Executive Summary

Environmental Impact Assessment for Road widening of 4/6 laning of Nagpur-Wainganga Bridge Section of NH6

1.0 Introduction

Ministry of Road Transport and Highways, Government of India has decided to take up development of various National Highways Stretches / Corridors **under NHDP Phase-III Programme in the Country**. The National Highways Authority of India (NHAI) has been entrusted to implement the development, maintenance and management of National Highways under NHDP Phase-III Programme for 4/6 laning of 10,000 km. on BOT basis which includes high density corridors / sections of National Highways having connectivity importance in the Country. Under above said programme, NHAI has selected the Project Road for 4/6 laning of Nagpur-Wainganga (Bhandara) Bridge Section of NH-6 from km. 485/000 to km. 544/100 (59.100 km.) in the State of Maharashtra. The Project Road passes through two districts, namely Bhandara and Nagpur. The remaining length of NH-6 from Nagpur to Raipur is already rehabilitated to 4 lane divided carriageway up to km. 485/000. This shall called for immediate improvement to Project Road stretch as the link is very important stretch of National Highway No.6 connecting to States of Maharashtra & Chhattisgarh and further to Zarkhand, Orissa & West Bengal. There is heavy movement of goods traffic on this corridor.

1.1 Project Description

(I) Basic Information

Name of the Project:	**Road widening of 4/6 laning of Nagpur-Wainganga Bridge Section of NH6**
Location/ site alternatives under consideration	
Size of the Project: *	**Length of the road from Km 485/000 to Km 544/100. Total 59.100 Km length (79^{0}7'0" – 79^{0}41' 30"E and 21^{0}7' 0"– 21^{0}9' 0"N)**
Expected cost of the project	***Rs. 930.683 Crore.***
Screening Category	**Category A**

The Project Road is located in Maharashtra State (particularly in Vidarbha Region) and in part of NH-6 joining Kolkata to Eastern end and Dhulia-Surat on Western end. This is most important corridor of the Nation connecting East – West parts of country.

The Project Road starts at km. 485/000 and ends at km. 544/100 at Municipal Corporation limits of Nagpur Municipal Corporation. The section of NH-6 passing through Nagpur Municipal Corporation is already widened to 4-Lane divided carriageway with 1.2 m raised median.

The Project Road is running East-West between latitudes 21º7′0″ N & 21º9′0″ N and lies between longitudes 79º7′0″ E & 79º41′30″ E. The Project Road passes entirely through Maharashtra State.

Onway, Project Road traverses Bhandara Town, Jawahar Nagar, Mouda (Taluka Place) and terminates at Nagpur city limits. Ordnance Factory is located 8 km away from Jawahar Nagar on Southern side of Project Road. As many as 21 villages are located on the Project Road. The land use by the side of Project Road is mainly agriculture. Rice is the main crop in addition to Gram, Wheat, Pulses, Jawar, Maize etc.

2.0 PROPOSED PROJECT DETAILS

Project improvement proposals are described as below :-

2.1 Traffic Surveys, Analysis and Forecast

- **Traffic Survey**

Sr. No.	Traffic Surveys	No. of Locations	Location at
1	Classified Traffic Volume Count Survey (7 days × 24 hrs.)	2	At km. 502/400 and km. 535/500
2	Origin Destination and Commodity Survey	1	At km. 489/400
3	Axle Load Characterization	1	At km. 489/400
4	Intersection Volume Count		At all major intersections
5	Speed Delay Characteristics		Project Road station
6	Pedestrian / Animal Traffic Count		All major inhabitations along the highway

- **Traffic Analysis and Forecast**

The Traffic count data was obtained from P.W. Department of Government of Maharashtra of 10 year i.e. from the year 1995 to December 2005. The last count data for the year 12/2005 for two count stations is given below.

Traffic Data collected by P.W. Department

Count Station at Km.	Two Wheeler	Three Wheeler	Mini Bus / Bus	LCV / Car / Jeep	Trucks / 3 - Axle / Multi Axle	Animal Drawn	Cycle	PCU
Km. 540/000	1822	---	334	2651	5797	4	543	22254
Km. 505/000	2352	---	417	2223	4900	21	1498	20268

- **Average Daily Traffic (ADT)**

Consultants has carried out volume count at two count stations in the month of June-July – 2009. The traffic volume count data collected by consultants at 2 locations (for 7 days × 24 hrs) are averaged out to arrive at ADT on the Project Road.

Average Daily Traffic as per Actual Volume Count

Vehicle Category	(In Numbers)		(In PCU)	
	Station		Station	
	1 Km 502/400	2 Km 535/500	1 Km 502/400	2 Km 535/500
Two Wheeler	4917	3588	2459	1794
Three Wheeler	464	402	464	402
Car/ Jeep/ Van/ Taxi	2173	2553	2173	2553
Mini Bus	38	52	56	77
Full Bus	510	465	1529	1396
LCV	572	591	858	887
2-Axle Truck	2030	2009	6090	6026
3-Axle Truck	2725	2712	12263	12204
Article/ Semi Artic Truck	297	324	1336	1459
Tractor with Trailer	23	19	105	87

Vehicle Category	(In Numbers)		(In PCU)	
	Station		Station	
	1 Km 502/400	2 Km 535/500	1 Km 502/400	2 Km 535/500
Tractor without Trailer	12	8	18	12
Total Fast Moving Vehicle (FMV)	**13761**	**12723**	**27351**	**26897**
Cycle	650	494	325	247
Cycle Rickshaw	9	10	18	19
Bullock Cart	4	8	31	62
Horse Cart	0	0	0	0
Total Slow Moving Vehicle (SMV)	**663**	**512**	**374**	**328**
Total ADT	**14424**	**13325**	**27725**	**27226**
Tollable ADT	**8344**	**8706**		

- **Annual Average Daily Traffic (AADT)**

From the past data collected from department for the month of May and December during every year for the year 1995 to 2005, it is observed that the variation is not liner; and the growth is not constant. During some period i.e. 1997-2001, negative trend is observed in the growth rate. It is therefore not proper to consider the growth rate for calculating the projections. The positive growth ranges from 1.6% to 17%.

- **Suggested Traffic Growth Rates for the Project Road**

As per guidelines of GOI-Ministry of Road Transport and Highways, issued under No. RW / NH-37011 / 57 / 2006-PIC, dt. 18th January 2008, five percent (5%) growth is to be considered for determination of lane requirements / project preparation and for financial viability of the project.

- **Future Traffic Growth Estimation**

Total Vehicular traffic applying the traffic growth rates of 5% to AADT traffic projections on the basis of average traffic in two sections will be from 14424 in the year 2009 and projected traffic will be 106623 in the year 2050 for section I (From km. 485/000 to km.515/000) and in Section II it will be 13235 in the year 2009 and 97830 (km. 515/000 to km. 535/200).

Guidelines for Capacity of Roads

IRC : 64-1990 – Guidelines for capacity of roads in Rural Areas recommends capacity values for two lane widths considering level of service (LOS)-B.

Guidelines for Capacity of Roads in Rural Areas

Type of Terrain	Curvature in degree per km.	Design Service volume PCU per day
Plain	Low (0 – 50)	15000
	High (above 51)	12500
Rolling	Low (0 – 100)	11000
	High (101 and above)	10000
Hilly	Low (0 – 200)	7000
	High (201 and above)	5000

Increase in capacity by 15% is to be considered if paved shoulders of 1.5 m width are provided on either side of carriageway.

Reduction in capacity occurs for substandard lane / shoulder widths.

For LOS-B, IRC recommends value of 35000 PCU for four lane carriageway in plain terrain assuming good earthen shoulders and minimum 3.0 m wide central verge. With 1.5 m wide paved shoulders on either side, this is increased to 40,000 PCUs.

Parameters :

a) Plain Terrain
b) Curvature : 0 to 100 degrees / km.
c) LOS : B
d) PHF : 8 – 10%

IRC : 64 – 1990 recommendations work out to:

Through the project road is passing through Rural Area, it carries inter state traffic, connecting industrial areas at Nagpur and Raipur, passing through built up areas at Nagpur, Jawahar nagar and Bhandara, towns. It is therefore recommended values of capacities can be increase by factor 1.2 for arriving at proper lane capacities

Justification for 4/6 laning of Nagpur – Wainganga Bridge Section of NH-6

From weighted Project Traffic it can be assessed that the Project Road qualifies for 4 lane divided carriageway with 2 × 1.5 m paved shoulders in the year 2021 and for six lane carriageway is the year 2031. It is seen that the capacity augmentation will be required within 8 years from the COD (i.e. year 2013).

Therefore, it is proposed to provide 4 lane divided carriageway with 2 × 1.5 m wide paved shoulders for entire Project Road length with Concession Period of 20 years including construction period.

2.2.1 Tollable Traffic & Toll Rates

- **Tollable Traffic**

The projected tollable traffic on the Project Road stretch is given below in table 1.20. The projected traffic is worked out by averaging the traffic at two count station. The Toll Plaza is proposed at km. 523/400. Average Projected Tollable Traffic will be from 8521 in 2009 and 63015 in 2050.

- **Toll Rates**

The toll rates are considered as per Ministry of Road Transport and Highways, Government of India's Toll Notification, dt. 5th December 2008. GSR 838(E). The toll rates are given in table 1.20 below. As per instructions the base year is considered as 1st April, 2007 to 31st March 2008.

The rate of fee for use of a section of National Highway of four or more lane for the base year 2007-08, be the product of the length of such section multiplied by the base rates per km. The design length of Project Road works out to 58.630 km and on the basis of the rates for each category of vehicles rates are worked out and used for revenue calculation.

For calculation of base rates for subsequent years these rates shall be increased by 3% per year without compounding. For each year with effect from 1st day of April 2008. Means for 2008-2009 by 3%, for 2008-2009 by 6% etc. and these shall be base rates for that year effective from 1st April onwards. It is expected that the construction of Project Road will be completed in year 2013 and the commercial

operation date will fall in 2013-14. The base rate will be applicable from 1st April 2013.

The applicable base rate shall be worked for the year in which toll fee is to be started after commercial operation date.

Combined Toll Rates of the total Project Highway (length 58.630 km.) for the year 2013 with 3% annual increase without compounding works out as given below

Toll Rates per Trip

Sr. No.	Category	Base Rates per km. (2007-08)	Base Rates per km. (2013-14)	Fee Rates applicable for 2013-14 (rounded)
1	Car / Jeep / Van / Light Motor Cycle	0.65	0.74	Rs. 95 Per Trip
2	Light Commercial Vehicle (LCV), Light Goods Vehicle/ Mini Bus	1.05	1.20	Rs. 147 Per Trip
3	Bus, Truck	2.20	2.53	Rs. 300 Per Trip
4	Heavy Construction Machinery (HCM) / Earth Moving Equipment (EME) or Multi Axle Vehicle (MAV) (Three to Six Axles)	3.45	3.96	Rs. 460 Per Trip
5	Oversized : greater than 7 Axles	4.20	4.83	Rs. 587 Per Trip

- **Toll Revenue**
  - The Toll Revenue is calculated by considering Traffic for the section in which toll plaza is proposed to be set up i.e. km. 523+400 along the Project Road.
  - Discount for local traffic, monthly pass, exempted traffic and leakages etc. is considered @ 3%.

The Present toll plaza for the BOT Project from km. 485 to 498 alongwith construction of Wainganga Bridge is in operation in km. 489+400. The length overlaps the existing Project Road length. It is therefore proposed to buyback the facility under suitable provisions of Concession Agreement.

The construction of widening & improvement to Nagpur-Raipur road from km. 405/000 to 485/000 is in progress and nearing completion. The toll plaza location for this project is fixed at km. 449/400. As per the recent directives of NHAI, the distance between two toll plaza shall be minimums 60 km and shall not be located within 5 km. from the city. The toll plaza location selected for toll plaza for Project Road will be at km. 523/400; which is 74.00 km. away from the proposed toll plaza for km. 405/000 to km. 485/000 section of NH-6. The present toll plaza at km. 488/200 shall be abandoned, after suitably compensating under prevailing rules or concession agree mental provisions.

2.3 Engineering Survey, Investigations and Proposed Road Features

- **General Alignment of the road**

Entire Project Road is covered in the GSI Topographical Maps bearing Nos. 55 – 0/4, 55 – 0/8, 55 – 0/12

Land Use

Land use along the Project Road is mentioned below

Land Use Pattern Along The Project Road

Land Use	Percentage (%)
Agriculture	73%
Built up land	24%
Barren Land	3 %

- **Existing & Proposed ROW**

The details of existing and proposed ROW are summarized below-

Sr. No.	Existing Chainage		Design Chainage		Existing ROW (m)	Proposed ROW (m)
	From (km)	From (km)	From (km)	From (km)		
1	485/000	491/000	485/000	492/000	45.00	60.00
2	491/000	494/000	492/000	492/236	35.00	45.00
3	494/000	544/000	492/236	543/630	45.00	60.00

- **Alignment Options for Bhandara city**

There are three options open for safe movement of Highway Traffic through Bhandara city.

a) **Alternative – A :** To take new bypass alignment outside Bhandara city on Southern side.
b) **Alternative – B :** To provide Elevated Highway by providing flyovers on existing alignment and taking highway traffic on elevated flyover to segregate from local traffic.
c) **Alternative – C :** To take new bypass alignment on Northern side of Bhandara city.

Out of above alternatives, alternative – C is not feasible due to following reasons:

i) The major spread of Bhandara city is on North side of existing National Highway No.6. The spread is about 4 km. from existing National Highway.
ii) Wainganga River encircles the city on east and south sides of the city and therefore the bypass alignment on north side will be with long detour to the extent of 18 km. or so.
iii) Due to meandering behaviour of Wainganga River, the economical bridge location site is not feasible on this bypass route.
iv) During high floods, the spread of flood water is more on eastern side of city due to low banks.
v) If existing recently constructed bridge on Wainganga River is to be used for one directional traffic, then the bypass alignment on north side will not be of use.

For these main reasons the bypass alignment on north side of the city mentioned under "Alternative-C" is not considered for detail study.

Alternative – A : Bypass on southern side

The alignment is to be located between the flood protection bund constructed by Irrigation Department on the bank of Wainganga River and existing built up zone of Bhandara city. Accordingly, three alternative alignments were studied with various geometrical parameters. The bypass alignment off takes from km. 491/259 and joins at

km. 495/600 after bypassing Ganeshpur village. The details of these alignments are given in **below**

Details of alignment : Widening Scheme

Sr. No.	Particulars	Alignment No.1	Alignment No.2	Alignment No.3
1	Length of Bypass	4799.31 m	4702.557 m	4766.166 m
2	No. of Curves involved	5	3	4
3	No. of Sharp Curves (non-standard)	--	--	--
4	No. of New Minor Bridges	1	1	1
5	No. of H.P. Culverts / CD Works	13	13	13
6	No. of Underpasses	6	6	6
7	Cost of Construction (Rs. Cr.)	98.37	97.54	98.08

- **Merits**
  i) Bypasses built up city area
  ii) Segregates highway traffic from local traffic effectively.

- **Demerits**
  i) Alignment passes through low lying area between city and protection bund.
  ii) Due to Back-water of "GOSIKHURD" Irrigation Project there will be standing water in the river bed throughout the year. This will raise the water table in adjoining area. Due to capillary rise the embankment will be charged and this may result in the repetitive distress in the existing pavement due to movement of heavy highway traffic, in respecting of provisions of filter median etc.
  iii) The land is adjoining to Bhandara city. The Land acquisition will be costly.
  iv) The alignment is not geometrically attractive as involves number of curves.
  v) Due to vicinity of city, encroachment problems of highway land can not be ruled out.
  vi) The owners of land are mostly small formers and belonging to SC/ST/ below BPL section of society.

Alternative – B : It is proposed to construct elevated highway by providing flyover for city length from km. 492/000 to km. 495/100 This flyover will allow highway traffic on elevated level and local city traffic on existing road level (ground level). This will segregate the main highway traffic from local traffic. The flyover will provide 3-Lane carriageway for each direction with 1.5 m raised Central median with RCC crash barrier at center and on both edges of carriageways. This flyover will provide 5.5 m clear head way at the bottom of pier cap to the heavy traffic like buses and trucks moving at ground level for safe movement of local traffic. The carriageways with 7.00 m width and 1.5 wide paved shoulders will be provided for these carriageways at ground level. These carriageways will be provided on both sides of Flyovers with 1.5 m footpaths above side drains. Curb shyness strip of 0.50 m will be provided near curbs. Clearance of 1.00 m will be provided on both sides from pier faces of flyover. Grades of 1 in 50 will be provided for approaches at both ends. Two obligatory spans for junction with Bhandara city, two more obligatory spans on left and right side, one obligatory span for railway (defence line) crossing and one obligatory span for Tumsar Road bypass are proposed in the via-duct of flyover.

The details of Alternative – B are as under-

i)	Length of Flyover	…	2310.000 (Abt. To Abt.)
ii)	City Roads for Local Traffic below Flyover	…	3500.00 m
iii)	No. of Spans	…	113 Nos.
	a) Obligatory at Tumsar Road Junction	…	3 Nos. 30.00 m
	b) Obligatory at ROB	…	1 No. 30.00 m
	c) Remaining Spans		1 No. × 25.00 m
		…	1 No. × 27.76 m
		…	1 No. × 18.00 m
			106 Nos. × 20.00 m
	d) Pedestrian Crossings		2 Nos. × 7.00 m
iv)	Cost of Construction	…	153.88 Crores.

Merits :

1. Minimum Land Acquisition and Property Acquisition.
2. Geometrically efficient.
3. Segregation of Local & Highway traffic is effectively done.
4. Due to provision of Elevated Highway, minimum disturbance to local traffic will be achieved.
5. Alignment is at safe distance from flood zone of Wainganga River.

De Merits :

Capacity Argumentation up to six lane divided carriageway is possible but beyond six lane augmentation will be impossible.

Both these alternatives were presented for Public Consultation on dt. 18th December 2009. As per general opinion of the Public Representative and Public present is the meeting, the Construction of Elevated Highway on existing alignment is acceptable to public. Moreover technically also the elevated Highway is more feasible and hence recommended for acceptance.

- **Existing and Proposed Embankment**

  Embankment heights are very low from km. 523/000 to 545/000 and 514/000 to 518/000. The sub-soil strata is also black cotton soil and soil testing result shows that the CBR values are poor; even below 2% at some locations. In these stretches it is proposed to raise the embankment heights. For new embankments, removal of top soil for 500 mm depth and the construction of 1.00 m high embankment with good quality borrowed soil is proposed. Pavement layers will be provided on good quality soil with capping layer of minimum CBR of 10% arrived by granular slab-base with minimum CBR of 30%. This shall be overlaid by WMM and bituminous layers of flexible pavement.

  There are existing large old trees along the Project Road alignment. At suitable locations eccentric widening is proposed to minimize the tree felling in these stretches.

It is proposed to relocate the existing utilities to the edge strip of 2.00 on at proposed ROW edges. The proposed ROW shall be 60.00 m at all locations except city area; where it is restricted to 45.0 to 50.00 m width to avoid large scale property dislocation.

- **Roadway Design**
  - **Lane requirements in Future**

    Traffic fore cast studies indicate that the Project Road qualifies for four lane divided carriageway with paved shoulders in the year 2021 and further qualifies for capacity augmentation to 6 lane divided carriageway in the year 2028. The details of average daily traffic as per traffic count survey in the year 2028 will be 36449 in section I (km. 485/000 to km. 515/000) and 33443 in Section II (km. 515/000 to km. 535/200).

Traffic Projections for Lane Requirements:

It is observed that traffic volume in two section is generally parallel with each other. However it is preferred to calculate the weighted average of traffic in both the sections for considering the same to workout lane requirements as well as revenue collections.

Therefore it is proposed to provide 4 lane divided carriageway with 2 × 1.5 m wide paved shoulders for entire Project Road length. Capacity augmentation is considered and accordingly design is proposed. The project road qualifies for four lane divided carriageway with 2 × 1.5 m paved shoulders in the year 2021 and for six lane divided carriageway in the year 2028.

- **Proposed Cross Sectional Elements**

The proposed cross sectional elements for 4-lane divided carriageway are as under:

- Width of Carriageway … 7.00 m on each side with 2 Lanes
- Width of Paved Shoulders … 1.50 m on both sides of main carriageway
- Width of granular shoulders … 2.00 m on Outer side of each carriageway
- Raised central median … 4.5 m up to outer edge of kerb
- Width of kerb shyness … 0.5 m on either side of raised median

Considering above elements the total width of roadway at pavement level works out to 26.50 m (including median). The new ROW shall be 30.0 m on each side of centre of raised median (New Central Line).

- **Geometric Design Standards**

Design Speeds are proposed as under

- Plain Terrain … Ruling 100 kmph, minimum 80 kmph
- Rolling Terrain … Ruling 80 kmph, minimum 65 kmph
- Hilly Terrain … Ruling 50 kmph, minimum 40 kmph
- Service Road … 40 kmph

There is no hilly terrain and very small length of rolling terrain. Therefore entire highway is designed for 100 kmph ruling speed.

- **Widening Scheme**

For Project Road stretch with existing low embankment height, it is proposed to raise the existing embankment and reconstruct the same. Widening for Project Road passing through built up area is proposed as concentric and remaining length eccentric widening is proposed.

- **Junctions and Intersections**
  - **Major Junctions:**

    The Project Road passes through number of habitation and towns as discussed earlier. Many other cross roads joins the Project Road at different locations. There are in all 46 junctions. Turning movement surveys are carried out for these junctions. At critical locations vehicular underpasses with escape ramps are provided at 14 locations; and widening to existing vehicular underpasses 3 Nos. At two locations flyovers are proposed at two locations. Thus, in all 19 Nos. of Junctions will be provided with regular vehicular underpasses facility under each flyover addition pedestrian and vehicular movement facilities will be provided for crossing of local traffic. Remaining junctions shall be developed as at grade junction.

  - **Minor junctions:**

    All other minor junctions will be improved due to widening scheme and merging the same at few locations with major junctions

Material and Geo-Technical Investigation

Existing Sub-Grade Soil:-

- It is observed that sub-grade in having CBR varying from 2.10% to 9.80%

- Soil type for existing sub grade soil varied from clay with high plasticity to clay with sand with intermediate plasticity. From Km. 522.00 to Km. 545.000 generally clay with high plasticity (CH) in met with. From road section from Km. 512.00 to 522.00 clay with medium plasticity in observed. From Km. 485.00 to Km. 512.00 clay with sand (SC) type of sub-grade soil in met with. Some stretches in Km. 486, 487 and 512, 517 soil with high plasticity is observed.
- The MDD observed for sub-grade soil varies from 1.753 to 2.210 and free swell index varies from 10 to 40 except in Km 530, 531 and 532 and 517 where it is 50.

Pavement Composition of Existing Pavement.

The existing pavement crust details indicate that bituminous pavement thickness varies from 100mm to 350mm comprising of BM, PMC/SDBC and cold mix layers WBM layers thickness varies from 150mm to 400mm and at most of the location sub-base layers are missing. At some locations sub-base layers thickness found varies from 100mm to 400mm, but is in the form of clay – sand - murrum.

2.4 Borrow Area for New Construction Material :

- Material investigation for barrow areas indicate that the soil suitable for embankment (CBR > 6% and density 1.6gm/cc) and for sub-grade (CBR > 10% and density 1.75gm/cc) is available at an average lead in 15 to 30 Km. for entire project stretch.
- There are two sources of stone aggregates with an average lead of 25 Km. to 30 Km. for the project road. The laboratory test results indicate that the material from these sources are suitable for making pavement construction and concrete etc.
- River sand in available in ample with good quality in Km. 490, 510 and 520. Alternatively stone crushed stand confirming to zone II is also proposed for concrete and masonry works.
- Cement factories are located in Chandrapur District which can be source of bulk cement supplier besides retail market supplier from Nagpur and Bhandara.
- Bhilai Steel Factory is located in Chhattisgarh at Durg with a lead of 200 Km. and suppliers are available from retail market at Nagpur.

- Bulk Bitumen of 30/40, 60/70 grades and CRMB-60 grade can be procured from Mumbai refineries with average lead 855 Km. for the project road. In view of aried zone 60/70 grade bitumen is proposed to be used and for wearing course CRMB-60 grade bitumen is proposed.
- Hume pipe manufacturing factories are located near Nagpur (MIDC area) and Bhandara: which are at 30 Km. average lead from project road.

Pavement Design :

- New flexible pavement and reconstruction of existing pavement.

  Flexible pavement design for initial life of 20 years is considered. The concession period of 22 year with 24 months for construction of project road in considered.

  Recommended flexible pavement composition for design life of 20 years with 217 msa, 30 msa for city roads and below flyovers and 10 msa for service roads in rural area has been worked out.

Remarks –

- Raising of embankment is proposed for road stretch from km. 514/000 to 519/000 and Km. 522/000 to 544/100. Existing embankment will be raised by scraping existing pavement BT-layer and then raising by suitable soil layers with minimum 10% CBR. Additional lane will be constructed by removing the existing soil layer of 500mm and then raising the embankment with barrowed soil having minimum 10% CBR for 1000mm height. Both RTL of existing embankment and newly widened embankment will match with each other. Then capping layer of 500mm with soil with CBR more than 10% shall be provided and then overlaid by GSB with minimum CBR not below 30% over which pavement layers will be provided.
- For construction of new embankment soil / muroom with minimum 10% soaked CBR is considered as the material is available and blended if required. Where existing sub-grade CBR is less than 5% soil shall be removed for minimum 500mm depth and then rebuilt with barrowed / selected soil with minimum 10% CBR.

- Only crushed rock type GSB is proposed to be used in sub-grade layers. Conventional type of blending with natural material like muroom, sand and aggregate is not permitted. The GSB shall have minimum CBR of 30.
- Modified binders such as CRMB – 60 are proposed to be used in bituminous mixes for weaving course.

Rigid Pavement –

- Slab Thickness --- 30 Cms (Flexural Strength – 45 kg /cum^2)
- Dry lean Concrete --- 15 Cms(10 mpa at 7 days compressive)
- Granular sub Base --- 150 mm(Drainage layer)
- Construction Joint spacing --- 3.75m c/c along length
- Expansion joint spacing --- 45m c/c along Transverse direction
- Dowel Bars --- 20mm dia.
- Tie Bars --- 12mm dia deformed bars
- Tie Bar Length --- 64 cm
- Tie Bar Spacing --- 55 cm C/C

2.5 Road Safety Features

1. Road Signs and Markings

Retro reflective road signs shall be provided at all locations necessitating informatory, Cautionary and Mandatory signs as per guidelines given in IRC : 35 – 1997 and IRC : 67 – 2001 for road markings, painting and signage systems. In addition to this proper safely signs and marking shall be provided at all busy crossings, median opening, underpasses and Flyovers for safety of traffic and pedestrians. For visibility at night times all road sections passing through built up areas shall be provided with lighting system as per standards and specifications.

2. Road Safety Features

To ensure the safety of commuters following minimum safety measures are proposed.

3. **Metal Beam Crash Barriers (MBCB)**

Metal Beam Crash Barriers are proposed on both edges of road embankments where the height is more than 3.00 m on both sides of main carriageway. Where the project road passes through built up area, on outer edges of roadway on curves and on at grade junctions for 100 m on all sides and road on valley side. The metal Beam Crash Barrier shall consist of W – Beam fixed on posts (15 MB 150) placed at 5.0 m apart c/c with spacers (also 15 MB – 150). Reflectors shall be fixed on the Metal Beams @ 3m c/c for proper delineation of barrier line.

4. **Guard Posts**

Standard Guard Posts made of M-20 grade concrete fixed with M-20 grade concrete foundation proposed to be provided on inner and outer edges of road with sharp curves, road on hill side at 1.50 m intervals and 200 m from edge of carriageway with reflectors fixed on it.

5. **200 m, Kilometer and 5th km. Stones-**

These stones shall be fixed as per guidelines of IRC : 8 and IRC : 26 with lettering and numbering as per codal provisions. These shall be fixed on LHS for each directions of travel.

6. **Delineators**

Delineators are provided for visual assistance to drivers to follow and negotiable the alignment of road ahead and provide warning about hazards particularly at night times. Various types in use are.

a. Clustered Red Reflectors on triangular nodes as object markers are provided at the edge of median and directional islands.
b. Circular red reflectors on face / top of islands and medians.
c. Circular white Reflectors on Guard Posts.

7. **Boundary Stones**

Road Boundary stones shall be fixed on both sides of the road to demarcate the boundary of new ROW of NH-way. These shall be fixed with proper founding concrete and dowel bars to guard against tampering.

8. Traffic Signals

All at grade junctions in built up areas shall be provided with traffic signals. These shall be provided as per safety manual.

9. Lighting System

All road stretch passing through built up area shall be provided with lighting system erected on poles with adequate height and 30 m c/c., Such that shall provide uniform illumination of 40 lux minimum at all places. The lighting posts erected on bridges, flyovers, underpasses shall have adequate height as per standards and shall also provide minimum illumination of 40 lux at all locations. Underpasses and Flyovers shall be illuminated with lighting below floors where pedestrian or other traffic is moving with minimum illumination of 30 lux at all places.

10. Land Scaping and Arboriculture

Tree plantation is proposed along project highway at 10-15 m c/c on both sides parallel to the road. Set back distance of trees in different situation shall be as per IRC : SP : 21 and IRC : 66. The nearest edge of tree trunk shall be at 2.00 m minimum from road edge or kerb edge. The plantation in median shall comprise of shrubs whose height would normally not exceed 1-1.5 m and shall be as per IRC : SP : 21.

The scheme of Landscaping shall be part of overall Environmental Mitigation Plan (EMP). The planting shall be such that it does not obstruct the visibility of traffic from any side and shall be pleasing in appearance. All stretches passing through built up area, toll plaza location etc. shall be provided with beautiful landscaping with ornamental shrubs in the central median or below Flyover open spaces.

11. Advertisement and Hoardings

No advertisements / hoardings are allowed to be erected on Project Highway

2.6 Structures

The abstract of structures such as Bridges, Slab Culverts, Box Culverts, H.P. Culverts, ROB, Flyovers, Underpasses etc. is given below.

Table – Abstract of structures

A. Bridges / Culverts

Sr. No.	Category of Structure		No.	Proposals			Remarks
				Widening	Re constr.	New constr.	
1	Major Bridges	Existing	5	--	--	--	With two lane configuration
		New	5	--	--	5	With three lane configuration
2	Minor Bridges	Existing	11	2	9	--	Existing 2 lane Widening 3 lane
		New	11	--	--	11	With three lane configuration
3	Slab Culverts / Box Culverts	Existing	20	4	16	--	Widening and Reconstruction to 4/6 lane configuration
		New	--	--	--	--	
4	Hume Pipe Culverts	Existing	49	45	4	--	Widening / Reconstruction to 4/6 lane configuration
		New	56	--	--	56	At all road junctions

B. Improvement Proposal for Flyovers / Underpasses

Sr. No.	Flyovers	Vehicular Underpasses with 5.0 m clearance with 15.0 m span width	Pedestrian / Cattle Underpasses with 7.00 m width × 3.00 m vertical clearance	Existing Vehicular / Pedestrian Underpasses to be widened	Remarks
	Full Flyover 2 × 3 lane divided configuration				
1	2 No. (Bhandara and Jawahar Nagar)	13 No.	10 No.	3 No.	---

2.7 Highway Drainage System

2.7.1 Pavement Drainage

For Pavement surfacing (Considering the Bituminous Layers) cross fall / camber is proposed @ 2.5 % (1 in 40) and for Earthen / Granular shoulders cross fall is proposed with 3% (1 in 33).

2.7.2 Median Drainage

Super elevated pavement cross falls are provided which slope on inner sides of curves and in such curvilinear road segments the run off water drains to inner sides of curve. Due to raised median for 4 / 6 lane divided carriageways the drainage from outer carriageway gets obstructed due to raised medians. It is therefore proposed to provide drainage outlets in the form of 300 mm dia RCC pipes embedded in the median with embedment below pavement by 100 mm at collecting end and raising above pavement by 50 mm at discharging end. This will facilitate effective drainage from outer carriageway to inner and ultimately to side drains. Where both carriageways are at different levels RCC chutes in skew directions shall be constructed to take the run off at controlled velocity to pavement on down stream side. The pipes and chutes shall be provided at 10 m intervals. In case of steep grades and high rainfall area, it is recommended to provide RCC drain in the central raised median and run off water from super elevated pavement be collected through embedded pipes in median and then shall be effectively disposed off from the central drain; to side drains through collecting chambers provided at regular intervals depending on grades.

2.7.3 Drainage at High Embankments

To avoid erosion of shoulders and earth fill on high embankments, longitudinal drains at the edge of shoulders with C.C. Chute drains at 20 m intervals to discharge water from drains to down side of fills, shall be provided in addition to stone pitching. Where RCC retaining walls are supporting embankment fills longitudinal drains shall drain out effectively through down take pipes provided at regular intervals.

2.7.4 Road Side Drains

Road side open drains with stone pitching are proposed throughout the Project Road length to effectively drain off the rain water to natural drain. The sections shall be as per design of drains on the basis of open channel flow hydraulics.

2.7.5 RCC Covered Drains

When the Project Road is passing through built up area RCC covered Drains with foot path are proposed.

2.8 Service Roads

Provision of Service Roads

Service roads are proposed for towns / villages area through which Project Road is passing.

The details of service Roads proposed are given below

Details of Service Roads

Sr. No.	Existing Chainage		Design Chainage		Length (Km)	Side	Total Length			Location
	From	To	From	To			Left Side (Km)	Right Side (Km)	Both Side (Km)	
1	486+940	488+285	487+050	488+450	2.80	Both side	-	-	2.80	Bhilewada Village
2	489+037	490+300	489+150	490+350	2.40	Both side	-	-	2.40	Karadha Village
3	491+700	495+075	491+800	495+300	7.00	Both side	-	-	7.00	Bhandara City
4	495+297	496+350	495+550	496+550	1.00	left Side	1.00	-	-	Bela Village
5	496+250	497+088	496+450	497+300	0.85	Right Side	-	0.85	-	Bela Village
6	496+400	497+088	496+600	497+300	1.40	Both side	-	-	1.40	Bela Village
7	497+200	498+650	497+400	498+850	2.90	Both side	-	-	2.90	Mujabi Village
8	498+250	499+500	498+450	499+700	2.50	Both side	-	-	2.50	Foolmogara Village
9	500+350	501+950	500+650	502+200	3.10	Both side	-	-	3.10	Shahapur Village
10	503+155	504+960	503+400	505+200	3.60	Both side	-	-	3.60	Jawahar Nagar
11	505+550	507+100	505+850	507+300	2.90	Both side	-	-	2.90	Kharbi Village
12	509+500	510+300	509+700	510+500	1.60	Both side	-	-	1.60	Borgaon Village
13	513+500	514+700	513+700	514+900	2.40	Both side	-	-	2.40	Chirva/Marodi Village
14	517+180	518+450	517+400	518+650	2.50	Both side	-	-	2.50	Mauda Road old NH-6

Sr. No.	Existing Chainage		Design Chainage		Length (Km)	Side	Total Length			Location
	From	To	From	To			Left Side (Km)	Right Side (Km)	Both Side (Km)	
15	520+820	523+120	521+000	522+500	3.00	Both side	-	-	3.00	Mauda Road old NH-6
16	528+100	529+500	527+500	528+900	2.80	Both side	-	-	2.80	Kuhi Junction
17	531+900	533+250	531+300	532+650	2.70	Both side	-	-	2.70	Kamptee Junction
18	533+940	535+150	533+350	534+550	2.40	Both side	-	-	2.40	Savali/Bhovari Junction
19	535+650	536+800	535+050	536+200	1.15	left Side	1.15	-	-	Kadoli Junction
20	538+200	539+400	537+600	538+800	2.40	Both side	-	-	2.40	Kamptee/Dighori Junction
21	539+000	539+800	538+400	539+200	1.60	Both side	-		1.60	Mahalgaon Village
22	540+800	544+187	540+200	543+630	6.86	Both side	-	-	6.86	Aasoli to Nagpur City
						Total Length	**2.15**	**0.85**	**56.86**	
							59.860		**Km.**	

2.9 Way Side Amenities

Way side amenities in the form of Bus stops / Bus shelters are provided as shown in below

- **Bus Bays / Bus Shelters**

Bus Bays / Bus Shelters

Sr. No.	Chainage		Side	Details Bus bay / Shelter proposed
	Existing	Design		
1	485+900	486+000	B/S Staggered	Busbay with Bus Shelter
2	487+400	487+500	B/S Opposite	Buspark Space with Bus Shelter
3	488+150	488+250	L/S	Buspark Space with Bus Shelter
4	488+250	488+350	R/S	Buspark Space with Bus Shelter
5	489+300	489+400	B/S Opposite	Buspark Space with Bus Shelter

Sr. No.	Chainage		Side	Details Bus bay / Shelter proposed
	Existing	Design		
6	492+700	492+800	B/S Opposite	Buspark Space with Bus Shelter
7	493+080	493+300	B/S Opposite	Buspark Space with Bus Shelter
8	494+500	494+700	B/S Opposite	Buspark Space with Bus Shelter
9	495+900	496+100	B/S Opposite	Buspark Space with Bus Shelter
10	497+550	497+750	B/S Opposite	Buspark Space with Bus Shelter
11	498+900	499+100	B/S Opposite	Buspark Space with Bus Shelter
12	500+950	501+200	B/S Opposite	Buspark Space with Bus Shelter
13	501+600	501+850	B/S Opposite	Buspark Space with Bus Shelter
14	503+700	504+000	B/S Opposite	Buspark Space with Bus Shelter
15	504+400	504+700	B/S Opposite	Buspark Space with Bus Shelter
16	506+000	506+150	B/S Opposite	Buspark Space with Bus Shelter
17	511+000	511+300	B/S Staggered	Busbay with Bus Shelter
18	514+000	514+150	B/S Opposite	Buspark Space with Bus Shelter
19	518+080	518+300	B/S Opposite	Buspark Space with Bus Shelter
20	521+000	521+150	B/S Opposite	Buspark Space with Bus Shelter
21	529+100	528+500	B/S Opposite	Buspark Space with Bus Shelter
22	532+700	532+100	B/S Opposite	Buspark Space with Bus Shelter
23	534+650	534+050	B/S Opposite	Buspark Space with Bus Shelter
24	536+100	535+500	B/S Opposite	Buspark Space with Bus Shelter
25	538+700	538+100	B/S Opposite	Buspark Space with Bus Shelter
26	542+200	541+600	B/S Opposite	Buspark Space with Bus Shelter
27	543+160	542+600	B/S Opposite	Buspark Space with Bus Shelter
28	543+750	543+200	B/S Opposite	Buspark Space with Bus Shelter

- **Truck Lay Bye**s

Truck Lay Byes are proposed at following locations

Truck Lay Byes

Sr. No.	Chainage		Remarks
	Existing	Design	
1	521 + 300	525/500	After crossing Kanhan River Bridge on LHS & RHS for twenty trucks on both sides.
2	541 + 850	541/650	Prior to Outer Ring Road (NH-7) junction on both side for 40 trucks on both sides

- **Toll Plaza**

One toll plaza is proposed to be established between km. 523/000 to km. 525/000 for entire project road length. The present toll station in located at km. 489/400 for ongoing toll project for construction of Wainganga Bridge with improvement to highway from km. 485/000 to 598/000. It is therefore proposed to bye back the on going toll project and location of new toll plaza for the proposed Project Road to be located in km. 523/400 at suitable location. As per information received from Project Director, NHAI-PIU-Nagpur the location of toll plaza for 4/6 lane divided carriageway Project Road from Raipur to Bhandara (km. 405/000 to 485/000) will be at km. 449/200. The proposed new toll plaza for Nagpur – Bhandara Project road to be located at chainage 523/400 which will be 74.200 km. away from the toll plaza in km. 449/200 and is admissible.

The toll plaza premises shall accommodate Medical facilities, Patrolling unit, Repair Shops, Canteen and other facilities as per standards and specifications. The toll plaza shall accommodate 8 lanes with rigid pavement for 150 m length on either side with convergence thereafter.

2.10 PIU Complex

Concessionaire shall provide separate building for locating PIU Complex near proposed toll plaza. The minimum carpet area shall be 3000 sq. fit with lavatory, lunch room, water room etc. complete.

2.11 Utility Shifting

Provisions for shifting of existing utilities such as water supply lines, electric lines / Poles, Telephone Poles, Gas Lines etc. is made in the cost estimate including relocation of the same at utility corridor. OFC cables shall be shifted and relocated at the cost of the service providers.

2.12 Land Acquisition

The existing ROW of NH-6 is 45 m extra through Bhandara city. It is proposed to acquire 60 m ROW for Project Road except for the stretch passing through built up area of Bhandara city where it is proposed to acquire 45 m land width.

2.13 Physical Scope

Sr. No.	Silent Features	Scope	Remarks
1)	Total Length	58.630 Km. (4-lane divided main carriageway with 2 x 1.5m paved shoulders & 4.50m raised median)	Including length of Toll Plaza where rigid pavement as per approved design and standards is to be constructed
2)	Major Bridges (New construction for 3-lane configuration)	5 No.	Existing two lane bridges to be retained and open gap between two bridges to be designed and constructed properly to retain earthwork of approaches.
3)	Minor Bridges	11 No.	Widening of existing 2 No, minor bridges to 3 lane configurations and 9 No. reconstructions to 6-lane configuration with 3-lane for each traffic direction and 3.5m open median.
4)	Flyovers	2 No.	A) Through Bhandara city from Km. 492/000 to 495+100 with approaches 790m. Main span - 3 x 30m, 1 x 30m (ROB), 1 x 25m, 1 x 27.760m, 1 x 18m, 106 x 20m. B) Flyover at Jawahar Nagar - Spans - 2 x 20m,

Sr. No.	Silent Features	Scope	Remarks
5)	Underpasses	a) Vehicular b) Pedestrian	16 No. 10 No.
6)	Culverts	a) HPC @ Junction b) Slab/Box Culverts c) Bridges on Service Roads	New Construction = 56 Nos. New / Reconstruction = 16 Nos. Widening = 4 Nos. New Construction = 17 Nos.
7)	Bus Bays & Bus Shelter	28 Nos.	
8)	Truck lay byes	2 Nos.	
10)	At Grade Road Junctions	8 Nos. (36 Nos. for Approaches to Underpasses & Service Roads)	

2.14 Total Project Cost

The break –up of Total Project Cost is as under.

Sr. No.	Particulars	Option-I Amount (Rs. Crores)	Option-II Amount (Rs. Crores)
A) Concessionaire Cost (Total Project Cost).			
1)	Civil construction cost	754.17	672.360
2)	Civil construction cost escalated @ 5% per annum for 6 months.	791.879	705.978
3)	Contingencies /QC @	23.756	21.179
	Total EPC Cost	**815.635**	**727.157**
4)	IC and Pre-operative expenses @ 1% of EPC	8.456	7.272
5)	Financing cost @ 2% debt at 70:30 DER	12.577	9.179
6)	Escalation @ 5% per annum during construction period of 30 months.	49.449	44.085

Sr. No.	Particulars	Option-I Amount (Rs. Crores)	Option-II Amount (Rs. Crores)
7)	Interest during construction @ 11% per annum on Term loan.	79.807	58.245
	Total Project Cost.	965.624	845.938
B) NHAI Cost (Non Civil Works)			
1)	Buy back of existing toll rights	Yet to be finalised	
2)	Shifting and relocation of utilizes	8.132	7.042
3)	Environmental and social mitigation measures		
	a) Land Acquisition Cost	103.69	125.323
	b) EMP Cost	9.00	9.00
	c) R & R Cost	3.00	3.00
4)	IC and preoperative expenses (1% of Non Civil Cost)	8.156	7.271

2.15 Economic & Financial Analysis

The Economic Inter Rate of Return (EIRR) for the entire project road is subjected to sensitivity analysis and results are as follows.

Construction Option	Economic Internal Rate of Return (%)			
	Base Case	Sensitivity S1	Sensitivity S2	Sensitivity S3
As Per Scope And Project Cost noted in preceding paras	21.65	18.85	18.10	16.26

Under worst scenario i.e. sensitivity options S3 EIRR is above threshold level of 12% hence the project is economically viable.

The results of Financial Analysis are as under-

Option I- With Flyover in Bhandara City

1. With maximum grant of 40%

Concession Period	20 Years
Total Project Cost	Rs. 930.683 Crore
Grant During Construction	40%
Grant for Operation & Maintenance	0%
Post Tax FIRR	18 %
Equity FIRR	24.17 %
NPV @ 12%	Rs. 279.68 Crore

2. With no grant

Concession Period	20 Years
Total Project Cost	Rs. 973.298 Crore
Grant During Construction	0%
Grant for Operation & Maintenance	0%
Post Tax FIRR	12.18 %
Equity FIRR	14.36 %
NPV @ 12%	Rs. 12.16 Crore

3. With Grant 7%

Concession Period	20 Years
Total Project Cost	Rs. 965.624 Crore
Grant During Construction	7%
Grant for Operation & Maintenance	0%
Post Tax FIRR	12.62 %
Equity FIRR	15.04 %
NPV @ 12%	Rs. 39.85 Crore

It is evident that the Highway Project is attractive under B.O.T. with concession period of 20 Years.

2.16 Procurement & Packaging

Suggested Packaging

The entire project road is proposed to be taken up under one package only considering short length of 58.630 km. of the project road and toll revenue management and financial viability. The concession period of 20 years including construction period is proposed.

There is one toll project length which overlaps the Project Road length from km. 485/000 to km. 498/000 including construction of Wainganga bridge. Toll construction for this project is in operation M/S Ashoka Buildcon Pvt. Ltd. Nagpur. The Toll Plaza is located at km. 489/400. The concession agreement was drawn by MoSRT&H – GOI on dt. 16.11.1998.

As per agreement the concession period in 18 years 9 months including construction period. On the basis of this the concession period shall be continued up to 15th day of August 2017 if no extension is granted further. On examination of the concession agreement, it is seen that no termination etc. The termination payments to the existing concessionaire will have to be decided by negotiations or the concessionaire may be asked to participate in the bidding process with right of refusal to match with the lowest offer. The concessionaire can be given first right of refusal to match the preferred offer of not then the termination payment will have to be decided by negotiations, mutually accepted.

2.17 Concessions and Recommendations

1. The widening and improvement proposals for road and structures as discussed in various chapters be adopted for development of highway project.
2. Since, sufficient ROW of 45.00 m is available for starting 4-lane construction, the land acquisition proceedings can be conducted simultaneously.
3. The liabilities on account of closer of existing toll plaza in km. 489/400 for Wainganga bridge will result in additional liability which are considered on approximate basis.

The concession period considered is 20 years including construction period.

The Project is financially viable as Equity IRR of 15% is achieved with Grant of 7% only.

Further that, due to acquisitions of toll rights of existing concessionaire M/S Ashoka Buildcon Pvt. Ltd.,M/S Jayaswal Ashoka Infrastructure Pvt. Ltd. Nagpur is respect of toll station in km. 489/400 the question of conflict between old on new concessionaire is fully avoided.

2.18 Rain Water Harvesting

- Along the project road corridor, at every 500m rain water harvesting system will be provided on both side of road.

3.0 Baseline Environmental Status

The existing environmental status in respect of road widening of NH 6 (km.485/000 to km. 544/100) from Nagpur – Bhandara serves as the basis for Environmental Impacts Assessment. The baseline environmental quality is assessed through field studies within the impact zone for various components of environment, viz. Air, Noise, Water, Land and Socio-economic. The baseline data was collected as per guideline for Environmental Impact Assessment for highway projects and as per the provision in the EIA notification of (dt. 14th September, 2006). and its amendment of December 2009

3.1 Air Environment

- **Methodology for Ambient Air Quality Monitoring**

The standard methods and procedures prescribed by CPCB were used for the monitoring of Ambient Air quality for various parameters like Suspended Particulate Matter (SPM). For which, the samples were collected as 24hr averages by drawing air at the rate of 1.0 -1.5 m^3/min through glass fiber filter paper and analyzed by gravimetric method.

The reparable suspended particulate matter (RSPM) was measured by gravimetric method. SO_2 and NO_X were analyzed by spectrophotometric method.

3.1.1 Micrometeorology

Sources of Information

Secondary information for the last years on meteorological conditions was collected from the nearest IMD station at Nagpur. Pressure, temperature, relative humidity, rainfall, wind speed and direction are measured twice a day viz., at 0830 and 1730 hr.

Temperature

The winter season starts from December and continues till the end of February. The maximum temperature recorded 36.1°C in the month of February and minimum temperature recorded 7.6°C in the month of December. Both the day and night temperatures increase rapidly during the onset of summer season from March to May.

During summer season, the mean maximum temperature (May) is observed at 45.9°C with the mean minimum temperature at 23.1°C in the month of March. The mean maximum temperature in the monsoon season was observed to be 44.2°C whereas the mean minimum temperature was observed to be 21.1°C. By end of September with the onset of post-monsoon, day temperatures decrease slightly with the mean maximum temperature at 34.2°C the mean minimum temperature at 10.5 ^{0}C.

Relative Humidity

The average monthly minimum and maximum relative humidity is observed around 19% to 40% during summer period. In the monsoon period the relative humidity ranges between 46% and 85%. During the post-monsoon season, the mean humidity is observed between 43% and 71%. During winter season, the mean humidity is observed between 26% and 65%.

Rainfall

The average annual rainfall based on the IMD data is 1127 mm. The monsoon generally sets in during the first week of June. The rainfall gradually decreases after August. The maximum numbers of rainy days are observed in the month of July.

Cloud Cover

During the winter and the summer seasons, it was observed that the sky was very clear. In the summer season, light clouds were observed in the evenings, with no clouds in the mornings. During monsoon season, both in the mornings and evenings the sky was observed to be generally cloudy.

Wind Speed / Direction

The IMD Nagpur based summer season & annual wind rose is shown that predominant wind direction was SW and NW

It was observed that the temperature at the proposed site during study period ranged from 17.0 ^{o}C to 46.6 ^{o}C. Where as the relative humidity ranged from 21% to 42%.

3.1.2 Ambient Air Quality Survey

The prime objectives of Ambient Air Quality (AAQ) monitoring within 7 Km distance on either side of the proposed road were to establish existing regional background levels and baseline air pollution status.

Ambient Air Monitoring was carried out at Ten (10) locations within radial distance of 7 km from center of the proposed road. The levels of Rrespirable Particulate Matter (RPM), Sulphur dioxide (SO_2) and oxides of nitrogen (NO_X), CO and PB representing the criteria of pollutants were monitored for assessing base line air quality status.

Results indicate that concentrations of SPM, RPM, SO_2, NOx and CO are well within the prescribed standards.

RPM (PM10) - 37 to 68 µg/m^3.

SO_2 - < 5 to 17 µg/m^3

NOx - 6 to 21 µg/m^3.

CO - <100 to 146 µg/m^3.

3.1.3 Noise Environment

The major source of noise along the existing NH-6 is due to vehicular traffic. The other sources; which exist in the villages along the road include small industrial, commercial establishments and other activities in residential areas.

Summary of Ambient Noise Levels along the Project Road

Parameters	Category	L_{day} dB(A)	L_{night} dB(A)	L_{dn} dB(A)	L_{eq} dB(A)	CPCB Standard dB(A) L_{eq}	
						Day	Night
Bhilwada	Residential	45.4	35.8	41.2	42.6	55	45
Bhandara	Commercial	55.7	41.0	51.0	48.7	65	55
Shahapur	Residential	55.1	39.7	49.3	46.2	55	45
Thana	Residential	51.0	37.7	46.0	44.3	55	45
Mauda	Commercial	55.0	38.9	49.0	45.7	65	55
Wadoda	Residential	54.0	38.6	48.5	45.1	55	45
Mahalgaon	Residential	55.0	38.6	49.0	46.0	55	45
Kapsi Khurd	Commercial	55.2	42.2	53.0	48.6	65	55

which are below the CPCB standard.

3.1.4 Baseline Data

The water quality in and around the project road was assessed through physicochemical analysis of surface and ground water samples collected during March 2010..

The existing status of ground water and surface water quality was assessed by identifying 2 surface water and 11 ground water (hand pump / wells) in different villages

It was observed that all the parameters are well below the stipulated Drinking Water Standards, except hardness in some villages, which may due to capillary action.

Bacteriological Characteristics

Coliform group of organisms are the indicator of faecal contamination. Only surface water samples were analyzed for total and faecal coliform which show the presence of faecal contamination, which may be due to human activities observed during study period.

3.1.5 Land Environment

Land use along the road side

The study area along both sides of the road is found occupied primarily for three activities, viz. agriculture, built up land and barren land. The stretch of road under consideration passes through Agriculture and barren land for its major portion. The detailed break up for the land use is as under:

- The land use pattern of the project area is as below.

Built up area (km)	One side Built up & and One side Agriculture (km)	Barren Land on both sides(km)	One side Barren & One side Agriculture (km)	Agriculture Land (km.)	Total (km)
14.40 (24%)	2.00 (3%)	1.80 (3%)	1.00 (1%)	41.10 (69%)	59.10

i.e. Agriculture land and barren land (73%), barren land (3%) & built up land (24%).

Hydrology

The water bodies observed in the study area are Wainganga and Kanhan rivers. The proposed road travels far away from the high flood level (HFL) of this rivers. Thus the proposed road is away from the influence of any flood from this reservoir.

Physical Characteristics of soil

Soil is one of the important components of nature and is a primary medium for biological and human activities including agriculture. The entire stretch of the proposed road from chainage 485/00 to 544/100, in general is at uniform elevation.

The soils with low bulk density have favourable physical condition whereas those with high bulk density exhibit poor physical conditions for agriculture crops. The bulk density of the soil in the study area ranges between 1.38 to 1.43 g/cm^3 which indicates favourable physical condition for plant growth.

Soil porosity is a measure of air filled pore spaces gives information about movement of gases, inherent moisture and development of root systems and strength of soil. The porosity and water holding capacity of the soils are in the range of 34% to 41% and 29 % to 37% respectively.

Chemical Characteristics of soil

The chemical characteristics of soils were analysed for selected parameters viz. pH, EC, soluble anions and cation, organic content.

pH is an important parameter indicative of alkaline or acidic nature of soil. It greatly affects the microbial population as well as solubility of metal ions and regulates the nutrient availability. The pH of the soil is found to range from 7.53 to 7.87 i.e. (neutral range), thus conducive for the growth of plants.

Electrical conductivity, a measure of soluble salts in the soil is in the range of 0.212 m mhos/cm to 0.377 m mhos/cm. The important cations in the soil are calcium and magnesium, whose concentration ranges from 0.022 to 0.039 % and

0.0013 to 0.019 % respectively. Variation in CEC of the study area is found to be in the range of 36.22- 46.25 meq/100g.

Organic carbon content present in the soil influences its physical and chemical properties that are responsible for the stability of soil aggregates. Organic carbon is found in the range of 0.47- 0.79%. This shows that soil is moderately good in organic and nutrient contents.

4.0 Anticipated Environmental Impact & Mitigation Measures

4.1 Identification of Impact

Identification of impacts is an important component in environmental impact assessment process. Several techniques and methodologies are in vogue for Identification of the impacts due to proposed widening of the road. The environmental impacts due to the proposed widening of the project can be classified as primary (direct) and secondary (indirect) impacts. Primary impacts are those which are induced directly by the project where as secondary impacts are those which are indirectly induced, which include changing patterns of social and economic activities due to the proposed road widening project. The assessment of the impact in respect of air, water, land and socio-economic components of environment have been made, based on available scientific knowledge and judgments.

The proposed widening of NH-6 will reduce the chances of accidents, greater travel speeds, reduced vehicular pollution and comfort for drivers/ users of the highway. However, it may have varied impact on the various environmental components like water quality and hydrology, air quality, noise levels, forests, public health and socio-economic structure of the surrounding area.

4.1.1 Impact on Air Environment

Impact	Mitigative Measures
Generation of Dust	• Sprinkling of water • Earth handling, Asphalt mixing site, borrow areas, construction site • Air Pollution control at stone crusher site • Masks for workers of stone crushing units • Regulation of construction timings near sensitive receptors and settlements • Regular Air Quality Monitoring
Gaseous Pollution	• Vehicles and machineries - regularly maintained to conform to the emission standards • Asphalt mixing sites atleast 500 m away from residential quarters. • Workers in asphalt mixing , application of asphalt mix will be provided with masks. • Supervising officers will ensure that the worker use the masks

4.1.2 Impact on Noise Environment

Impact	Mitigative Measures
Noise	• Noise levels of machineries used shall conform to relevant standard • Workers shall not be exposed to noise level more than 90 dBa (Leq) for 8 hours. • Workers will be provided ear plugs • Regulation of timings of construction work generating noise pollution near the sensitive and residential areas. • Regular Noise Level Monitoring

4.1.3 Impact on Water Environment

Impact	Mitigation Measures
Loss or impacts on water bodies	Precautions need to be taken during the construction work of culverts and bridges across the rivers and canals such that the flow in these water bodies is not obstructed thus affecting the cross drainage. Further, attention to be paid so that no waste, debris is discharged into surface water body.
Siltation of water bodies	• Turfing or pitching of embankments where possible to prevent erosion. • Slopes of embankments - modified and re-channelised so that contaminants may not enter the water body

Impact	Mitigation Measures
	• No solid waste will be dumped in or near the water bodies or rivers
Flooding due to siltation of drainages channel	Excavated earth and other construction materials shall be stored away to prevent washing away
Water for construction	Water sources would be selected such that local availability is not affected
Contamination from wastes	• Septic tanks and oil interceptors will be provided to prevent any uncontrolled effluent discharge from workers camps and storages. • The camp site will be provided with proper drainage connected with local drain
Contamination from fuel	• Vehicle maintenance will be carried out in a confined area, away from water sources. • It will be ensured that used oil or lubricants are not disposed to watercourses.
Sanitation and Water use in Construction Camps	• Construction camp will be organized in a planned manner. • Workers shall be provided proper sanitation facilities including toilets. • Camps will have water supply facilities like tube wells
Rain Water Harvesting	• Rain Water Recharge Pits at every 500 m of the project road will be provided.

41.4 Impact on Solid Waste Generation

Item	Management Strategy
Top Soil 105000 m3 To be utilized in median (Top layer of 150 mm thick) -- 30000 m3 In slopes of embankment -- 75000 m3 To be disposed off in low lying areas within ROW	Completely used in Green Belt Development
Overburden – 245100 m3 To be utilized in median (Below layers) -- 70,000 m3 To be utilized for construction of Roads to quarries -- 75,000 m3 In road embankment for additional 2 lanes -- 100100 m3	Used for strengthening of slopes of embankments, construction of haul roads to quarries & median filling

Item	Management Strategy
Construction debris 17000 m3 Bituminous material removed from existing pavement -- 33000 m^3 **Total 50000 m^3**	Construction Debris – Mostly reused for filling of low lying areas and in road construction. Remaining dumped after requisite permission in designated disposal grounds
Domestic Solid Waste – 0.16 m3 / day	Disposed in Municipal / Grampanchayat at Dumping grounds after requisite permission

4.1.5 Impact on Land Environment

Impacts	Mitigation Measures
Loss of topsoil Total land requirement for Project (Available ROW land & land to be acquired) : 131.186 ha	• Removed and stockpiled on sides and used on the side slopes & shoulder, for top cover of borrow areas and in green belt development. • Turfing of road embankment slopes with herbs, shrubs and grasses
Loss of topsoil from borrowing	• Arable lands will be avoided for earth borrowing. If needed, topsoil will be separated and refilled after excavation
Borrowing of fill materials	• Excavation from pre-selected locations. After excavation the borrow pits will be dressed to match with the surrounding. • Borrow pits - depth regulated. Slope of Sides of the excavation not steeper than 1 vertical to 4 horizontal from the edge of the final section of bank.

4.1.6 Impact on Ecological

Impacts	Mitigation Measures
Loss of trees	• About 5933 trees likely to be felled • Thrice the no. of tree cut will be planted i.e. More than 17799 trees will be planted as per the compensatory afforestation. • Shrubs to be planted in median. • Arjuna, Pipal, Nili gulmohar, Mango, Kachnar, Siris, Neem are the predominant tree species along the project corridor and same species will be planted

4.1.7 Impact on Public Health / Occupational Safety

Impacts	Mitigation Measures
Safety to Public	Signs on road before construction areas
Restriction to Access	Safe and convenient passage for vehicles, pedestrians and live stocks to and from the side roads and property across the road.
Occupational safety for workers	Contractor will arrange all safety measures for workers as per factories Act
Occupational safety for Asphalt plant workers and crusher plant	• All worker employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. • For crusher workers masks should be provided.
Explosive use	Contractor shall obtain such permission as required from all Government Authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.

4.1.8 Cultural Properties / Roadside Amenities / Archeological Sites

Impacts	Mitigation Measures
Affected roadside amenities and cultural properties	• Affected religious structures will be relocated. Alternative sites will provided and appropriate enhancement will be done. • All common property resources will be replaced before the start of construction. Relocation site identification will be in accordance to the choice of the community / concerned agency.

5.0 Environmental Management Plan

- The objective of Environmental Management Plan is to suggest mitigative measures for adverse impact due to the proposed road widening project. A comprehensive environmental management plan consisting of proposed pollution control system and additional mitigative measures for abatement of undesirable impact are delineated in this section. The action plan includes effective pollution control measures, road side plantation; adequate safety measures during road accidents and post project environmental monitoring.

Impacts anticipated due to project activities are not very severe, care has to be taken to ensure that the ambient environmental quality do not deteriorate further. These projects will improve connectivity to various regions and provide safe and efficient service to the vehicles.

5.1 Air Environment

Construction Phase

- To prevent fugitive dust emissions from Stone crusher and hot mix plant and due to vehicular movement of raw material transports, during construction activities, provision for on line water sprinkler on stone crusher and dust collector at hot mix plant shall be made and regular water sprinkling on constructions site shall be made.
- Construction work should be taken during peak hours in day time in the area requiring road closing specially during heavy traffic.
- The construction activities shall be carried out under restricted condition. The work schedule and the operation time of each machine shall be suitably modified to exercise a control on the ambient air quality levels.
- Proper care should be taken for storage of Diesel and fuels.
- Delivery trucks or other equipment shall not be permitted to park when they are not in active use.
- Tarmix shall be supplied from the plant located away from project site in order to reduce travel distances of tarmix delivery trucks which will help in reducing dust emissions by not transporting cement, sand etc. to actual site.
- Dust covers shall be provided on the trucks to be used for transportation of materials prone to fugitive dust emissions.
- All the stationary equipment shall be located at far off distance from sensitive locations which will result in less impact due to dust emission.

- All the activities such as demolition, excavation, grading sites and routes of delivery vehicles shall be frequently watered to suppress dust.
- Low emission construction vehicles/ equipment shall be used wherever feasible. Construction areas should be enclosed, wherever possible.

Operation Phase

- Plantation of trees along the ROW shall help to reduce air/noise pollution effects.
- Continuous maintenance of highway shall help in maintaining traffic flow and will help to reduce air pollution effects.
- The traffic flow at signalised junctions shall be operated as follows:
  - Minimum numbers of signals should be provided.
  - Additional sets of signals should be provided at elevated locations,
  - Provide signal time indicators, so as to eliminate unnecessary idling, at intersections.
  - Amber signals should be provided on subsidiary road.
  - Mitigation measures to reduce air pollution levels at operation phase shall be due to the use of fuel efficient vehicles and fitting catalytic converters. Though there is a constraint in implementing these devices by implementing agency, the following measures if enforced by implementing agencies shall reduce further ambient air pollution level.
  - Plantation of trees which are known to absorb hydrocarbons is recommended. The trees recommended are Ficuc bengalensis (Banyan tree), Ficus religiosa (Sacred fig tree), Terminalia catappa (Indian almond) and Pongamia pinnata (Pongam oil tree).
  - Development of the land scape along the road is recommended which shall reduced the concentration of ground level pollutants.

5.2 Noise Environment

Construction Phase

- The prime sources of noise levels during the construction phase are due to construction machinery, vehicular noise and material movement at the site.
- The use of equipment generating noise level of not greater than 90 dB(A) shall be used by contractor.
- Construction Contract Specification should be at stipulated levels of maximum noise generation in various zones (residential, commercial and sensitive) based on CPCB Noise Standards.
- High noise generating construction activities like drilling, compacting etc. should be carried out only during day time in residential areas and during non teaching hours near schools.
- Workers working near high noise construction machinery should be supplied with ear muffs/ear plugs.
- The noise producing sources such as concrete mixers, generators, grader etc. shall be provided with noise shields around them. The noise shields can be physical barriers, which is effective in adequate attenuation of noise levels.

Operation Phase

- Noise levels at highway will always exceed noise standards for residential area during day and night time (Noise standard for sensitive receptors: 50 dB(A) during day time and 40 dB(A) during night time). These noise levels shall be attenuated by providing wall barrier.
- Noise barriers shall be provided at appropriate locations particularly in the areas where the alignment passes through inhabited areas so as to ensure that the noise levels do not exceed the prescribed standards.
- Road passing through sensitive areas like schools and hospitals a 3m high enclosure made up of brick and mud with internal plastering of a non-reflecting surface shall be very effective for reducing the noise levels. The

levels of noise that can be attenuated by various wall heights at these receptors varies with distance from ROW The following mitigative measures has been suggested to control the noise levels:

- The area of ROW available on both the sides of the road should be used to develop green belt consisting of selected plant species of trees with high canopy to provide added attenuation of noise.
- Use of horns should be minimised on the road during nights. During daytime use of horns should be restricted at sensitive locations. This can be achieved through the use of appropriate signboards along the road, especially at sensitive locations.

5.3 Water Environment

Construction Phase

- Adequate provision for infrastructure facilities including water supply fuel and sanitation must be ensured for construction workers during the construction phase of the project in order to avoid any damage to the environment.
- Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.
- Water should be judiciously used in order to avoid the use of the access water which will restrict the generation of waste water during the construction activities.
- The EMP for the waste water and solid waste generation by workers during constructions activities should be implemented so as the aesthetics and environment of the surrounding area is maintained.
- The issue of blocking of cross drainage should be taken care throughout the project stretch.
- Runoff from the construction site shall be passed through silt traps.
- Pitching stabilisation of soil and slope protecting measures shall be taken up to reduce erosion of soils.

- Appropriate drainage system with catch drains and catch pits shall be designed to drain out hazardous chemicals in case of accidental spillage of hazardous material due to the road accidents.
- The workers camp shall not be located within 1 km from the densely populated area.
- Adequate sanitary facilities, drainage, washing and toilet facilities with septic tanks and refuse collection and disposal should be provided to the workers. The provision of water supply and toilet facilities should be made as per the stipulated guideline in the Indian Labour Act.
- The project proponent shall obtain necessary permission from the State Irrigation Department before drawing water from the river sources for the purpose of the proposed construction activity. No groundwater shall be drawn for the project.
- Longitudinal drains shall be provided all along the project road to ensure proper drainage of the area. In addition, adequate number of under passes and culverts to act as cross drainage structures shall also be provided.

Operation Phase

- No EMP is envisaged in post operation phase, due care of all surface water shall be taken during the construction phase only.

5.4 Land Environment

Construction Phase

- Soil Erosion:

  Soil erosion is likely to occur during the constructions activities which may lead to silting of nearby water bodies. The following measures should be taken to prevent soil erosion and land degradation.

  - All slopes in cut and embankment section should be made stable to avoid slides and should be provided with benches, pitching, breast walls etc.
  - All slopes with soil surface should be either pitched or turfed.

- Earthwork should be carried out sufficiently in advance of monsoon season, and temporary or permanent erosion protection work as may be feasible should be provided.
- Drainage of water from road surface and land along the alignment should be planned to avoid flooding and high velocity flows be properly linked to natural drainage system.
- All culverts and bridges should be designed so as to avoid silting at inlets and erosion at outlets.
- All areas within the right of way except carriageway and shoulders should be planted with trees or grass.

- Borrow sites for earth, quarry sites for road construction material and dump sites must be identified keeping in view the following:
  - No excavation or dumping on private property is carried out without written consent of the owner.
  - No excavation or dumping shall be allowed on wetlands, forest areas or other ecologically valuable or sensitive locations.
  - Excavation work shall be done in consultation with the Soil Conservation and Watershed Development Agencies working in the area.
  - Construction spoils including bituminous material and other hazardous materials must not be allowed to contaminate water courses and the dump sites for such materials must be secured so that they should not leach into the ground water.
- The construction material shall be obtained only from approved quarries. In case new quarries are to be opened, specific approvals from the competent authority shall be obtained in this regard.

- The hot mix plant shall be located at least 500 mtrs. Away from the habitation and on the barren land to avoid its adverse impact on the human population.
- The embankments / slopes and the slopes left after cutting will be provided with vegetative turfing to avoid soil erosion.

Operation Phase

- Construction material shall be disposed to low lying area.
- The land use along the project road is expected to change due to increase economic activities during operation phase. The management plan for land use shall be considered as under:
  - Many heavily built-up settlements along the project road which are densely populated will be very closed to the road after the project road widening is over, there by creating the safety concerns of the people. A care should be taken to avoid accidents.
  - The water bodies, canals and small streams is likely to get contaminated during the construction and operation phase. Any activity that obstructs the natural flow of these streams could lead to flooding problems. This could be avoided by the project authorities by providing the facilities for drinking water and for other use, away from the water sources.

5.4.1 Terrestrial Ecology

Construction Phase

- The 5933 number of trees to be cut during the construction of the proposed road.
- Survival rate of plants must be included in the contract specifications so as to ensure that the compensatory plantation of 17799 trees are proposed to be planted achieves the objective of compensating lost trees.

- Indigenous and endemic tree species suitable for the area should be planted at the onset of monsoon season. The plants should be provided with adequate protection from animals and proper monitoring should be carried out to ensure their growth during construction activities.
- All the major and sensitive tree species, wherever possible shall be transplanted to minimize the impacts of loss of vegetation before the start of construction activities.
- The equal number of plants should be planted for each tree cut as a part of compensatory plantation. The compensatory plantation should be done in consultation with the forest department. Adequate care of the compensatory plantation should be taken up so as to achieve 90% survival rate.
- The construction material shall be brought from already existing nearby approved quarries and borrow areas to minimise the adverse impact on land use.

Operation Phase

- The widening of the road as per the proposed plan is likely to results in uprooting of existing plants / trees. An attempt should be made to save as many of these trees as possible.
- Many young trees on the immediate border of the existing road can be considered for protection in the Median Verge (MV).
- Specifically large and healthy trees of Banyan, Neem etc. should be given maximum weightage in tree protection than giving importance to merely the number of trees to be protected.
- For protecting the trees necessary change in alignment shall be made in ROW if possible.

- Wherever possible, existing trees in the isolated patches, groves, clusters, open space, should be offered protection as a part of the road widening activity and they should be further strengthened.
- The rate of survival of the trees on the roadside required attention at least for five years. For this appropriate funds should be earmarked for comprehensive tree plantation programme.
- The plantation should be based on ecological value followed by aesthetic value of the tree.
- The topography, agro-climate, soil profile should be considered while selecting the tree species.
- No fruit trees are recommended for plantation which could be nuisance at latest stage of plant growth.
- The species of trees to be selected for plantation should preferably be Banyan, Pimpal, Neem, Karaj, Tamarind, Karambola, Spathodia, Bahava, Indian Cork Tree, Peltoforum, which provide shelter, good aesthetics with greener foliage for a longer duration.
- The saplings to be used should be at least 5-6 feet tall & healthy which are grown in nursery for at least 2-3 years.
- Individual protection to the trees with steel tree guard should be provided.
- Plantation shall be done on the available space of ROW which will be maintained by way of watering and soil work at least for 5 years.

5.5 Socio-economic Environment

The following management plan shall be implemented.

- Rehabilitation and payment of compensation to the affected people (PAPs) shall be made as per the policy of the State Government.
- Project Authorities shall provide gum boots, goggles and other appropriate protective equipments during construction phase.

- Project Authorities shall provide medical facilities during construction phase in the event of accidents.
- Heads of the local population control authorities / Administration shall be taken into confidence to minimize friction between management and localities.
- Safety measures shall be identified in the event of accident during operation phase of the proposed road in collaboration with district authorities.
- Adequate arrangements shall be provided for crossover to residents, school children, cattle and bullock carts.
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- From the above, it has been observed that the environmental issues can be resolved satisfactorily, if the suggested mitigative measures are properly implemented as a part of the project both during construction and operation.

5.6 Post Project Environmental Monitoring

5.6.1 Air Environment

- For the proposed road widening activities following monitoring systems are proposed:
- Ambient Air Quality monitoring programme at sensitive and residential area in respect of RPM, NOX, SO2, methane and non-methane hydrocarbons shall be undertaken by the authorised monitoring agencies.

5.6.2 Noise Environment

- Monitoring of the noise levels at sensitive and residential area is essential to assess the effectiveness of Environmental Management Plan implemented to reduce noise levels.

5.6.3 Land Environment

- Condition of the various plant species should be recorded regularly simply by visual observations with respect to vegetation growth, flowering etc. this may help in identifying affected plants. The survival rate of plants needs to be monitored and if required may be replaced by planting fresh plants.

5.6.4 Budgetary Provisions for Environmental Management Plan

- Adequate budgetary provision has to be made by the project authorities by identifying the appropriate monitoring agencies for the following component.

Item	Assumptions	Cost (Rs. In Lakhs)
DURING CONSTRUCTION PHASE		
• POLLUTION CONTROL		
1. Provision of Sewage and Sanitation Facilities for the construction camp sites to be established including their maintenance for 3 years.	Lump Sum	20.00
2. Provision of Water Supply Facilities towards meeting the water demand of camp site people for their daily chores.	Lump Sum	16.00
3. Dust Suppression at Site by sprinkling of water on loose beds and active work sites.	Rs. 800 / trip for 4 trips a day for 5 tankers for 700 working days.	224.00
	TOTAL	**260.00**
• MONITORING COSTS		
4. Air Pollution Monitoring during the construction period, 10 locations and three seasons in a year for three years.	Rs. 3000/ Sample	2.70
5. Noise Monitoring during the construction period, 10 locations and three seasons in a year for three years.	Rs. 2000 per location for 24 hour sampling	1.80
6. Soil quality monitoring for the agricultural soil samples in the vicinity of the project site; 10 locations and two seasons (Monsoon and Summer) in a year and for three years.	Rs. 2500 per Sample	1.50
7. Water quality monitoring for 12 locations (4 rivers, 4 bore wells, 4dug wells for construction sides), three seasons in a year for three years.	Re. 2500 per sample	2.25
	TOTAL	**8.25**
• GREEN BELT		

Item	Assumptions	Cost (Rs. In Lakhs)
8. Avenue plantation for the entire corridor @200 saplings per kilometer, 17799 saplings will be planted as avenue plantation.	Rs. 900 / Sapling (Including fencing and maintenance for three years).	160.19
9. Shrub plantation in the median for the entire corridor (For every kilometer @1000 (double row sapling from rural area (around 59 km) with 4.5m of median.	Rs. 700 / Sapling (Including fencing and maintenance for three years).	413.00
	TOTAL	**573.19**
• **SEVERANCES & OTHERS**		
10. Severance & Others (including training, workshops, awareness campaigning etc.)	Lump sum	10.00
TOTAL COST DUING CONSTRUCTION PHASE (A)		**851.44**
• **DURING OPERATIONAL PHASE**		
• **MONITORING**		
1. Air Pollution Monitoring for 10 location for three seasons in a year for two consecutive post constructions, operational years.	10 x 3 x 2 x Rs. 3000/- sample	1.80
2. Noise level monitoring for 10 locations for three seasons in a year for two consecutive post constructions, operational years.	10 x 3 x 2 x Rs. 2000/- per lodation for 24 hr monitoring	1.20
3. Soil quality monitoring for the agricultural soil samples in the vicinity of the project site; 10 locations and two seasons (Monsoon and Summer) in a year and for two consecutive	10 x 2 x Rs. 2500/- per sample	0.50
4. Water quality monitoring for 12 locations (4rivers, 4 bore wells, 4 dug wells), three seasons in a year for two post construction, operational years.	12 x 3 x 2 Rs. 4500/- per sample	3.24
TOTAL MONITORING COST DURING OPERATIONAL PHASE DURING FIRST TWO YEARS (B)		**6.74**
• **GREEN BELT**		
1. Landscaping (Maintenance of Avenue plantation & median plantation).	Rs. 12,000 / km/year (from i.e. @ 4th year onwards only)	7.08 per year
TOTAL LAND SCAPING COST DURING OPERATIONAL PHASE FROM 4TH YEAR ONWARDS FOR 10 YEARS (C)		**70.80**
TOTAL EMP (A + B + C)		**928.98**

i.e. Rs. 9.29 Crore