	Details of Improvement Proposed for Culverts	No
1	Culverts Repair & Retained	12
2	Reconstruction proposed	51
3	Repair and Widening proposed	31
4	New culvert proposed	15
	Total Culverts after Improvement	**109**

0.9.7 Provision of New Underpasses, Over Bridges & ROB

Along the project alignment, there is no requirement for proposal of new Flyover, VUP, and ROB.

0.10 Cost Estimate

Preliminary cost estimate for the project Road is finalised based on the improvement proposed. The preliminary cost estimate is worked out based on the block quantities calculated for major items of work to be executed in the project and also rates derived after detail analysis.

Table 0.23 : Cost of Civil Works

Section	Proposed Length (Km)	Base Cost (Rs.)
BagraMore to Panki (Ch 00+000 to 46+187)	46.187	**1,521,025,757/-**.
Total	**46.187**	**1,767,780,506/-**

0.11 Environmental Impact Assessment

Direct impact zone for the project corridor will be within the proposed ROW, although magnitude of indirect impact will varies depending upon location of environmental receptors and type of impact, as a primary requirement of of EIA process, primary baseline data will be collected in the right of way as well as the area falling within 500 meters on either side of the right of way.

The study is carried out as per the requirements stipulated by the Ministry of Environment and Forests, Government of India for Environmental Impact Assessment of Rail / Roads / Highway Projects. Important features from environmental point of view observed along the project road are as mentioned below.

- The project road is situated at North-western part of the State of Jharkhand and is a section of Major District Road (MDR/PMGSY), having total length of 46.6

Kilometre.

- Winter: From mid November to mid February. The temperature falls up to 4oC in the month of December/January. During November and early part of December, the season is pleasantly cool but it becomes severe in the later part of December and whole of January, when occasional frost occurs in this pocket. During February the nights are cold but the days become progressively warmer.
- Summer: From middle of February to middle of June. The temperature progressively rises up to 45^0 C in the month of June. During this period desiccated hot westerly wind locally termed as "Loo" blow over the area and frequently causes sun-strokes.
- Rainy: From the Mid of June to Mid of September. The average rainfall during the season is 900 mm and most of the rainwater is drained out through rivers.
- Autumn: From middle of September to middle of November, the forests are green and pleasant looking.
- Rainfall: Rains occur mostly during the period of southwest monsoon i.e. from June to September. The average yearly rainfall is about 1100 mm in the area.
- Temperature: The temperature in the area varies from a minimum of 50c in the peak of winter to a maximum of 48^0c in the summer.
- Humidity: It varies from a maximum of about 90 percent during monsoon to a minimum of around 10 percent, during March/April of the year.
- Wind: A hot westerly wind generally known as "Loo" blows during the summer months.
- Project road is passing through the lawalong wildlife sanctuary stretches of the sanctuary area will be confirmed with the wildlife division.
  Lawalong Wild Life Sanctuary was constituted vide Bihar Government Notification no. : S.O. – 1077 dated 07-08-1978 under section 18 (1) of wild life (protection) Act, 1972. **The total area of the Sanctuary is 21103.34 Hac.**
- Some part of the project road is passing through the Reserve /protected forest area.
- All along the project road, dense trees are observed. The main tree species observed like Asan, Sidha, Pandan, Siris, Kendu, Salai, Dhaura, Jamun, Bijasal, Gamhar, Mahua, Bhelwa, Beri, etc. Depending upon the widening of road, some trees may be affected..
- The common wild animals in the regions are *Tiger, Leopard, Cheetal, Barking Deer, Sambhar, Wild Boar, Neelgai, Langur, Gaur, Wolf Elephant, Wild Dog, Sloth Bear, Rhesus Monkey, Black Buck* etc. Leopard & deer species are the main species of vital importance.

0.12 Social Screening

Execution of the project shall have direct impact on people. It is therefore necessary to undertake Social Impact Assessment (SIA) study for the project to assess the potential critical impact of the project on community in order to suggest mitigation measures, which are required to be incorporated during the planning stage. Social Impact Assessment and Management Plan shall be prepared in conformity with TOR.

Purpose of Social Impact Assessment preparation is to establish the baseline social aspects of the project road and to analyze all the expected impacts, required avoidance and the possible cost effective mitigation measures. Further these mitigation measures need to be stream lined with the engineering design and the contracting process for effective implementation.

It was seen that the project road passes through few settlements and congested areas. It is quite likely that for rehabilitation and upgrading of the project road, many properties of cultural importance, community use and of importance as water resources (schools, temples, wells, bus-stops, hand pumps, Mosques etc) are likely to be affected. These properties will be required to relocate/ resettle and rehabilitate.

0.13 List Clearances Required for the Project

Following clearances are required before the commencement of construction work. Out of these, few are critical and need to be obtained immediately to avoid the time lag at later date.

Table 0.24: Project Clearances

Sr. No.	Item	Agency	Responsibility
1	Pollution Clearance - Consent to Establish (CTE) / No Objection Certificate (NOC)	Jharkhand State Pollution Control Board	SHAJ through Contractor
2	Reserve/Protected Forest Clearance / Forest Area Diversion	MOEF New Delhi/MOEF Regional Office / State Forest Department	SHAJ through Design Consultant
4	Shifting of services and utilities including underground water pipeline sewerage line and optical fibre cables	BSNL, BSEB, Public Health Engineering department, Optical fibber cable operator	Concerned Dept, State of Jharkhand
5	Clearance for crossing other waterways	Irrigation Department	SHAJ through Design Consultant
6	Clearance for cutting trees and transporting	Forest Department, /District Level Committee constituted by the State Govt.	SHAJ through Design Consultant
7	Dismantling of structure falling within right of way	Competent Land Acquisition Authority	SHAJ through Design Consultant
8	Quarry operations	Mining Department	Contractor/ Concessionaire
9	Clearance for cutting and transporting soil	Department of Geology and Mines	Contractor/ Concessionaire
10	Extraction of Ground water	Central Ground Water Board and State Pollution Control Board	Contractor/ Concessionaire
11	Clearance for employing imported labour	State Labour Commissioner	Contractor/ Concessionaire

0.14 Results of Economic Analysis

Economic analysis was carried out using HDM-4 software. The sensitivity analysis is carried out by varying cost and benefit as under:

1. Base costs plus 15% and base benefits
2. Base cost and base benefits minus 15%

3. Base costs plus 15% and base benefits minus 15%

The analysis has been done by changing the cost and benefit streams independently as well as in combination. The end results of this study have been presented in a series of EIRRs and NPVs.

The sensitivity case S2 and S3 is not considered for economic analysis as major diverted traffic does not exist on project road, majority of traffic includes inter village traffic that exists on the project road. This traffic will not diminish drastically and hence, ruled out.

The end results of this study have been summarised below:

Table 0.25 : Results of Economic Analysis

Option	Net Economic Benefit (NPV @ 12%)	Economic Internal Rate of Return (%)			
		Base Case	S1	S2	S3
With time saving	14116.06	13.5	12.7	-	-

The project road is economically viable for proposed improvement as it yields more than 12% return (assumed interest rate for the analysis). It is also viable for various sensitivity alternatives.

0.15 Results of Financial Analysis

To assess whether the project is a profitable proposition, the returns to investors are measured by the post-tax project FIRR and the equity FIRR, which is estimated from the cash-flow statements, based on discounted cash-flow technique. To qualify the project in terms of attractive financial returns, the following criteria have been adopted:

- Post tax IRR on Project Investment : minimum 12%
- Post tax IRR on Equity : minimum 12%
- DSCR : >1.0
- BCR : >1.3
- NPV @ 12% : must be positive

0.15.1 Findings of Financial Analysis

With the assumptions already stated above the financial analysis for the project corridor has been undertaken. The results of financial analysis have been presented in the table given below for BOT and annuity option;

Table 0.26 (a): Findings of Financial Analysis (BOT)

Concession Period	Govt. Grant (Const.) In %	Debt : Equity	FIRR (post tax)		Average DSCR	BCR	NPV @ 12 % (Cr.)
			On Whole Investment	On Equity			
17 Years	40.00% (72.98 cr.)	70 : 30	-	-	-	-	-115.88

Table 0.26 (b): Findings of Financial Analysis (Annuity)

Concession Period	Debt : Equity	FIRR (post tax)	Annuity Amount (cr. / Year)
		On Whole Investment	
17 Years	70 : 30	12.00%	27.18 Crore

Financial analysis results show that the project is not getting viable under BOT option with 40 % grant. Therefore annuity option for the project road with single package and 17 years concession period is adopted. The annuity amount is Rs. 27.18 crore with IRR of 12.00%.

0.16 Issues Specific to the Project

- Volume IV: Environmental Assessment Report including Environment Management Plan(EMP)
- Lowalong Wild lIfe sanctuary from Km 8+177 to km 34+815 is designed at 20 to 30 kmph so cross section can be accommodated with in ROW.
- Drain has been designed for Km 8+177 to Km 34+815 although it can only be constructed in future if land is acquired.

0.17 Recommendations

Project Study confirms that the rehabilitation and upgrading of the project corridor as a whole is technically feasible. It is recommended that the implementation of the project should commence without delay, as proposed hereunder:

- Based on the lane capacity analysis results, the project road requires 2 lanes with earthen shoulder for capacity augmentation and efficient movement of traffic in horizon year 2026.
- Along the project corridor Two lane carriageway with Lined Drain has been proposed in built up areas, however Two lane with CC Pavement section is proposed in Panki town at following locations.

Sr. No.	Section (Design Chainage)	Improvement Proposed
1	Km 45+825 to Km 46+187	Two Laning in Built Up area(CC Pavement)

- The project road can be improved without causing significant adverse environmental impacts to the natural, social, economic or cultural environments.
- Realignments have been proposed at following locations to improve the design speed as per proposed design standard.

Table 0.27 : Proposed Realignments

Sr. No.	Existing Chainage		Design Chainage		Length	Cross Section	Widening	Remarks
	Start	End	Start	End				
1	2/490	2/600	2+490	2+600	0.110	TCS 4	New Construction	Realignment Curve Improvement
2	5/740	5/950	5+740	5+950	0.210	TCS 4		Realignment
3	7/460	7/610	7+460	7+610	0.150	TCS 4		Realignment
4	34/500	35/000	34+500	35+000	0.500	TCS 4		Realignment New Major Bridge on Chako River
5	35/950	36/275	35+950	36+275	0.325	TCS 4		Realignment
6	36/370	36/530	36+370	36+530	0.160	TCS 4		Realignment
7	42/215	42/430	42+215	42+430	0.215	TCS 4		Realignment

- Existing geometry of the project highway has been improved to achieve the 65km/hr ruling speed and minimum speed of 50km/hr for plain and rolling terrain and 40km/hr ruling speed and minimum speed of 30km/hr in mountainous and steep terrain except with following locations which are proposed as “Speed Restriction Zone” and improved with design speed of 20km/hr to 30km/hr to reduce land acquisitions and R&R (Wild Life Portion) in the project.

Table 0.28 : Speed Restriction Zone

Design Chainage		Design Speed	Remarks
From	To	Km/hr	
8+200	35+000	20 to 30	Lowalong Wild Life Sanctuary
42+800	43+600	25	Existing Barrage- Junction

- The process of land acquisition has to be initialised immediately after the approval of the alignment, to expedite construction of re-alignments.
- The project can be constructed within 18 months period with strategic planning and through one construction package. The estimated basic cost is **Rs. 1,521,025,757/-**.
- Financial analysis results show that the project is not getting viable under BOT option with 40 % grant. Therefore annuity option for the project road with single package and 17 years concession period is adopted. The annuity amount is Rs. 27.18 crore with IRR of 12.00%. Due to high annuity amount in annuity option the project will be suggested to be floated on EPC basis.
- Project road is economically viable under sensitivity analysis and it may be taken for implementation.