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E EXECUTIVE SUMMARY

E1. Introduction

This DETAILED PROJECT REPORT (DPR); FINAL is submitted in accordance with the Contract Agreement for Preparation of DPR for Rehabilitation and Up-gradation of NH Stretches under NHDP-IVB; Group B: Package-7 in State of Maharashtra to two lane carriageway and paved shoulder **with provision of capacity augmentation under Stage 3**.

E2. Project Background

The National Highway Authority of India (NHAI) on behalf of Ministry of Road Transport and Highways (MORTH), Government of India National Highways Authority of India (NHAI) has been entrusted to implement the development of stretches of NH under NHDP Phase IVB on BOT Mode / EPC mode. Under Phase IV, the Government is considering widening of 20,000 km of highways that were not part of Phase I, II, or III of NHDP program. Phase IV will convert existing single lane / sub-standard two lane highways into two lanes with paved shoulders in four stages, i.e., IVA, IVB, IVC and IVD. 5000 km of roads have been allotted in each of these stages. The subject project road intends to be developed under NHDP Phase IVB.

NHAI appointed M/s EGIS India as consultants for "Detailed Engineering Studies (DPR)" of 459km as **ONE Project** road sections as below:

- Vedshi - Osmanabad - Solapur section on NH-211; (Length 85 km)
- Dhule - Aurangabad on NH-211. (Length 140 km)
- Solapur – Sangareddy on NH-09 (km 249 to km 493); Length 234km.

Solapur Bypass & Aurangabad bypass were added by NHAI officials in July 2010 and September 2010 respectively for Feasibility & DPR study of 519km comprising of **Three Projects** as below:

- Solapur (km 0) –Yedeshi (km85) of NH 211 (length 85km)
- Aurangabad (km290.200) – Dhule (km 452.800) of NH 211 (length 162.6km); and
- Solapur (km249) – Sangareddy (km493) of NH-9 (length 244km) and Solapur Bypass (25.34km).

As per PD PIU Solapur letters NHAI/PIU/SLP/NHDPIVB/Pkg-7(Gr.B)/14011/10/1/499 dated 15-11-2010 and NHAI/PIU/SLP/EGIS/SS/14014/10/1/597 dated 02-12-2010 the NH-9 project road is divided into two construction Packages as below:

I. Solapur (km 249) – Sangareddy (km 348.8) up to Maharashtra/ Karnataka Border including Solapur Bypass (25.34km); Total length 125.4km and

II. Maharashtra/ Karnataka Border (km 348.8) – Sangareddy (km 493) in Andhra Pradesh; Total Length 145km.

In June 2011; Solapur Bypass was excluded from Solapur – M/K border Project by NHAI as per observations on PPPAC from MoRTH.

A meeting under the Chairmanship of the Hon'able Chairman with Member, CGMs, GM was held to discuss DPR of "Aurangabad – Dhule Road, NH-211" at NHAI office on 7th October 2010. In this meeting the scope of services is modified by excluding Ghat Section improvement as a combination of Tunnel and High Level Bridges as a separate project under variation to this project. Hence this DPR report excludes the details of Ghat Section.

In October 2010: Autram Ghat Section improvement was excluded as supplementary project from Aurangabad – Dhule section.

In this way one consultancy project is Divided into 6 Construction Projects under the supervision of Four PD PIU and three CGM RO officials as below:

i. Solapur (km 0) –Yedeshi (km85) of NH 211 (Design Length 84.05km) – *PD PIU Solapur*

ii. Aurangabad (km290.2) – Dhule (km 452.8) of NH 211, excluding Autram Ghat section (km 370.875 to km 390); (Design Length 143.475km); *PD PIU Aurangabad*

iii. Improvement of Autram Ghat Section (km 370.875 to km 390); - *PD PIU Aurangabad*

iv. Solapur Bypass Joining NH-13 (km 13.500) to NH-9 (km 254.585) (25.34km). – PD PIU Solapur

v. Solapur (km 249) – Maharashtra/ Karnataka Border (km 348.8) Design Length 100km; – *PD PIU Solapur All these five packages are under CGM RO Maharashtra.*

vi. Maharashtra/ Karnataka Border (km 348.8) – Sangareddy (km 493) in Andhra Pradesh; Total Design Length 145.096km. – *PD PIU Dharwad & Hyderabad, CGM RO Bangalore & Hyderabad*.

- PPPAC proposal for Solapur – M/K Border and M/K Border to Sangareddy was approved by CIC in November 2011. Concessionaires have been appointed and Project Clearances are at advance stage.

- PPPAC proposals for Solapur – Yedeshi and Aurangabad – Dhule Projects submitted in January/ Feb/ June 2011 but due to non-viability, not included in 2011 list.

- Revised PPPAC Proposals have been asked by NHAI for BOT (Toll) based on current traffic, cost and financial viability in April 2012. The consultant has submitted revised PPPAC proposals in April/May/ June 2012 to PD PIU officials for review and onwards submission to RO & HQ NHAI for approval.

- The Consultant has recommended these projects under EPC and Draft DPR is submitted n December 2011; Final DPR reports for Solapur –Sangareddy packages have been submitted in March/April2012.

After joint site visit of CGM RO Maharashtra and PD PIU Aurangabad on 13th May 2012, the Autram ghat improvement section lengths were redefined as below:

i. **Aurangabad (km290.2) – Dhule (km 452.8) of NH 211, excluding Autram Ghat section (km 376 to km 390); (Existing Length 148.6km);**

ii. **Improvement of Autram Ghat Section (km 376 to km 390); - *Existing Length 14km.***

Final DPR Report and PPPAC proposal for Aurangabad (km290.2) – Dhule (km 452.8) of NH 211, excluding Autram Ghat section (km 376 to km 390); (Existing Length 148.6km); Design Length 153.850km.

A Supplementary report of Autram Ghat section (km 376 to km 390) improvement as 4-lane Tunnel and High Level Bridge combination for further studies had been prepared and submitted to NHAI separately vide Ref: Egis-India/ NHAI/MAH DPR/11432 dated 15th June 2012.

This supplementary report for Improvement of Autram Ghat (km 376/000 to km 390/000), Section of NH-211 had been prepared comprising of the all alternatives and options studies carried out till date. Typical cross section of road approach, tunnel section, viaduct section has been prepared. Tentative Plan & Profile of the FINAL ALIGNMENT based on Google Earth & MX has been prepared. The same alignment was briefed, discussed & agreed on 13th May 2012 during CGM visit at Aurangabad. Tentative Lengths of tunnels & viaducts has been fixed based on Google Earth/ Global Mapper. Tentative BOQ & Abstract of Cost for tunnel & viaducts, road approaches has been prepared based on sqm/ thumb rule/ similar project basis. The Abstract of Cost is as below:

ABSTRACT OF COST ESTIMATE For 4-LANE ROAD, 2X12M TUNNEL AND VIADUCTS						
S. No.	**Items**	**Unit**	**Quantity**	**Rate (Rs)**	**Amount (Rs)**	**Remarks**
A	**ROAD WORKS**					
1	EACH INDIVIDUAL CROSS SECTION (TCS1, TCS2, ETC)					
	4-lane Road TCS for Fill Section	km	0.400	80,000,000	32,000,000	4-lane in Filling
	4-lane Road TCS for Hill Section	km	0.940	120,000,000	112,800,000	4-lane in Rock Cutting
	Refer Tunnel Cross Sections	km	6.860	1,055,224,342	7,238,838,985	Tunnel 2 X 12M
	Subtotal		8.200			
B	**BRIDGES AND STRUCTURES**					
2	Viaduct-1	m	**3,880.00**			
		Sqm	93,120	80,000	7,449,600,000	2 X 12M
3	Viaduct-2	m	**1,280.00**			
		Sqm	30,720	60,000	1,843,200,000	2 X 12M
	Sub total for length	**km**	**13.360**			**DESIGN LENGTH**
C	**OTHER ROAD APPURTENENCE/MISCELLENEOUS ITEMS**					
	Tunnel system cost				86,703,500	
	Tunnel maintenance Cost per year				8,670,350	
	Electrification & Ventilation cost				21,716,517	
	Miscellaneous items 0.75 cr per km				100,200,000	
	TOTAL AMOUNT				**16,893,729,352**	Rs.1689 Crores
Say Rs 1700 Crores						

Contract Agreement for the consultancy service was signed on 31 March 2010 and commencement of services started on 7th April 2010.The project duration was 10 months. Extension of Time up to 31st July 2012 was requested for approval since Feb/ August/ Dec 2011/ Jan/March 2012. The EOT approval from NHAI is still waiting.

E3. Project Description & Approach Methodology

The project road is comprising of NH-211, SH-16, SH-180 as commercial vehicles are not being allowed to travel on NH-211 due to "Archeological constraints of world heritage sites Daulatabad Fort, Khultabad gate, Ellora Caves and Lord Shiva Ghrushneshwar Jyotirling Temple from km 320+200 (Daultabad "T" Point) to km 339+000 (Ellora Junction). The section wise details of the project road are as below:

Table E.1: Existing Road Details

Sl	From (km)	To (km)	Existing Road Description
1	**290.200 (NH-211)**	**311.800 (NH-211)**	The project road starts from km 290+200 of NH-211, passing through Cantonment, urban/ semi-urban section of Aurangabad City. Existing road from km 292+000/ Zalta phata to km 311+800/ Nagar naka section is a "4-lane divided Arterial Road" *(This road section of NH-211 is not the part of the project as new Aurangabad bypass is proposed.)*
2	**311.800 (NH-211)**	**320.200 (NH-211)**	It is 7m wide 2-Lane road with Earthen Shoulder on either side. There is a heavy ribbon development along the project road causing bottleneck for the 4-lane upgradation.
3	**320.200 (NH-211)**	**339.000 (NH-211)**	This part of NH is 7m to 10m wide road, passing along archaeological monuments viz. Daulatabad fort, Khultabad gate, Ellora caves Lord Shiva Ghrushneshwar Jyotirling Temple etc. Only cars and buses are allowed to travel on this section*.
*	*Heavy traffic is not allowed to ply on NH-211 adjoining world heritage sites from km 320.200 to km 339.000 and diverted along SH-16 and SH-180 to join back NH-211 at km 339.000 as detailed below:*		
(a)	*SH-16 km 218.000*	*SH-16 km209.100*	*Existing 2-Lane 7m wide road with earthen shoulder, SH–16, being maintained by State PWD. It is being used by Heavy traffic of NH-211.*
(b)	*SH-180 km 47.570*	*SH-180 Km 52.500*	*SH-16 joins SH-180 at km 209.100(of SH 16). Existing 2-Lane 7m wide road with earthen shoulder, SH–180, being maintained by State PWD. It is being used by freight traffic of NH-211. SH-180 joins NH-211 at km 339.0.(of NH 211)*
4	**339.000**	**376.000#**	It is 7m wide 2-Lane road with Earthen Shoulder on either side.
#Autram Ghat section from km 376.000 to km 390.000 is proposed to be improved as separate project, hence excluded. The details of existing road are as below:			
(i)	*376.000*	*378.000*	*It is 7m wide 2-Lane road with Earthen Shoulder on either side.*
(ii)	*378.000*	*387.500*	*It is called Autram Ghat Section. It passes through Hilly terrain, Wild Life Sanctuary and Reserve forest area. The road carriageway width is 5.5m with one side Vertical Hill and other side deep valley. There is a level difference of approximate 350m at start and end of the Ghat section. Tunnel & Viaducts are proposed in this section.*
(iii)	*387.500*	*390.000*	*It is 7m wide 2-Lane road with 1.5m paved Shoulder on either side.*
5	**390.000**	**396.400**	It is 7m wide 2-Lane road with with 1.5m paved Shoulder on either side.
6	**396.400**	**404.200**	Chalisgaon bypass is 7m wide 2-Lane road with Earthen Shoulder on either side. This bypass is being Tolled and maintained by MSRDC Ltd. The concessionaire period is up to year 2022.
7	**404.200**	**452.800**	It is 7m wide 2-Lane road with Earthen Shoulder on either side.

Note: The Chainages of NH-211 marked in Bold letters are the part of the project road.

At Galleboregaon Village (km. 348) road geometry is substandard with curve of radius 180m. To improve the road geometry and bypass development on either side of NH a bypass is required. Starting of this bypass will be km. 347/200 and ends at km. 348/200.

At Kannad town, from Km. 363/000 to 370/000 urban development is on either side of road. Movement of traffic is very slow at this location because NH traffic is mixed with local traffic. There are 5 nos. sharp horizontal curves at this section with are not as per standard because of having approx radius less than 130m. A bypass proposal has been worked out to bypass this Kannad town and the substandard road geometry. Starting of this bypass is km. 364/600 and ends at km. 370/400. (approx. bypass length 6km).

There is a Ghat section of 7.7 km from Km. 379/800 to Km. 387/200. At this section carriageway width 5.5m without any hard shoulder. Retaining wall and crash barrier are damaged at various locations. Various alternatives have been studied at the ghat section as widening of the existing road looks to be difficult. An alternative route has been identified for a length of 20km apart from studying the tunneling option.

There is an EXISTING 2-Lane Bypass without paved shoulder constructed by MSRDC under BOT. The bypass length is 11.618km. The concession period of the existing bypass is up to **28/05/2022**. In this section construction of additional 2-Lane carriageway with paved shoulder has been proposed parallel to the existing 2-lane Chalisgaon bypass.

There exists an ROB at Chalisgaon bypass, a level crossing at km. 447/600 and a Junction with NH-3 exists at km. 452/800.

Proposed Bypasses and Re-Alignments

The NH 211 passes through many congested settlements where lot of local traffic gets mixed up with the through traffic. It is required to segregate the local traffic from through traffic, either by providing service roads or bypassing the settlements. Therefore following bypasses are proposed after carrying out detailed engineering studies:

Table E.2: Bypasses and Re-alignment Details

S. No.	New 4 Lane Bypass	From (Existing km)	To (Existing km)	From (Design chainage)	To (Design chainage)	Design Length (km)	Remarks
1	Aurangabad Bypass	-	-	290+200	324+400	34.200	Alignment is finalized and approved by NHAI officials on 17-12-10 and reviewed time to time
2	Galleborgaon Bypass	346+800	348+800	348+497	350+929	2.432	Three options have been compared, out of which, Option 1 is recommended on the Western Side of NH-211
3	Kannad Bypass	364+200	370+420	366+230	371+327	5.097	Three options have been compared, out of which, Option-1 is proposed on the Western side of existing NH-211.
4	Mehunbarne Village	411+600	416+100	415+400	419+900	4.500	Only one option is possible due to heavy built up area
5	Garthad Bypass	446+850	450+200	450+639	454+379	3.740	Three options have been compared, out of which, Option-1 is recommended on the Western side of existing NH-211.
	Total Length (km)					**49.969**	

Up-gradation of existing 2-lane Roads other than NH-211

Two Lane to Four Lane upgradation of existing SH-16, SH-180, which are not part of NH-211, but are being used, as "Commercial traffic" is not allowed to ply on NH-211, due to adjoining world heritage sites viz. Ellora Caves, Daulatabad Fort, Grusneshwar Jyotirling Temple etc., from km 320.200 to km 339.000 and diverted along SH-16 and SH-180 to join back NH-211 at km 339.000. The details are as below:

Table E.3: Improvement of Roads other than NH-211

Name	Existing Chainage (km)		Design Chainage (km)		Design Length (km)	Remarks
	From	To	From	To		
Existing Daulatabad Road (2 –Lane to 4 Lane)	218+900 on SH-16	209+300 on SH-16 near Kasabkheda Junction	324+400	334+060	9.660	**These are the existing SH 16 & SH 180 roads being used as bypass to existing NH-211 for freight vehicles by Traffic Regulatory Authorities**
Existing Ellora Road (2- Lane to 4 Lane)	0+000 on SH-180 near Kasabkheda Junction	340+250 on NH-211	334+060	341+950	7.890	
Chalisgaon Bypass (2 L Existing & 2 L New)	396+110	404+200	396+100	407+770	11.670	Existing 2-lane bypass is upgraded as 4-lane
Total Design Length of Bypasses (km)					29.220	

For ease of the project implementation, the consultant has recommended the project road as one Construction Package.

Table E.4: Proposed Details of Proposed Construction Packages

Package	Existing Chainage (km)		Location		Existing Length (Km)
	From	To	From	To	
I	290+200	452+800	Aurangabad	Dhule	148.600
	Including new 4-lane Aurangabad Bypass (34.43km) and Daultabad Road SH-16 (9.66m) ; Ellora Road SH-180 and NH-211 up to Km 376+000 and Km 390+000 to Dhule Intersection (km 452.8), Excluding Autram Ghat Section from Km 376+000 to km 390+000				
	Total Existing Length = 148.600; and Design Length = 153.850 km				
II	Autram Ghat Section from km 376 to km 390 to be improved as 4-lane Tunnel and High Level Bridge/ Viaduct combination under EPC Contract				

E4. Socio Economic Profile

The area in which the works are located is mostly plain to rolling terrain. The longitude and latitude of the project road lies between Aurangabad – Dhule 75.31^0 E to 74.77^0 E and 19.87^0 N to 20.90^0 N through two districts viz.,Aurangabad and Jalgaon.

Maharashtra State has a population of 9.67 crores. The Percentage of urban population to total population in the State is 42.40 percent. The sex ratio of 922 females per 1000 males in the State is less than that of the All India ratio of 933. The density of population of the state is 315 persons per square kilometre as against 324 persons per sq.km of the country

as a whole. The overall literacy rate of population in the state is 76.88 %,

The State of Maharashtra, which has a geographical area of 307,713 Km2. Forests occupy 46,865 Km2 of land with rich flora and fauna. Obviously, Maharashtra has to take its share in improving its forest cover. Thus about 15.23% of the total geographical area of the state is under forest cover. As per available data the per capita income for the year 2007-08 at current prices is estimated at Rs. 47051 as compared to Rs. 41144 for the previous year 2006-07. The Net State Domestic product at constant (1999-2000) prices is estimated to be Rs. 79999732 lakhs in the year 2007-08 as against Rs. 73367128 lakhs during 2006-07, showing an increase of 8.29 % over the previous year. The Gross State Domestic Product at constant (1999-2000) prices for the year 2007-08 is estimated to be Rs. 95026514 lakhs as compared to Rs. 87065619 lakhs in the year of 2006-07, showing an increase of 8.38%.

E5. Traffic Studies During Feasibility Study (May 2010)

To establish the traffic characteristics along the project road, Consultants have carried out 7-day classified traffic volume count, intersection turning movement surveys, O-D surveys, willingness to pay toll surveys, pedestrian surveys, axle load surveys, travel time surveys. Based on traffic counts, the project road has been divided into four traffic homogeneous sections:

Table E.5: Proposed Homogenous Sections

S.No.	Description	Existing Chainage	
		From	To
HS 1	Aurangabad - Kannad	Km 290.200	Km 366
HS 2	Kannad – Chalisgaon	Km 366	Km 396
HS 3	Chalisgaon – Shirud	Km 396	Km 435
HS 4	Shirud - Dhule	Km 435	Km 452

Aurangabad bypass is added in scope of work afterwards, hence HS-1 is considered from km 290.200 to km 366.

O-D and Willingness to Pay Survey

An Origin-Destination (O-D) and Willingness to Pay Survey was carried out adopting Road Side Interviews (RSI) method at the three of the classified count stations for a continuous period of 24 hours along with the classified counts. The location and schedule of the Origin-Destination survey as below.

Table E.6: Location & Schedule of Origin-Destination surveys

S.No.	Orgin-Destination Survey			Date	
I	Chainage	Location	Survey	From	To
1	341+00	Before Verul Village	OD	28-May-10	28-May-10
2	391+00	Near Police check post after Ghat Area	OD	25-May-10	25-May-10
3	441+500	Before Gartad Village	OD	21-May-10	21-May-10

E6. Traffic Surveys During Detailed Project Report (April 2012)

In order to assess the current traffic volumes fresh traffic studies are conducted. 7 day traffic volume counts were conducted at 3 locations on NH-211. Origin-Destination surveys were conducted at 3 locations i.e. one on project corridor and the other two on alternate corridors along with 1 day traffic volume counts. The survey locations and schedule of traffic surveys is presented in Table below.

Table E.7: Locations & schedule of Traffic Counts in Year 2012

S.No.	Classified Traffic Volume Count Survey (Apr,2012)			Date	
I	Chainage	Location	Survey	From	To
1	319+700	Near Daulatabad 'T' point	7 day TVC	23-Apr-12	29-Apr-12
2	391+000	Near Police Check post	7 day TVC	23-Apr-12	29-Apr-12
3	441+500	Before Gharthad Village	7 day TVC	23-Apr-12	29-Apr-12
4	97+000	On SH-10 near Malegaon	1 day TVC	27-Apr-12	27-Apr-12
5	2+000	On SH-176 near Wadigodri	1 day TVC	02-May-12	02-May-12
	Origin-Destination Survey (Apr,2012)				
1	319+700	Near Daulatabad T point	OD	24-Apr-12	24-Apr-12
2	97+000	On SH-10 near Malegaon	OD	27-Apr-12	27-Apr-12
3	2+000	On SH-176 near Wadigodri	OD	02-May-12	02-May-12

NHAI has adopted the concept of development of the projects on BOT(Toll) basis. The user pays for the development of the project criteria has been adopted in various projects and is received well all over the country. The result is well developed highways. The toll rates are also established on per km basis which is applicable to all the projects. Detailed guidelines are given to revise the toll rates.

For the present project also the Consultants have carried out the "Willingness To Pay Toll Survey" at different locations as indicated in the survey schedule. The results are analyzed and found that about 74% of the users are willing to pay for the cost of project development.

S.No.	Description	%
1	Percentage of people willing to pay the toll for the improvement of highway to 4 lanes	74 %

Annual Average Daily Traffic (AADT) Year 2012

The classified vehicle count details at different count stations are as below:

Table E.8: AADT Traffic Volume (PCU) Traffic 2012

Vehicle Type	Near Daulatabad T Point	Near Police Checkpost after GHAT	Near Garthad
	Km 319+700	Km 391+000	Km 441+500
Two Wheeler	10,048	1,447	2,336
Three Wheeler	856	125	356
Car/Van/Jeep/Tempo	4,648	1,215	1,620
Taxi	345	96	425
Mini Bus	40	9	6

Private/Company Bus		129	50	40
Bus		380	152	171
LCV		665	367	182
2 Axle Truck		1,161	695	1,003
3 Axle Truck		1,621	1,422	1,625
MAV		434	394	471
MAV >6A		3	1	1
HCE/EME		6	-	2
Agricultural Tractor		19	8	12
Agricultural Tractor & Trailor		58	50	29
Non Motorised Vehicels	Animal & Hand drawn	2	6	2
	Cycle	25	25	3
	Cycle Rickshaw	3	1	-
	Others	-	-	-
Toll Exempted Vehicles	Car / Van/Jeep	29	12	4
	Ambulance	11	2	3
	Bus / Truck	5	-	-
Vehicles	Motorised	20,458	6,046	8,286
	Non Motorised	30	32	5
	Total	**20,488**	**6,078**	**8,291**
PCU	Motorised	24,155	11,711	14,659
	Non Motorised	31	51	14
	Total	**24,186**	**11,762**	**14,673**
Tollable Traffic in PCU		**17,923**	**10,609**	**12,979**

Analysis of O-D surveys conducted during April, 2012

To understand the travel pattern on the proposed Aurangabad bypass and to estimate the divertible traffic, O-D surveys were conducted during April, 2012 at the identified locations. Mode-Wise samples obtained at the survey locations are as below. It is generally observed that the sample sizes obtained is reasonable.

Table E.9: O-D Sample

S.No.	Mode	Km 319+700 on NH-211			Km 97+000 on SH-10			Km 2+000 on SH-176		
		Sample	AADT	%	Sample	Vehicles	%	Sample	Vehicles	%
1	Car	1202	4993	24%	487	2202	22%	351	622	56%
2	Bus	173	509	34%	112	497	23%	84	118	71%
3	LCV	196	665	29%	118	506	23%	79	199	40%
4	2 Axle Truck	403	1161	35%	282	1388	20%	273	395	69%
5	3 Axle Truck	506	1621	31%	334	1600	21%	291	417	70%
6	MAV	125	434	29%	164	622	26%	21	63	33%

O-D matrices for each vehicle type were developed separately to understand the travel pattern, to estimate the traffic to estimate the divertible trips from alternate routes. The passenger and commercial vehicles O-D matrices developed are presented in Volume-1 Annexure ro Main report (Annexure 4.12).

The O-D data at Km 319+700 on NH-211 is analysed to find out commodity carried by the commercial vehicles and is presented below:

Table E.10: Commodity distribution by commercial vehicles at Km 319+700

S.No	Commodity Type	Km 319+700				
		4 Wh Tempo	LCV	2-Axle	3-Axle	MAV
1	Food Grains	11%	17%	14%	17%	10%
2	Fruits/vegetables	20%	8%	8%	12%	8%
3	Fertilizers	4%	3%	2%	1%	1%
4	Petroleum	0%	3%	6%	6%	8%
5	Building Materials	4%	14%	11%	12%	13%
6	Textiles	2%	5%	8%	9%	6%
7	Household Goods	10%	10%	10%	9%	10%
8	Mineral oils	0%	1%	2%	2%	1%
9	Heavy Machinery	1%	1%	5%	2%	2%
10	Empty	31%	30%	21%	17%	26%
11	New vehicle	0%	1%	4%	3%	6%
12	Plastic / Medicines	3%	3%	4%	3%	2%
13	Metal Scrap	2%	0%	1%	2%	3%
14	Colour	0%	0%	0%	0%	0%
15	Miscellaneous (pipe,Dabur,Kudcha,Bekri)	13%	5%	4%	6%	5%

Food grains, Fruits & Vegetables, Building materials, and household goods are the major commodities carried by the commercial vehicles.

Divertible Trips

Presently most of the truck traffic is not using the project corridor due to the presence of Ghat section. There are there alternate routes to avoid ghat portion on project corridor viz SH-10 (via Dhule-Malegaon-Kopargaon-Ahmednagar-Solapur), SH-16 (via Dhule-Malegaon-Nandagaon-Aurangabad) and SH-176 (Dhule-Jalgaon-Wadigodri) and are shown in Figure 4.28. Once the project corridor is developed with tunnel at ghat portion most of the commercial traffic which are currently using alternate route will get diverted to the project corridor. To assess the divertible traffic OD surveys along with willingness to divert survey was conducted on alternate corridors SH-10 and SH-176. The survey locations are mentioned in previous sections.

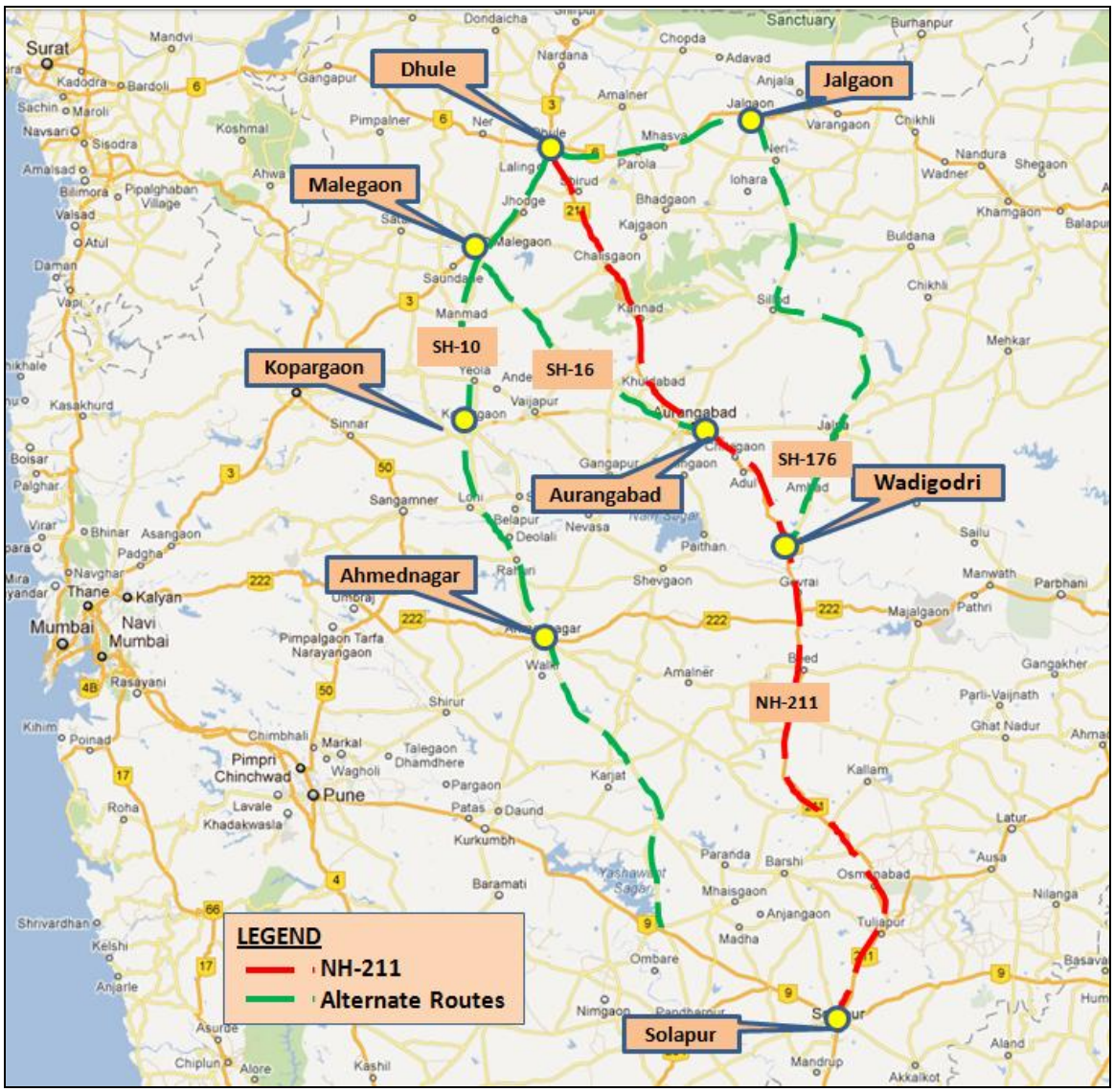


Figure E-1: Alternate Routes and Road Network

The Origin and Destination trips from the zones which are beyond north of Dhule and south of Aurangabad are considered for diversion analysis. The estimated percentage of commercial traffic willing to divert on NH-211 after tunnel construction is as below:

Table E.11: Willingness to Divert on to NH-211

Alternate Route	% of Willingness to divert
From SH-16 & SH-10	71.27%
From SH-176	49.93%

Total commercial traffic bypassing the ghat section and the estimated divertible traffic is presented in **Table below**. It is considered that about 70% of the commercial truck users who are willing to divert will only get shifted to NH-211

Table E.12: Divertible Traffic on to NH-211

Mode	Traffic Bypassing NH-211 and using SH-10/SH-16	Traffic Bypassing NH-211 and using SH-176	Divertible traffic from SH-10/SH-16	Divertible traffic from SH-176	Total Divertible Traffic in Vehicles
LCV	214	18	107	6	113
2 Axle	571	111	285	39	324
3 Axle	925	175	461	61	523
MAV	391	30	195	10	206

Since improvement of the ghat section is going to take some time say 3 years, the divertible traffic is added from 2016 i.e. 50% of the divertible traffic in the year 2016-17 and the balance 50% in the year 2017-18.

Future growth of the PIA economy

The Delhi-Mumbai Industrial Corridor (DMIC) is proposed to be developed in the vicinity of the project corridor. The details of the Development of the Industrial Regions and the Industrial Areas in the phase I and phase II are provided in the previous section. Due to these huge developments, the economy of the area will get galvanised which will reflect in the growth rates of the economy. In view of the above an additional growth of 1% is considered in the PIA economy. Since the project DMIC is expected to be implemented from 2015, the impact is considered for the period afterwards. The considered growth rates of the economy are provided below:

Table E.13 : Projected Economic Parameters with impact of DMIC

Parameter	2011-2015	2016-2020	2021-2025	> 2025
PCI	5.6	6.0	5.5	5.1
NSDP-Passenger	7.2	7.5	6.9	6.3
NSDP -Commercial	8.0	7.8	6.8	5.9

Traffic Forecast

Traffic on different section (HS-1 to HS-5, Table 3.1) of the project corridor is forecast 30 years into the future based on the growth rates estimated for the project. The traffic on the highway is estimated in three categories – Generated Traffic, Induced Traffic and Diverted Traffic.

Generated Traffic

The proposed new developments in the vicinity of the project highway will generate additional traffic. The Delhi Mumbai Industrial Corridor project is being developed by GOI. The development regions and areas in different phases are being contemplated in Maharashtra state also, the details of which are given above. Since these developments have vide spinoffs in the economy an additional 1% growth in the economy due to the

above is considered. Further to the above two Special Economic Zones are being developed in Maharashtra state in proximity to the project corridor. The impact of these SEZs are being considered in different phases and impact of the same is estimated based on the trip rates (ITE). The developmental area and estimated trips from the upcoming SEZs is presented in table below.

Table E.14: Generated Traffic from SEZs

Total SEZ area	435.39 Ha
Developmental area	108.85 Ha
Estimated total generated trips	4,485

It is considered that 30% of the total generated traffic i.e. 1346 trips of (50% -3 axle trucks, and 50% MAV) will use the project corridor. These trips are considered from the year 2016-17.

Induced Traffic

Development of the project highway will induce more traffic on to the highway. It is normal based on past experience to consider a 2% of induced traffic on such facilities. Accordingly 2% induced traffic is considered on the present project highway. Since the project highway will take three years to get developed these induced trips are considered from the year 2016-17.

The growth rates for realistic scenario of different types of vehicles are as below:

Table E.15: Growth rates for the Realistic Scenario

Period	Two Wheeler	Car/ Jeep/ Van	Mini Bus	Bus	LCV	2 Axle Truck	3 Axle Truck	MAV up to 6 Axle	MAV >6 Axles	HCM/EME
Upto 2015	10.9	9.9	6.6	6.6	8.3	3.7	10.1	10.1	10.1	10.1
2016-2020	11.7	10.4	6.9	6.9	8.1	2.7	9.0	9.0	9.0	9.0
2021-2025	10.1	8.7	6.3	6.3	7.0	1.6	7.8	7.8	7.8	7.8
> 2025	9.4	8.0	5.8	5.8	6.1	1.4	6.8	6.8	6.8	6.8

Number of Lanes Requirement as per Traffic 2012

It is considered that the Medium Economic Growth Scenario (MEGS) is the most likely one to occur in future. Traffic forecasts for MEGS indicate that the traffic along the project corridor varies between 35 and 55 thousand PCU's by the horizon year in different sections. The summary of the Traffic forecast is presented in **Table below**.

Table E.16 : Summary of Traffic Forecast as per Traffic 2012

Year	Traffic Volume in PCU s			Remarks
	319.7	391	441.5	
2012	**24,191**	11,774	14,676	**4-Laning as per LOS"B"** Base Year
2013	**25,377**	12,352	15,400	**4-Laning as per LOS"C"**
2014	26,622	12,958	16,159	
2015	27,929	13,594	16,956	Construction Ends
2016	37,145	21,806	**25,407**	**4-Laning as per LOS"C"**
2017	**40,934**	24,843	28,624	**6-Laning as per LOS"B"**
2018	42,702	**25,820**	29,791	**4-Laning as per LOS"C"**
2019	44,556	26,846	31,015	
2020	46,503	27,922	32,301	
2021	48,547	29,053	33,650	
2022	50,691	30,239	35,067	
2023	52,942	31,485	36,554	
2024	55,305	32,792	38,115	
2025	57,785	34,165	39,753	
2026	60,388	35,606	**41,473**	**6-Laning as per LOS"B"**
2027	**63,120**	37,118	43,279	**6-Laning as per LOS"C"**
2028	65,987	38,706	45,174	
2029	68,997	**40,373**	47,164	**6-Laning as per LOS"B"**
2030	72,157	42,123	49,253	

IRC-64:1990 specifies a design service volume of 15,000 PCUs/day for two lane roads (plain terrain, low curvature) which can be increased by 15% with the provision of paved shoulders i.e. 17,250 PCUs /day. This refers to a Level Of Service (LOS) of B i.e. 0.5 times the Capacity. It was also recommended to design the highway for the LOS B only. The above table shows when (the year) this threshold value is crossed and when we should go for the 4 lanes and it is summarized in the **Table below**.

Table E.17 : Section-wise 4 Laning requirement

S.No.	Section	Year in which 4 lanes are required
1	Aurangabad-Kannad section	**2012**
2	Kannad- Ghat section	**2016**
3	Ghat Section - Chalisgaon	**2016**
4	Chalisgaon-Shirud section	**2015**
5	Shirud-Dhule Section	**2015**

Capacity Augmentation

IRC indicates that the design service volume is 15,000 PCU per day for two lane road with earthen shoulder at Level of Service (LOS) – B (50 % capacity) in plain terrain. Similarly for four lane road, the design service volume is 35,000 PCU per day at LOS – B. The same capacities can be increased by 15 % for roads with paved shoulder. Capacities for different lane configuration at various levels of services are presented in **Table below**

Table E.18: Capacities for Rural Highways (PCUs / day)

Capacity @ Level of Service (LOS)	Percentage of total capacity	Without Paved Shoulder		With Paved Shoulder	
		Two Lane	Four Lane	Two lane	Four Lane
Capacity @ LOS-B	50 %	15,000	35,000	17,250	40,000
Capacity @ LOS-C	70 %	21,000	49,000	24,150	56,000
Capacity @ LOS-D	85 %	25,500	59,500	29,325	68,000
Capacity @ LOS-E	100 %	30,000	70,000	34,500	80,000

Source: IRC:64-1990

Projected traffic in cardinal years and lane requirements at LOS B and LOS C are presented in **Table below**.

Table E.19: Section-wise Capacity Augmentation

Capacity Augmentation Section	Requirement of Four Laning		Requirement of Six Laning	
	Level of Service B PCU >17250	Level of Service C PCU >24150	Level of Service B PCU > 40000	Level of Service C PCU > 60000
Aurangabad-Kannad section	**2012**	2012	2017	2026
Kannad- Ghat section	**2016**	2017	2030	2040
Ghat Section - Chalisgaon	**2016**	2017	2029	2039
Chalisgaon-Shirud section	**2015**	2016	2026	2037
Shirud-Dhule Section	**2015**	2016	2026	2037

It shows that number of vehicles drastically reduce in Ghat Section which is a bottleneck to the project road. 4-laning of Solapur to Aurangabad (290km) is already in process. NH-3 & NH-6 joining Dhule junctions are already 4 lane. Hence improvement of Aurangabad – Dhule section including Ghat section is essentially required for better connectivity to NH-13, NH-9 at Solapur, NH-3 and NH-6 at Dhule. Four Laning is recommended for implementation.

E7. Design Standard

Project road generally runs in plain & rolling terrain. Kannad, Autram ghat bypass stretch of 8km length is under hilly terrain. As per NHAI design guidelines, Right of Way (ROW) of 60 m and 45m has been considered for the proposed project upgradation at rural and urban areas respectively. At isolated locations like junctions, rest areas, toll plazas, wayside amenities etc. more land has been proposed in order to accommodate these facilities.

As per ToR, the geometric elements covering lane width, horizontal alignment, and vertical profile have been considered for a design speed of 100 Kph with a 2x2 Lane configuration of 7m carriageway plus 1.5 m paved shoulder and 1m granular shoulder. Camber of 2.5 per cent has been adopted for pavement. Super elevation is limited to 5% as per codal requirements. The radius of more than 360 m has been provided for the horizontal curves, wherever possible, higher radii are being adopted. The horizontal curves with radius of curvature less than 2000 m, transition curves are provided on both ends of circular curve. Desirable sight distance is taken as 180m as per codes. 2.5% (1 in 40) vertical gradient for approaches of grade separators is adopted as per IRC 92.

Median openings shall be provided approximately 2.0 Km. intervals. However, median openings have been limited to authorized intersections with public roads and will not be provided for individual business needs. Where the median openings are provided at important road junctions (VR/ODR/MDR) with considerable turning traffic, storage lanes have been considered in the design proposals for smooth and safe travel of traffic.

Widening schemes, proposed cross sectional elements, identification of the overlay sections for rehabilitation/strengthening of existing carriageway and new pavement stretches, drainage, service road provision and provision of the other components along the road have been developed as per IRC design standards. For structures, relevant IS/IRC design codes/guidelines have been followed.

For the design & construction of 4 Lane Highway sections the Consultants have referred to the latest IRC publications and MORT&H circulars regarding design standards for National Highways in India as well as the international American and Canadian geometric design guidelines. The relevant Indian and international design standards consulted include:

- IRC:SP:84-2009 "Manual of Specifications & Standards for FOUR laning of Highways through public private partnership" 2009.

E8. Engineering Surveys & Investigations

The Consultants have carried out following engineering surveys to serve as a basis for project design and land acquisition planning. These include Road and Bridge Inventory and their Condition Survey, Pavement Condition and Sub-grade Characteristic Investigations, Soil Investigation, Hydraulic and Hydrological Studies. In brief, these are discussed below:

Topographic Surveys

A complete ground topographic survey of the land, generally 60 meters wide and centered on the existing road centerline, sufficiently detailed to produce contours and identify the main features of the existing road as well as adjacent structures utilities, river channels, drainage courses utility service components and trees have been carried out confirming to the ToR requirements. At junctions, survey has been extended to 100 m on each side. At major junctions where there is a possibility of providing grade separators, the survey has been extended to 500m on all sides.

Road Inventory, Bridge Inventory and Condition Survey (Year 2010)

Aurangabad-Dhule section of NH-211 is a 2-Lane road, 7m carriageway predominantly without paved shoulder. In the Daulatabad/Ellora section of NH-211 (km 320 to km 339) project road is going through archeological sensitive areas like Daulatabad fort, Khuldabad and Ellora caves. The existing SH-16 and SH-180 bypasses Daulatabad fort and Ellora caves. The commercial vehicles (trucks) are being diverted to SH-16 and SH-180, due to insufficient road widths near Daulatabad fort. In Kannad town from km 365 to km 370 the road passes through urban section with development on both sides of NH-211. In Kannad town from km. 367+200 to km 368+800 the road is 4-lane without paved shoulder. NH-211 passes through ghat section in between Kannad and Chalisgaon town between km. 379+800 to km. 387+200 with carriageway width of 5.5m with no shoulder. After ghat section from km. 387+200 to km. 396+400, the cross section of the road changes to 7m wide carriageway with 1.5m paved shoulder on either side. The existing Chalisgaon bypass start at km. 396+200 and ends at km. 404+400. This is a toll road operated and maintained by MSRDC Ltd, and the total length of this bypass is 11.7Km. The carriageway width of the bypass is 7.0m with earthen shoulder of 2.5m on either side. Rest of the section of NH-211 from km. 404+400 to km. 452+800 is 7.0m carriageway without paved shoulders. The pavement condition on SH-16, SH-180 and ghat section of NH-211 from 380+000 to km. 387+200 is poor with cracks and potholes, with some of the stretches completely damaged. Except for such locations, riding quality of road is fair to poor, with Block/Longitudinal cracks visible on pavement surface.

The summary of the **Existing** Major, Minor bridges and culverts are presented below:

Section	Major bridges	Minor bridges	ROBs	Culverts
Aurangabad – Dhule	6	46	1	368

Pavement Investigations

Investigation of the existing pavement and sub-grade involving visual inspection of various distress conditions (cracking, raveling, pot holes and rutting), Benkelman Beam Deflection Test, Roughness test, DCP test, test pits for pavement crust and sub-grade have been carried out as per the ToR of the study.

The Subgrade Samples were tested for Grain Size distribution, Atterberg limits. MDD (heavy Compaction) and soaked CBR at OMC.

The Consultants have also been carried out the soil characteristics of natural ground by test pitting and testing of the in-situ soils adjacent to the existing road at stretches where the provision of widening and service lanes and new bypasses have been proposed. The tests carried out were Atterberg limits, Sieve analysis, Compaction (Heavy Compaction) and soaked CBR

Three types of pavement layers have been found, these are granular sub base, WBM and Bituminous wearing course. All the three types of layers have been found in every location over the project road length. The thickness of each type of pavement layer varies along

the length. The bore log diagram of the test pits is given in the figure below, and the observed variations of thickness of different pavement layers are as given in Table.

Type of Layer	Thickness Range (mm)
Bituminous course	61 mm to 212 mm
WBM	132 mm to 312 mm
Granular-Sub base	72 mm to 301 mm

- Sub-grade CBR of existing pavement

  (4 days soaked CBR) - 8.0%

- Characteristic deflection - 0.96 mm to 1.48 mm

- Average Roughness - 2.43 to 4.08 IRI

The above results have been used for designing an overlay for existing pavement and economic evaluation of the Project Road.

Material Investigations

Investigation of known potential sources of construction materials (moorum, sand and granite) in the vicinity of the project road including test pitting, sampling and testing to evaluate materials to be used for construction such as embankment, subgrade, GSB, WMM and concrete. Investigations also included verification of sufficiency of construction materials at those sources.

Material investigations along the new alignment are in progress and results will be presented in the Preliminary Project Report.

Nearest sources identified for construction materials are :

a) Embankment/Subgrade : Along the project corridor, Aurangabad, Daulatabad, Kannad, Chalisgaon, Kannad, Gartar, Dhule
b) Coarse Aggregates : Along the project corridor, Aurangabad, Daulatabad, Kannad, Chalisgaon, Kannad, Gartar, Dhule
c) Sand : Along the project corridor, Aurangabad, Daulatabad, Kannad, Chalisgaon, Kannad, Gartar, Dhule
d) Bitumen : Mumbai refinery
e) Cement : Birla Cement Solapur and Pune
f) Steel : SAIL Vishakhapatnam, Bhiliai

E9. Alignment Design & Improvement Proposals

In order to develop the concept of upgrading the Project Road for reduction in transport cost and enhancement of comfort and safety of the road users, appropriate engineering solutions were proposed. The detailed design was primarily aimed at providing the basis for estimating the project costs to a suitable level of approximation, for use as vital inputs for finalizing detailed design and the economic and financial viability for the project

investments. Existing Right of Way has been utilised to the maximum possible. The proposed design utilised the existing road's embankment, pavement layer and structures to the maximum extent.

Following typical cross sections are proposed for the widening/new construction of highway keeping in view the site requirements, and schedule of cross sections is presented below:

1. Type I: Existing 2-Lane to 4-Lane "Eccentric widening in Rural Area", Median 4.5m and proposed 60m Right of Way.
2. Type II: Existing 2-Lane to 4-Lane "Symmetrical widening in Urban Area", Median 2m and proposed 60m Right of Way.
3. Type III: Existing 2-Lane to 4-Lane "Four lane Divided Carriageway with Service Road in Urban Area", Median 2.0m and proposed 60m Right of Way.
4. Type IV: Existing 2-Lane to 4-Lane "Vehicular/ Pedestrian Underpass with Slip Roads", Median 4.5m and proposed 60m Right of Way.
5. Type V: Existing 2-Lane to 4-Lane "Vehicular/ Pedestrian Underpass with Slip Roads", Median 2.0m and proposed 50/60m Right of Way.
6. Type VI: 4-Lane New Construction in "Re-alignment, Bypasses, New Alignment", Median 4.5m and proposed 60m Right of Way.
7. Type VII: Existing 2-Lane to 4-Lane "4 Lane ROB Approach", Median 4.5m and proposed 60m Right of Way.
8. Type VIII: "2 Lane ROB Approach", proposed 60m Right of Way.
9. Type IX: 4-Lane New Construction in "Re-alignment, Bypasses, New Alignment with Service Road", Median 4.5m and proposed 60m Right of Way.
10. Type X: Existing 2-Lane to 4-Lane "Symmetrical widening in Rural Area with Service Road", Median 4.5m and proposed 60m Right of Way

Typical cross sections are given in Chapter 7 and Volume IX: Drawings and the application schedule is described below:

Table E.20: Cross Section Schedule

EXISTING KM.		DESIGN CHAINAGE		Length (m)	FOUR LANE IMPROVEMENT SCHEME	CROSS SECTION TYPE	PROPOSED ROW (m)
FROM	TO	FROM	TO				
290+200		290+200	290+420	220	Bypass alignment 4L	VI	60
		290+420	291+700	1280	VUP at the Start of Aurangabad Bypass	IV	60
		291+700	298+275	6575	Bypass alignment 4L	VI	60
		298+275	299+260	985	VUP on MDR 38 Devolai Village	IV	60
		299+260	303+000	3740	Bypass alignment 4L with Service Road	IX	60
		303+000	303+600	600	PUP on Police Colony City Road	IV	60
		303+600	306+790	3190	Bypass alignment 4L with Service Road	IX	60
		306+790	308+360	1570	Flyover on SH-30 Paithan Road Junction	IV	60
		308+360	310+960	2600	Bypass alignment 4L with Service Road	IX	60
		310+960	311+970	1010	Flyover on 4-Lane SH-60	IV	60

EXISTING KM.		DESIGN CHAINAGE		Length (m)	FOUR LANE IMPROVEMENT SCHEME	CROSS SECTION TYPE	PROPOSED ROW (m)
FROM	TO	FROM	TO				
					Junction.		
		311+970	312+620	650	Bypass alignment 4L with Service Road	IX	60
		312+620	313+500	880	VUP on Wadgaon kolati road Waluj Junction	IV	60
		313+500	317+300	3800	Bypass alignment 4L	VI	60
		317+300	318+134	834	Bypass alignment 4L with Service Road	IX	60
		318+134	318+824	690	VUP on Shirdi Road (MSH)	IV	60
		318+824	320+970	2146	Bypass alignment 4L	VI	60
		320+970	321+670	700	PUP for Asegaon Village	IV	60
		321+670	322+700	1030	Bypass alignment 4L	VI	60
		322+700	323+400	700	4-lane ROB approaches	VII	60
	218+900 SH-16	323+400	324+400	1000	Bypass alignment 4L	VI	60
218+900 SH-16	218+088 SH-16	324+400	325+200	800	Right Side Widening 4L	I	60
218+088 SH-16	213+800 SH-16	325+200	329+530	4330	Concentric 4L With Re-construction of existing BT Road	II	60
213+800 SH-16	211+900 SH-16	329+530	330+430	900	Concentric 4L with Service Road	III	50
211+900 SH-16	209+300 SH-16	330+430	333+000	2570	Concentric 4L With Re-construction of existing BT Road	II	60
209+300 SH-16		333+000	333+600	600	VUP on SH 16 and SH 180 Junction	IV	60
	47+570 SH-180	333+600	334+300	700	Realignment 4L	VI	60
47+570 SH-180	50+620 SH-180	334+300	337+400	3100	Concentric widening	II	60
50+620 SH-180	50+850 SH-180	337+400	337+600	200	Realignment	VI	60
50+850 SH-180	52+500 SH-180	337+600	340+300	2700	Right Side Widening	I	60
52+500 SH-180		340+300	341+060	760	Realignment	VI	60
	340+250	341+060	341+950	890	VUP on SH 180 and NH 211 near Verul village	IV	60
340+250	342+900	341+950	344+638	2688	Right Side Widening	I	60
342+900	343+400	344+638	345+125	487	Left side widening at Palaswadi village	I	60
343+400	343+950	345+125	345+690	565	PUP at Palaswadi Village	IV	60
343+950	344+600	345+690	346+302	612	Realignment	VI	60
344+600	346+800	346+302	348+497	2195	Right Side Widening	I	60
346+800		348+497	348+900	403	Bypass alignment	VI	60
		348+900	349+797	897	Bypass alignment 4L with Service Road	IX	60
		349+797	350+300	503	PUP at Galleboregaon bypass	IV	60
	348+800	350+300	350+929	629	Bypass alignment	VI	60
348+800	352+630	350+929	354+900	3971	Right Side Widening	I	60
352+630	352+890	354+900	355+200	300	Concentric	II	60
352+890	354+630	355+200	357+000	1800	Realignment	VI	60
354+630	355+800	357+000	358+300	1300	Right Side Widening	I	60
355+800	356+530	358+300	359+050	750	PUP at Hatnur Village	V	60

EXISTING KM.		DESIGN CHAINAGE		Length (m)	FOUR LANE IMPROVEMENT SCHEME	CROSS SECTION TYPE	PROPOSED ROW (m)
FROM	TO	FROM	TO				
356+530	360+980	359+050	363+500	4450	Right Side Widening	I	60
361+530	362+320	363+500	364+300	800	VUP on Panpoi Junction	IV	60
362+320	363+000	364+300	365+000	700	Re-alignment 4L with service road on both sides	IX	60
363+000	364+200	365+000	366+230	1230	Right Side Widening	I	60
365+346		366+230	369+754	3524	Kannad bypass	VI	60
		369+754	370+125	371	PUP at Kannad bypass	IV	60
	370+420	370+125	371+327	1202	Kannad bypass	VI	60
370+420	372+550	371+327	373+500	2173	Right Side Widening	I	60
372+550	372+960	373+500	373+900	400	Realignment	VI	60
372+960	373+140	373+900	374+100	200	Right Side Widening	I	60
373+140	373+840	374+100	374+800	700	Realignment	VI	60
373+840	374+245	374+800	375+200	400	Right Side Widening	I	60
374+245	374+740	375+200	375+700	500	Realignment	VI	60
374+740	375+030	375+700	376+000	300	Concentric with service road	X	60
375+030	375+700	376+000	376+700	700	Realignment with service road	IX	60
375+700	**376+000**	376+700	**377+000**	300	Concentric with service road	X	60
Ghat Section from km 376+000 to km 390+000 is excluded from this project)							
390000	396+110	390+000	396+100	6100	Right Side Widening	I	60
396110		396+100	396+600	500	Realignment	VI	60
Chalisgaon Bypass additional 2L configuration.		396+600	397+700	1100	Left side widening	I	60
		397+700	398+400	700	PUP on Patnadevi-Chalisgaon Road at Chalisgaon bypass	IV	60
		398+400	401+000	2600	Left side widening	I	60
		401+000	401+500	500	Realignment	VI	60
		401+500	402+500	1000	Left side widening	I	60
		402+500	403+200	700	2 lane ROB	VIII	60
		403+200	403+600	400	Realignment	VI	60
		403+600	405+500	1900	Left side widening	I	60
		405+500	406+300	800	VUP on Malegaon Road	IV	60
		406+300	407+900	1600	Left side widening	I	60
404+200	404+500	407+900	408+200	300	Realignment	VI	60
404+500	411+600	408+200	415+400	7200	Right Side Widening	I	60
411+600		415+400	418+100	2700	Mehunbarane Bypass	VI	60
		418+100	418+900	800	VUP on SH 25	IV	60
	416+100	418+900	419+900	1000	Mehunbarane Bypass	VI	60
416+100	421+380	419+900	425+100	5200	Right Side Widening	I	60
421+380	421+680	425+100	425+400	300	4-L Road with service road	X	60
421+680	427+400	425+400	431+100	5700	Right Side Widening	I	60
427+400	428+200	431+100	431+900	800	PUP for Tarwade Village	IV	60
428+200	434+620	432+900	438+320	6420	Right Side Widening	I	60
434+620	435+315	438+320	439+005	685	VUP on SH 15 Shirud Junction	IV	60
435+315	436+800	439+005	440+500	1495	Left Side Widening	I	60
436+800	438+200	440+500	441+900	1400	Concentric	II	60
438+200	438+800	441+900	442+500	600	PUP for Junawane Village	IV	60
438+800	443+000	442+500	446+820	4320	Left Side Widening	I	60
443+050	443+550	446+820	447+300	480	Realignment	VI	60
443+550	445+450	447+300	449+200	1900	Left Side Widening	I	60
445+450	445+750	449+200	449+500	300	Realignment	VI	60
445+750	446+850	449+500	450+639	1139	Left Side Widening	I	60
446+850		450+639	450+960	321	Realignment	VI	60
		450+960	451+570	610	4-lane ROB and PUP on Bypass	VII	60

EXISTING KM.		DESIGN CHAINAGE		Length (m)	FOUR LANE IMPROVEMENT SCHEME	CROSS SECTION TYPE	PROPOSED ROW (m)
FROM	TO	FROM	TO				
					Garthad Village		
		451+570	452+070	500	PUP on Bypass Garthad Village	IV	60
	450+200	452+070	454+379	2309	Garthad Bypass	VI	60
450+200	450+450	454+379	454+600	221	Left Side Widening	I	60
450+450	451+150	454+600	455+300	700	Realignment	VI	60
451+150	**452+800**	455+300	**457+050**	1750	Concentric	II	60
Dhule NH-3 Jn				**153.850**	**Total Design Length (km)**		

Summary of Cross section types and road lengths including structures used:

TCS Type	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
Total Length (km)	70.489	13.450	0.900	16.249	0.750	35.891	1.210	0.700	13.311	0.900	153.850
Structure Length (km)	1.329	0.687	0.007	0.588	0.014	1.279	0.153	-	0.161	-	4.218
Net Road Length (km)	69.160	12.763	0.893	15.661	0.736	34.612	1.057	0.700	13.150	0.900	149.632

Design Length = CH. 290+200 to CH. 377+000 = 86.800 km; and CH. 390+000 to CH. 457+050 = 67.050km; Total Design Length = 86.800 + 67.050 = 153.850 km

The project was designed as 2-Lane with paved shoulder from Kasabkheda junction (meeting point of SH-16 & SH-180) to Dhule (km 452.800) considering maximum utilization of the existing pavement and minimum tree cutting. As the project is decided to be implemented as four laning based on current traffic 2012 and the consultant is asked to submit PPPAC proposal at the earliest. The consolidated design of "4-lane Aurangabad – Dhule Road" is under preparation, plan & profile design shall be completed by 10th August 2012 and accordingly the cross section schedule will be updated.

Land Acquisition of 60m in rural areas and 50m in urban areas is proposed considering future four lane as per discussion held with the client time to time.

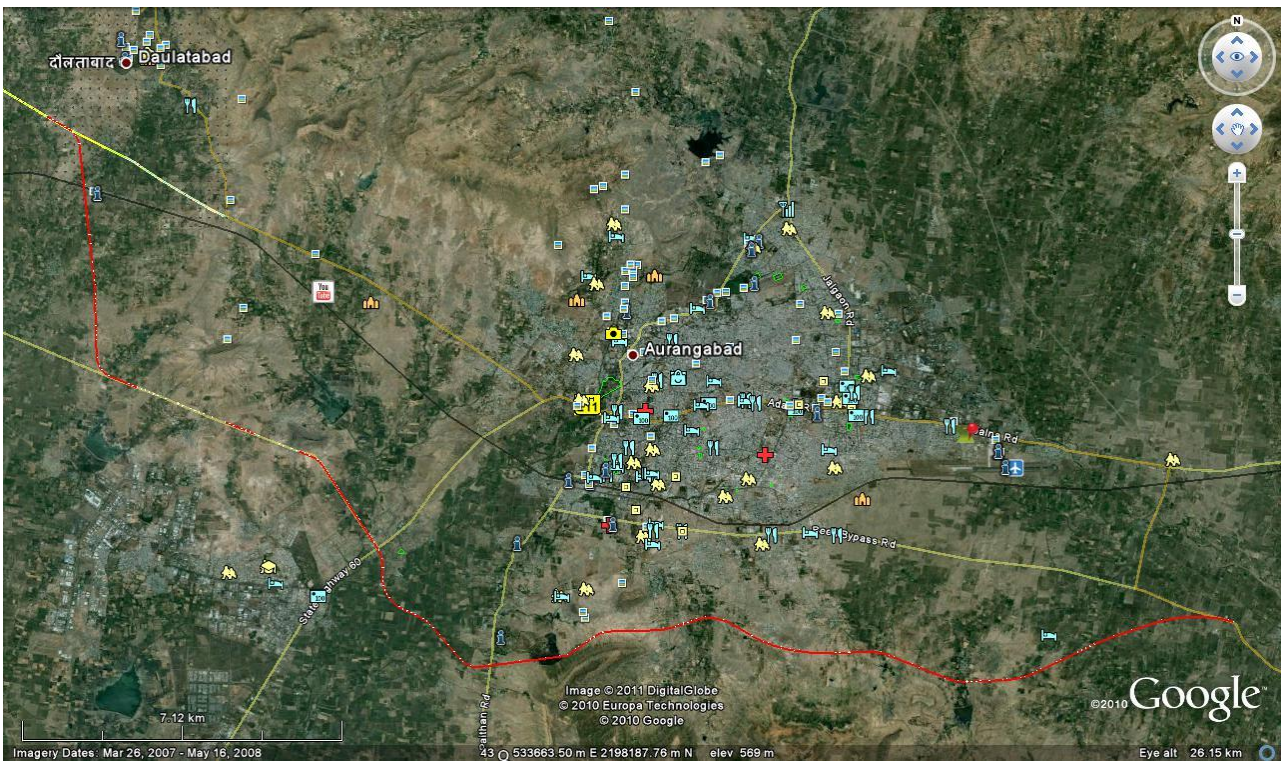
New Alignment/ Bypasses/Realignment

a) Aurangabad Bypass:

The existing BEED bypass (a part of Aurangabad – Jalana Toll Road from km 298+000 to km 307+800; 9.8km) which is under State Government of Maharashtra (PWD) is passing through built-up areas and habitations. The existing RoW on this BEED bypass is only 30m, additional land acquisition in this road section is practically difficult, therefore the new bypass proposal is proposed after the completion of traffic surveys. Accordingly, 4-Lane bypass is essentially needed for free flow of through traffic and to avoid congestion in the city. The 4-lane proposed Aurangabad Bypass alignment is reviewed again considering present city scenario, on-going development, Sahara Township, land terrain, water bodies, cantonment area and activities, future projects and commercialization. CGM RO Maharashtra visited the project site on 13th May 2012 and reviewed in detail on 11th July 2012 at NHAI Panvel office with PIU Aurangabad officials and Consultant. It was

advised to verify and validate the bypass alignment already finalized earlier. Accordingly, PIU officials visited the project site jointly with Consultant between 12th to 17th July 2012.

The modified alignment takes off from the southern side of existing NH-211 (Km. 290+200) and bypassing Aurangabad City south end limit and Sangram Nagar, passing through toe of Hill at South side of Sangram Nagar, Crossing MDR-38, Police Colony, Paithan road, Pune Road SH-60, Wadgaon kolati road Waluj Junction, Bhanshi Mata Mandir Road, SH-30 (part of Nagpur- Mumbai Highway), container road near Asegaon, and Railway line at south-west of Aurangabad city near Maliwada. The bypass predominately passes through green fields and ends at Shirdi Road (Km 218+400 on SH-16). As per detailed design the proposed bypass starts at design Ch 290+200 and Ends at design Ch 324+400 of NH-211; total length 34.2km. Topographic survey, engineering studies including geotechnical investigations have been carried out for the proposed Bypass. The proposed bypass alignment uses a part of Nagpur – Mumbai Highway (Shirdi road) for about 8km. The pavement condition of this existing road is poor to fair. There are pot holes, patches and failed pavement sections. The existing pavement crust is substandard due to improper material and insufficient WBM and GSB layers thickness. Hence RE-CONSTRUCTION of the existing road is proposed. The road passes through ribbon developed villages and semi urban areas. The alignment plan is as below:



A coordination meeting was arranged by PIU Aurangabad with all local authorities viz, PWD, CIDCO, MSRDC, MIDC, DMIC, Town Planning departments on 18th July 2012 to discuss about the proposed Aurangabad Bypass and project up to Dhule. All authorities appreciated the project proposals and assured their cooperation & coordination to implement the project successfully.

It was requested to MIDC/DMIC and PWD authorities to submit their details of DMIC proposals/ maps. They informed that the proposals are at initial stage of planning. DMIC is planning to acquire 100m land corridor for the proposed 8 lane road from Adul (km 272+500 to Maliwada (km. 219+500) which is a part of proposed Aurangabad bypass. It is opinion by all that DMIC shall follow proposed Aurangabad Bypass by *"Cost sharing with NHAI against Civil Construction and Land Acquisition"*.

MSRDC officials welcome the proposal of using 8km road section of "Nagpur-Mumbai Road SH-30" by NHAI and expressed their willingness to buy back the required road section. They also discussed about cash flow details of buy back cost and submit their proposal officially at the earliest.

Alternatively, MSRDC may allow four laning of required SH-30 section with O&M as per IRC guidelines by NHAI. Toll Collection right shall remain with MSRDC.

Town planning officials shared their City Plan and informed about corporation limits of Aurangabad City & Kannad Town.

The proposed Aurangabad Bypass consist of 2 Flyovers, 4 Vehicular Underpasses (VUP), 2 Pedestrians Underpasses (PUP), 1 Rest Area, 1 Toll Plaza, 1 ROB, 38km service/slip roads with street lighting, 16 Bus bays on either sides, 4 Major & 5 Minor at grade junctions, 1 Major Bridge, 20 Minor Bridges and 55 culverts as follows:

Table E.21: Salient Features of Aurangabad Bypass

S. No	Design Chainage	Span Arrangement (m)	Minimum Vertical Clearance (m)	Total width* (m)	Location
1	291+000	1x20	5.5	2x12	VUP at the Start of Aurangabad Bypass
2	298+850	1x20	5.5	2x12	VUP on MDR 38 Devolai Village
3	303+280	1x7	4.5	2x12	**PUP** on Police Colony City Road
3	307+435	1x15+1x30+1x 15	5.5	2x12	Flyover on Aurangabad Bypass, SH-30 Paithan Road
4	311+433	1x20+1x40+1x 20	5.5	2x12	Flyover on 4-Lane SH-60 Junction.
5	313+182	2x15	5.5	2x12	VUP on Wadgaon kolati road Waluj Junction
6	314+200				**Rest Area** on RHS
7	318+600	1x30	5.5	2x12	VUP on Shirdi Road (MSH)
8	320+500				5+5 Lane **Toll Plaza**
9	321+360	1x7	4.5	2 x 12	**PUP** for Asegaon Village
10	323+051	1x11.5+2x30+1 x11.5	8.5	2x12	4- Lane ROB on railway line at south west
11	7m wide Service Road and Slip Road are provided on either sides for 11.43 km and 7.515 km respectively.				
12	8 Nos of Bus Bays are proposed on Either sides of the project road.				
13	4 Major and 5 Minor Junctions.				
14	Street Lighting for Major junctions, Service & Slip Roads are provided as per IRC guidelines & standard.				
15	1 Major Bridge (3x21m), 20 Minor Bridges (7m to 20m length) and 55 nos Culverts are provided.				
16	Civil cost of the 4-lane Aurangabad bypass with above facilities is Rs 312 Crores				

b) Two to Four Laning of Daulatabad and Ellora Roads

At km 320/200, NH-211 forming a junction with SH-16 and project road is going to north direction and passes through populated/historical place like Daulatabad and Khuldabad. At Daulatabad, the NH is adjacent to Daulatabad fort and passes through a heritage gate. The Ghat sections between Km. 326+000 to km 328+000 and km. 334+500 to km. 337+700 are with steep gradient, poor visibility and sharp bends which make the traffic movement very slow. The Speed limit in the ghat section is 30km/hr. The ghat section passes through reserved forest area which makes it very difficult for widening. Between km 337 to km 339, the project road passes along World famous Archeological Heritagesite viz. Ellora Caves and Lord Shiva Ghrushneswar Jyotriling Temple etc. There are large numbers of old & big trees in this section. Freight movement is not allowed in Daulatabad-Ellora section of NH 211.

Aurangabad-Ellora section of NH from km 320+100 to km 339+000 is being avoided by using the State Highways SH-16 & SH-180 as "Existing Bypass" for Heavy vehicles by Traffic Regulatory Authorities. SH-16 is going in west direction towards Nasik / Nandgaon. SH-16 and SH-180 is forming a junction (at km 216 of SH-16) and SH-180 is going towards North direction. The SH-180 is joining with NH-211 at km 339+000. Total length of this existing bypass is about 20km. The existing ROW is 30m and proposed ROW is 60m. This alternative route is a part of "Improved 4-lane Daulatabad- Ellora section of NH-211.

2-Lane to 4-Lane widening of The Daulatabad Road is proposed which is in continuation of Aurangabad bypass; from km 324+400 to km 334+060; length 9.66km on SH-16. One VUP (2x20m span) at SH-16 & SH-180 junction and 6 Minor Bridges (span 7m to 22m) are proposed. The pavement condition of the existing SH-16 road is poor to fair. There are a number of pot holes, patches and pavement failed sections observed. The existing pavement crust shows are substandard due to non availability of proper thickness of WBM and GSB layers. Hence RE-CONSTRUCTION of the existing road is proposed. The road passes through ribbon developed villages and semi urban areas of Fatiabad and Jambala etc. The project road diverts to Ellora at junction of SH-16 & SH-180 at km 219+300 of SH-16 & 47+570 of SH 180 (Kasabkhedaphata) .

2-Lane to 4 Lane Ellora Road (7.4km) from design Chainage 333+600 to 341+060 SH-16 & SH-180 junction (km0+000) to km 5+700 is upgraded as 2-Lane to 4-lane widening and further re-alignment is proposed from km 5+700 to km 339+800 on NH-211. One VUP (1x20m span) at NH-211 junction and 4 Minor Bridges (span 7m to 22m) are proposed.

These road sections of SH-16 and SH-180 are to be notified as National Highways and undertaken by NHAI for implementation.

SH - 180
SH-16
211
खुलताबाद
फुलंब्री
औरंगाबाद
दौलताबाद
वेरुळ

Khultaba
Khuldabad
Daulatabad
22
16

Flyovers

Keeping in view of NHAI's mandate to develop the Project Road as a 4-lane divided carriageway based on IRC:SP-1984 guidelines the Consultants have proposed Flyovers/Vehicular Underpass/ Grade Separators at locations where the Project Road crosses the other NH/SH.

S. No	Location and Design Chainage	Span Arrangement (m)	Minimum Vertical Clearance (m)	Total width* (m)	Location
1	307+435	1x15+1x30+1x15	5.5	2x12	Flyover on SH-30 Paithan Road Junction
2	311+433	1x20+1x40+1x20	5.5	2x12	Flyover on 4-Lane SH-60 Junction.

Underpasses

Provision of underpasses at strategic locations within the project stretch is an important consideration in highway development. The project road traverses through many villages. Safe crossing facilities should be provided as the project road is designed for 80 to 100 Kmph speed and is designed for partially access controlled. Underpasses are recommended wherever cross traffic is more and are vital. In total, 2 flyover & 13 VUPs are recommended having total clear height of 5.5m. These are meant for major cross roads. Pedestrian Underpasses are proposed at 12 locations have total clear width of 7.0m & clear height of 4.5m.

Table E.22: Proposed Vehicular Underpass locations

S. No	Existing Chainage	Design Chainage	Span Arrangement (m)	Vertical Clearance (m)	Total width* (m)	Location
1	Start of Proposed Bypass	291+000	1x20	5.5	2x12	VUP at the Start
2	Proposed Aurangabad Bypass	298+850	1x20	5.5	2x12	VUP on MDR 38 Devolai Village
3	Proposed Aurangabad Bypass	307+435	1x15+1x30 +1x15	5.5	2x12	Flyover on Aurangabad Bypass, SH-30 Paithan Road
4	Proposed Aurangabad Bypass	311+433	1x20+1x40 +1x20	5.5	2x12	Flyover on 4-Lane SH-60 Junction.
5	Proposed Aurangabad Bypass	313+182	2x15	5.5	2x12	VUP on Wadgaon kolati road Waluj Junction
6	Proposed Aurangabad Bypass	318+600	1x30	5.5	2x12	VUP on Shirdi Road (MSH)
7	209+000 on SH-16	333+300	2x20	5.5	2x12	VUP on SH 16 and SH 180 Junction
8	Merging Point of Proposed Ellora Bypass with NH-211	341+516	1x20	5.5	2x12	VUP on SH 180 and NH 211 near Verul village
9	361+025	363+900	1x15	5.5	2x12	Panpoi Road Junction
10	Malegaon junction on existing Chalisgaon bypass	405+900	1 x 20	5.5	2x12	At Cross Road Chalisgaon Bypass
11	Proposed Mehunbarane Bypass	418+500	1x20	5.5	2x12	VUP on SH 25 at Mehunbarane Village
12	434+950	438+736	1x20	5.5	2x12	VUP on SH 15 near Shirud Junction
Three (3) Nos Additional VUPs 1x20m x 5.5m ht; total width 2x12m are proposed; the locations shall be decided as per public demand.						

Table E.23: Proposed Pedestrian Underpass locations

S. No	Existing Chainage	Design Chainage	Span Arrangement (m)	Minimum Vertical Clearance (m)	Total Width * (m)	Location
1	Proposed Bypass	303+280	1x7	4.5	2 x 12	PUP on Police Colony City Road
2	Proposed Bypass	321+360	1x7	4.5	2 x 12	PUP on Aurangabad Bypass for Asegaon Village
3	343+675	345+390	1x7	4.5	2 x 12	PUP at Palaswadi Village
4	Proposed Bypass	350+020	1x7	4.5	2 x 12	PUP on proposed Galleboregaon Bypass
5	356+165	358+675	1x7	4.5	2 x 12	PUP at Hatnur Village
6	Proposed Bypass	369+870	1x7	4.5	2 x 12	PUP on proposed Kannad Bypass
7	Chalisgaon	398+030	1x7	4.5	2 x 12	PUP on Patnadevi-Chalisgaon road at Chalisgaon bypass
8	Tarwade	431+500	1x7	4.5	2 x 12	PUP on Tarwade Road
9	Junawane	442+200	1x7	4.5	2 x 12	PUP on Junawane
10	Proposed Bypass	451+897	1x7	4.5	2 x 12	PUP on proposed Garthad Bypass
Two (2) Nos Additional PUPs 1x7m x 4.5m ht; total width 2x12m are proposed; the locations shall be decided as per public demand.						

***** The total width excludes the clear gap between the two superstructures, which will be dictated by the road way width.

ROB

There are two 4-lane ROBs proposed and one 2-lane ROB at Chalisgaon Bypass as detailed below:

Table E.24: Details of Rail Over Bridges (ROB)

S. No	Existing Chainage	Design Chainage	Type of structure	Type of superstructure	Span (m)	Total length in m	Deck width (m)
1	Aurangabad Bypass	323+051	ROB	Composite steel structure with RCC slab	1x11.5+2x30+1x11.5	83	12
2	Chalisgaon Bypass	402+950	ROB	Composite steel structure with RCC slab	1x11.5+1x24+1x11.5	47	12
3	Garthad Bypass	451+432	ROB	Composite steel structure with RCC slab	1x11.0+2x24+1x11.0	70	12

Service Roads/Slip Roads

In order to segregate the local traffic from the main highway traffic, service roads of intermediate widths (7.0m) on either one side or both sides are proposed at appropriate stretches. Slip roads are mainly proposed near underpasses/mini flyovers/flyovers etc. to take care of turning traffic at such locations. In total 64km length service roads/Slip Roads

are proposed. The details are given as below:

Table E.25: Details of 7m wide Service Road

Sl. No	Existing Chainage		Design Chainage		Length (m)	Village/Town name
	From	To	From	To		
1			299+260	303+000	3740	Service Road in Urban area of Aurangabad bypass
2			303+600	306+790	3190	Service Road in Urban area of Aurangabad bypass
3			308+360	310+960	2600	Service Road in Urban area of Aurangabad bypass
4			311+970	312+620	650	Service Road in Urban area of Aurangabad bypass
5			317+300	318+134	834	Service Road in Urban area, near MIDC Road (Bhanghi Mata Roas Junction)
6	213+800	212+900	329+530	330+430	900	Jambala Village on SH-16
7			348+900	349+797	897	Service road for Cross road on Galleboregaon Village
8	361+980	363+000	364+300	365+000	700	Service road for College
9	374+740	376+000	375+700	377+000	1300	Service Road at Talewadi/Satkund Village
10	421+200	421+500	425+100	425+400	300	Service road at Londhe/Dahiwade junction
One side Length of Service road (km)					14.911	
Both sides Length of Service road (km)					29.822	

Table E.26: Details of 7m wide Slip Road

Sl. No	Existing Chainage		Design Chainage		Length (m)	Village/Town name
	From	To	From	To		
1			290+420	291+700	1280	VUP at start of Aurangabad Bypass
2			298+275	299+260	985	VUP on Aurangabad City Road
3			303+000	303+600	600	PUP on Aurangabad Bypass
4			306+790	308+360	1570	Flyover on Aurangabad Bypass, SH-30 Paithan Road
5			310+960	311+970	1010	Flyover on Aurangabad Bypass, SH-60
6			312+620	313+500	880	VUP on Waluj Junction
7			318+134	318+824	690	VUP on Shirdi Road
8			320+970	321+670	700	PUP for Asegaon
9	209+300 SH-16		333+000	333+600	600	VUP on SH 16 and SH 48 Junction
10		340+250	341+060	341+950	890	VUP on SH 48 and NH 211 near Verul village
11	343+370	343+990	345+125	345+690	565	PUP at Palaswadi Village
12			349+797	350+300	503	PUP on proposed Galleboregaon Bypass
13	355+800	356+530	358+300	359+050	750	PUP at Hatnur Village
14	360+760	361+590	363+500	364+300	800	VUP on Panpoi Junction
15			369+754	370+125	371	PUP on proposed Kannad Bypass
16			397+700	398+400	700	PUP on Patnadevi-Chalisgaon road at Chalisgaon bypass
17			405+500	406+300	800	VUP on Chalisgaon Bypass
18			418+100	418+900	800	VUP on SH 25 at Mehunbarane Bypass
19			431+100	431+900	800	PUP on Tarwade Road Crossing
20	438+300	439+100	438+320	439+005	685	VUP on SH 15 near Sirhud Junction
21			441+900	442+500	600	PUP on Junawane
22			451+570	452+070	500	PUP on Garthad Bypass
One side Length of Slip road (km)					17.079	
Both sides Length of Slip road (km)					34.158	

Total Length of Service Road and Slip Road = 29.822 + 34.158 = 63.980 km; say 64 km.

Way side Amenities, Bus Lay Bys, Truck Lay byes & Truck Terminal

There are 30 x 2 = 60nos. Bus bays, 3 nos Truck lay bys, 4 nos; rest areas are proposed along the project corridor. The location and details are as below:

Table E.27: Details of Bus-bays road

S. No	Name of the Location	Existing Km LHS	Existing Km RHS	Design Ch. LHS	Design Ch. RHS
1	Start of Aurangabad bypass	Aurangabad Bypass		290+300	291+300
2	Gandheli Village			296+100	296+200
3	Deolai phata			298+800	298+900
4	Police Colony			302+800	302+900
5	Paithan junction			307+100	307+500
6	AS Club/SH-60 Junction			311+500	311+700
7	Bhansi Mata Junction			317+500	317+700
8	Asegaon			320+800	321+500
9	Fatiabad	217+788 SH-16	217+688 SH-16	325+500	325+600
10	Jambala	212+530 SH-16	212+430 SH-16	329+800	329+900
11	Potul /Nashik Junction	209+000 SH-16	208+900 SH-16	333+300	333+400
12	Kasabkheda village	51+350 SH-180	51+550 SH-180	338+100	338+300
13	Ellora Village	340+190	340+090	341+900	341+800
14	Palaswadi	343+675	343+570	345+433	345+342
15	Deogaon/ Ambar	Bypass		348+900	349+100
16	Tapargaon	352+600	352+415	354+874	354+670
17	Hatnur	356+000	355+695	358+500	358+197
18	Chapner/ Panpui junction	361+430	362+420	363+400	364+400
19	Kannad Bypass	363+520	363+330	369+600	370+200
20	Satkundtanda village	375+500	375+700	374+850	375+050
21	Khadki/ Nandgaon	Bypass		402+400	402+600
22	After Chalisgaon bypass	405+800	405+600	409+707	409+507
23	Mehunbarane	413+700	413+600	417+700	417+600
24	Khadkesim/ Dhamangaon	417+200	417+300	421+105	421+205
25	Londhe	421+680	421+780	425+100	425+200
26	Tarawade	427+880	427+700	431+642	431+440
27	Sirhud Junction	434+500	435+500	438+200	439+200
28	Junawane	438+500	438+200	442+306	442+105
29	Garthad Bypass	444+010	443+810	451+400	452+200
30	NH-6 Bypass Interchange	450+650	451+050	454+800	455+200

Table E.28: Details of Truck–Lay Bys

S. No.	Existing (km) LHS	Existing (km) RHS	Design CH. (LHS)	Design CH. (RHS)
	Ellora Village		**Ellora Village**	
1	342+860	342+500	344+600	344+234
	Kannad		**Kannad**	
2	370+420	370+600	371+327	371+507
	After Shirud Junction		**After Shirud Junction**	
3	435+418	435+820	439+200	439+600

Table E.29: Details of Rest Areas

Sl. No	Name of the Location	Existing Km	Design Km	Side
1	Near Waluj junctuion	-	314+200	RHS
2	Ellora Village	341+000	342+733	LHS
3	Kannad	373+200	374+180	RHS
4	After Shirud Junction	423+800	427+720	RHS

Landscaping & Arboriculture

Landscaping is recommended at toll plaza, median etc. Trees can be planted along the highway. The tree species suggested for compensatory plantation and plantation in median would include Mudhuca indica, Magnifera Indica, Terminalis Arjuna, Dalbergia Sisoo, Azarichta Indica, etc.

Toll Plaza & Weigh Bridges

Toll Plaza should be located at such places so as to capture all the traffic to avoid any leakage of revenue. Recommended Toll Plaza locations are given in Table below. Weigh bridge also is proposed at each toll plaza location with emergency lane on either side.

Table E.30: Proposed Toll Plaza locations

Section	Location	Existing Km	Design Chainage	Lane
Aurangabad Bypass	Bypass	Nil	320+500	5+5
Ellora-Kannad	Kannad	372+300	373+250	5+5
Chalisgaon Bypass -Dhule	Junawane	442+400	446+210	5+5

In Ellora – Kannad section, alternative location at Hatnur (km 360+480); Design Chainage 363+090 of the toll plaza is identified to fulfill the criteria of 60km distance inbetween two Toll Plazas.

In addition to above toll plazas, there is one Toll Plaza (2+2 lane) at 10th km of existing 2-lane Chalisgaon Bypass (Design CH 404+400) operated by MSRDC. As per MSRDC records, the Toll start date is 15.05.2010 and concession period is 12 Years 04 Months 25 Days. This Toll Plaza shall be upgraded to 5+5 lane after buy back of this bypass from MSRDC as per MoRT&H/Maharashtra State Government norms. Till that time "Toll collection right" shall be with present concessionaire for 11.67 km bypass.

MSRDC officials welcome the proposal of upgrading existing 2 lane Chalisgaon bypass to 4-lne standard with geometry improvement by NHAI and expressed their willingness to buy back the bypass. They also discussed about cash flow details of buy back cost and assured to submit their buyback proposal officially at the earliest.

Alternatively, MSRDC may allow four laning of existing 2 lane Chalisgaon bypass with O&M as per IRC guidelines by NHAI. Toll Collection right shall remain with MSRDC till the end of concession period. After the expiry of concession period this section will be handed over to NHAI/developer of 4 lane facility.

E10. Pavement Design

Pavement design life is the period for which the initial design of pavement structure shall be carried out. According to IRC: 37-2001, the pavements of National Highways should be designed for a life of 15 years and that of expressways can be designed for a longer life of 20 years, while economical analysis is carried out for a period of more than 20 years to assess the economical viability of the project. Also, recently released IRC: SP: 84-2009, Manual of Specifications and Standards for 4 Laning of Highways through Public Private Partnership, published by IRC, flexible pavement shall be designed for a minimum design period of 15 years or operation period whichever is more (Refer Clause 5.4 of the stated manual). In the present case, the project is likely to be awarded for an operation period of 25 years, excluding construction period. Thus the design life of the pavement will be 25 years. However, stage construction is also permitted subject to compliance to certain requirements specified at clause 5.4.1 (ii) of the stated IRC manual.

Pavement design has been performed for both flexible and rigid pavement options as per TOR. Axle load surveys have been conducted on two locations on project corridor. Adopted VDF factors are as below:

Table E.31: Proposed VDF

Vehicle Type	km 341+000		km 391+000		km 441+600		Adopted VDF
	Towards Aurangabad	Towards Dhule	Towards Aurangabad	Towards Dhule	Towards Aurangabad	Towards Dhule	
LCV	0.25	0.42	0.45	0.10	0.35	0.6	**0.60**
2-Axle Truck	2.65	2.57	2.14	1.93	1.58	1.91	**2.65**
3-Axle Truck	3.19	3.09	2.98	2.25	2.38	3.18	**3.19**
MAV	7.92	3.16	6.00	1.74	6.38	3.37	**7.92**
Bus	0.4	0.4	0.55	0.29	0.32	0.3	**0.55**

Based on the design traffic in MSA and the subgrade strength in terms of CBR, the pavement composition worked out by IRC catalogue design procedure to account for entire design period of 25 years life (2014 to 2038) .The thickness of subgrade is 500mm with selected borrow area soils with 8% CBR is proposed, and over which the pavement crust will be built. 8% CBR was considered for subgarde. Design based on IRC:37-2001 was compared with AASHTO method. The expected design MSA from traffic fore cast on each homogeneous section are given in Table below:

Table E.32: MSA for various sections

Traffic Homogeneous Section	Design Traffic Loading in terms of MSA	
	15 year period (2014 to 2028)	25 year period (Operation Period-2014 to 2038)
Section 1 – km 290.2 to km 366	70	165 (150)
Section 2- km 366 to km 396	60	140
Section 3- km 396 to km 435	63	145
Section 4- km 435 to km 452	70	160(150)

The design period of flexible pavement structure for the new carriageway will be taken as equivalent to an operation period of 25 years. If stage construction is adopted, the Sub-base and Base of pavement is designed for an entire operation period of 25 years and initial bituminous surfacing for a period of 15 years.

The design period considered for strengthening of existing pavement is 15 years and subsequent strengthening to extend the pavement to full operation period shall be implemented at the end of initial design period or earlier based on pavement deflection studies.

Design of Pavement Structure as per IRC: 37-2001

Two alternative designs as below are presented:

Alternative -1: This alternative provides the design for entire operation period. In other words, pavement structure worked out for the entire operation period will be constructed in one-go before opening to traffic.

Alternative -2: This alternative phase out the construction in multiple stages. Initially, the thickness of bituminous layers will be provided for 15 year period, though non-bituminous layers can be designed for an entire operation period.

Staged construction will also lead to cost savings for initial construction. For these reasons, Alternative-2 "Stage construction" is adopted for bituminous layers.

Hence, the bases and sub-bases have been designed for the full design life of 25 years (operation period), while the surfacing course has been designed for a life of 15 years. A structural overlay is proposed to be provided after 15 years of service life. The SN requirements for 25 years and 15 year periods for different traffic homogeneous sections are compared in respect of both IRC & AASHTO method of design as shown in Table below

Table E.33: SN Requirement for Pavement Structure (AASHTO & IRC)

Design Section	Structural Number(SN) Required			
	15 years		25 years	
	IRC	AASHTO	IRC	AASHTO
Section 1- km 290.2 to km 366	4.73	5.20	5.29	5.81
Section 2- km 366 to km 396	4.73	5.08	5.22	5.69
Section 3- km 396 to km 435	4.73	5.12	5.29	5.71
Section 4- km 435 to km 452	4.73	5.20	5.29	5.77

It may be observed that both the design method compares well in respect of SN requirement for new pavement with AASHTO method requiring additional SN of 0.35 to 0.47 for 15 years and 0.42 to 0.52 for 25 years life over IRC design.

Therefore, the composition of initial pavement has been worked out on the basis of IRC: 37-2001 recommendations with the satisfying requirements of AASHTO design. Thus, the

proposed composition of initial pavement for various traffic homogeneous sections is given in Table below

Table E.34: Proposed Initial Pavement Composition

Component Layer	Material Type	Pavement Layer Thickness (mm)				Remarks
		Section 1 – km 290.2 to km 366	Section 2- km 366 to km 396	Section 3- km 396 to km 435	Section 4- km 435 to km 452	
Surfacing Course	BC	50	50	50	50	15 years life
	DBM	115	115	115	115	
Base Course	WMM	250	250	250	250	25 years design life
Sub Base Course	GSB	250	250	250	250	
Sub Grade CBR (%)		>=8%				
SN Provided		4.95				

Aurangabad Bypass (km 290.2 to km 324.63, a new 4-lane road alignment) is added afterwards for which same composition is proposed.

Based on the present traffic estimates, structural overlay composition after 15 years of surfacing course life is worked out as below.

40 mm BC+ 50 mm DBM

As per IRC: 81-1997, the minimum design life of 10 years had to be adopted for national highways. Thus, for the present study, the design life of 15 years for overlay has been adopted. The MSA calculations have been done from the base year 2010 to the end of 15 years design life i.e., 2028. Accordingly, the overlay required has been calculated for various sections. Recommended pavement composition for new construction and Overlay are summarized as below:

Table E.35: Recommended Overlay for Existing Road

Sr. No.	Homogenous section		Length (km)	Average Characteristic Deflection (mm)	Traffic Loading in MSA (2010-2028)	Overlay in terms of BM (mm)	Overlay in terms of BC+DBM (mm)
	From (km)	To (km)					
HS-1	290+200	312+000	21.8	-	-	-	Mostly New Road except 5km
	312+000	323+000	11.0	1.10	79	145	50+50
HS-2	km 228.000 of SH-16 to km 7.000 of SH-180, near Ellora caves		22.0	1.11	79	146	50+50
HS-3	339+000	362+000	23	1.05	79	130	50+50
HS-4	362+000	366+000	4.0	1.14	79	147	50+50
	366+000	380+000	14.0	1.14	68	135	50+50
HS-5	380+000	390+000	10	0.96	68	100	50+50

Sr. No	Homogenous section		Length (km)	Average Characteristic	Traffic Loading in MSA	Overlay in terms of BM	Overlay in terms of BC+DBM
HS-6	390+000	396+000	6	1.29	68	150	50+60
	396+000	410+000	14	1.29	72	155	50+60
HS-7	410+000	426+000	16	1.26	72	154	50+60
HS-8	426+000	435+000	9	1.33	72	165	50+70
	435+000	440+000	5	1.33	82	170	50+70
HS-9	440+000	452+000	12	1.48	82	180	50+70

Service road pavement composition is designed for 5 MSA traffic loading as given in para 5.5.5 of IRC: SP-84-2009, The composition and thickness of component layers as worked out is given in Table below:

Table E.36: Pavement Composition for Service Roads

Sr. No.	Pavement composition	Design thickness (mm)	Total thickness (mm)
1	Semi Dense Bituminous Concrete (SDBC)	25	475
2	Dense Bituminous Macadam (DBM)	50	
3	Wet Mix Macadam (WMM)	250	
4	Granular Sub-Base (GSB)	150	
5	Subgrade with 8% CBR	500	500

E11. Environmental Considerations

Initial Environmental screening have been carried out by the Consultants to assess the impact arising out of land acquisition for widening of existing road and for construction of new bypass/realignments around congested towns/villages along the project road. The initial impact assessment concluded that the proposed road widening and improvement would be overwhelmingly beneficial. There are however, some issues that need to be addressed. Comprehensive action Plan Matrix have been prepared and presented in Chapter 9. Mitigation measures have been suggested and accordingly, preliminary budget estimation for measures has been suggested. The likely environmental management cost works out to Rs. 1.71 Crores.

E12. Social Considerations

The scope of work envisages widening and strengthening of the project road from present status to 4 lanes divided carriageway standard. The proposed up gradation will be mainly along the existing alignment. It has been proposed to have a uniform land width of 60m for Rehabilitation and Upgradation along the existing road. This means that the impact of project road up gradation will remain confined to 60 m only. Simple calculation reveals that a minimum of **659** ha of land area will be required for widening and up gradation along the project road including proposed bypasses/realignments, truck lay bye and toll plaza. Thus the quantum of land area required for Rehabilitation and Upgradation would be quite substantial. Except at realignment/bypass locations all along the project road additional land width required would be more than 25m. Wherever the bypass and realignment is

proposed, 60 m wide strip of land is required. So, the adverse impact of widening and up gradation on people and property in this section of the road is likely to be substantial.

Tentative Budget for Resettlement and Rehabilitation Activities R&R Program

It has already been stated that the list of affected properties is yet to be firmed up. However, a tentative estimate of cost for Rehabilitation & Resettlement has been worked out to Rs. 70.62 Crores, which covers all components of compensation, assistance and entitlements. The detailed cost estimate for resettlement will be provided in the Preliminary Project Report. The broad break up of tentative R & R budget is given below:

E13. Cost Estimate

The "Guidelines for Costing Methodology" to be adopted for framing up Cost Estimates of BOT Projects was issued by NHAI on 8th December 2010. These are adopted for preparation of Rate Analysis, Estimation of Quantities and Cost Estimates.

The rates of various items of construction work have been analysed as per procedure laid down in the "MORT&H Standard Data Book"-2003 (Fourth Revision, Reprint 2006) and guidelines set there in Market studies were made to ascertain the rates of various items of construction materials. The rates of natural materials like river sand, moorum, gravel and stone aggregate etc. have been collected from the available quarry sources, in the vicinity of the road, by local enquiry and from government departments. Aggregate quarries are at longer leads, nearest quarries available are at Aurangabad, Chalisgaon and Dhule. In case if number of local aggregate crushers are not sufficient to meet the requirement, the rates of crushed aggregate, and crusher dust are adopted in the rate analysis by considering own cone crusher by the contractors. Sand is available at the river and nalla beds all along Aurangabad, Kannad, Chalisgaon and Dhule, Rates of manufactured / proprietary items have been ascertained from the trade. Unit cost of transportation to site, based on the average lead, has been added to the basic cost. Cartage rates have been considered as per MORT&H Data Book and guide lines laid there in. Hourly cost of owning and operating various machineries and equipment has been considered as per the Standard Data Book and local market enquiry. Local prevailing hire charges and diesel charges were also considered in arriving at Machinery & Equipment hiring charges. For machinery and equipment not covered by the Data Book, prevailing market rates were considered. Rates of different categories of skilled and unskilled manpower, labor have been taken from the rates as provided in the PWD NH Division SSR of Aurangabad, Jalgaon, Dhule circle Maharashtra state for year 2011-2012. Weightage rates are adopted as per weightage length falling in the Aurangabad, Jalgaon and Dhule Districts. Rates have been adopted by adding Lead Charges as per the project. Current rates for Bitumen, Steel and Cement have been adopted.

An escalation as per RBI indices has been taken into account wherever applicable for determining current year 2011-2012 rates. A conscious effort has been made to arrive at reasonable and logical rates for various items of work. Unit rates have been checked against rates of similar ongoing project under NHAI near the project road vicinity and were found reasonable.

The quantities of earth work in cut and fill were computed after designing horizontal and vertical alignment using MX software. Digital Terrain Modeling (DTM) has been developed using topographic survey data. A number of typical cross sections have been developed as per

site requirements and optimum utilization of existing road. Highway alignment has been fixed based on existing road conditions, bridges widening and reconstruction proposals, VUP, PUP, RoB proposals, typical cross sections, cross drainages structures and pavement crust design. Detailed Cross Sections @ 50m interval are generated using MX and TCS adopted in the respective chainages. Provisions are made for the soft and hard rock excavation based on the road inventory and the site investigation. Quantities of all other items like subgrade, granular subbase, wet mix macadam, dense bituminous macadam and bituminous concrete for new construction of 2/4 lanes have been worked out using the typical cross sections adopted in the respective locations. Quantities for over lay have been computed based on overlay thickness and typical cross sections proposed. Profile Corrective Course (PCC) quantities are computed based on MX Renew. The quantities for junctions, bus bays, traffic appurtenances and other miscellaneous items have been calculated from the standard drawings and Consultant's previous experience. The quantities for culverts, bridges and flyovers have been calculated from detailed drawings and design of individual structures proposed for required widening and new-construction. Road signage, toll plaza, lighting, avenue plantation etc all itesms are calculated as per Design Plan and IRC standard.

The abstract of the Cost Estimate is presented in Table below.

Table E.37: Summary of Project Civil Cost for 4-laning Excluding Ghat Section

Bill No.	Description	Aurangabad-Dhule (Design Length 153.850) Amount (Rs .in figures)
1	Site Clearance	25,580,827
2	Earthworks	2,574,794,060
3	Sub-Base Course & Base Course	1,999,115,024
4	Bituminous Works	3,691,116,937
5	Cross Drainage works - Culverts	582,176,088
6 a)	Major Bridges, ROB, Flyover, Underpasses & Minor Bridges.	1,711,488,379
b)	R.E.Wall	1,005,375,145
c)	Repairs and Rehabilitation of Bridges	4,388,090
7	Drainage and Protection Works	687,325,423
8	Traffic Signs, Markings & Other Road Appurtenances	177,751,779
9	Maintenance, Repair & Rehabilitation during construction	86,543,251
10	Truck Laybys & Bus bays	46,945,000
11	Lightings Urban Areas, Major intersections, flyover and toll Plaza	75,576,662
12	Toll Plaza	83,514,192
13	Avenue Plantation	45,679,875
14	Administrative Block and Maintenance Base Camp ,	96,515,150
15	Rest areas	40,000,000
16	Miscellaneous works	416,342
TOTAL AMOUNT OF BILLS		**12,934,302,225**
Total Civil Cost(Rs. In Crores)		**1,293.400**
Rate (Rs. In Crores per km);		**8.41**
Total Project Cost 25% over Total Civil Cost (Rs. In Crores)		1616.75
Rate (Rs. In Crores per km);		**10.51**

E14. Economic Analysis

Economic benefits of the project were estimated in terms of savings in VOC and savings in travel time for passenger and goods vehicles. The estimates of VOCs and time costs of each vehicle type in with and without project scenario have been made using HDM-4.

The economic analysis has been based on comparison of costs and benefits under two scenarios 'without the Aurangabad-Dhule road project' and 'with the Aurangabad-Dhule road project'. All costs and benefits are valued in monetary terms and expressed in economic prices to have the analysis on resource based frame-work. The analysis is made corridor-wise as well as project-wise. The results are expressed in terms of Economic Internal Rate of Return (EIRR) and Economic Net Present Value (ENPV). The summary of project cost at Financial Prices is given in Table below:

Table E.38: Changes in Length after Improvement

Section No.	From	To	Existing Length (km)	Improved Length (km)	Remarks
1	Aurangabad	Daullatabad	85.8	86.850	4L
2	Daulatabad	Kannad			4L
3	Kannad	Chalishgaon	Ghat section and road; 14km is excluded		
4	Chalishgaon	Shirud	62.8	67.050	4L
5	Shirud	Dhule			4L
Project			**148.6**	**153.850**	

Note:

1. Design Length = CH. 290+200 to CH. 377+000 = 86.850 km; and CH. 390+000 to CH. 457+050 = 67.050 km; Total Design Length = 86.850 + 67.050 = 153.850 km
2. The Ghat section (km 376 to km 390) is excluded from this project.
3. Km 390.000 to km 396.450 section of existing road is 2-Lane with paved Shoulder; It needs overlay; geometry improvement and rehabilitation of existing CD structures.
4. Km 396.400 to km 404.200 section is existing Chalisgaon Bypass which is a BOT road; toll is being charged for this 11.67km road length.

Economic Analysis has been carried out for two options i.e (1) Improved Length = 153.850km with bypass and (2) Existing Length = 148.6km without bypasses using NH-211. However the cost difference is very nominal; hence same cost is adopted for both options.

Table E.39: Per Km Construction Cost at economic prices

Section No	Description	Length (km)	Civil onstruction Cost (Rs in crore) at Financial prices	Civil cost at Economical prices (Rs in Crores)	Construction Cost /km (Rs in Cr.) at Economic Prices
1	Aurangabad-Daulatabad (4L)	43.86	408.658	347.529	7.92
2	Daulatabad – Kannad (4L)	43.39	287.592	244.454	5.63
4	Chalishgaon-Shirud (4 Lane)	45.79	397.020	337.469	7.37
5	Shirud-Dhule (4 Lane)	21.35	200.129	170.110	7.97
	Total cost	**153.850**	1293.400	1099.562	7.15

The economic cost per km at 2012 prices has been considered for the sections are given in below. All the cost figures are tentative and to be rigorously scrutinized during detail study.

Economic appraisal has been carried out separately for each sections of the package. The results of the economic packages were combined to arrive at the results of the project corridor as a whole. This analysis was carried out using the HDM-4 software. This appraisal included sensitivity analysis to assess the impact of increased costs of construction and decreased benefits. The analysis also considered the value of savings in travel time. Thus the benefits estimated for this appraisal are very conservative. The exclusion of these benefits does not alter the relative importance of different considered alternatives, as these benefits would have been added equally to all the considered alternatives. The results of economic analysis based on DDPR cost are presented in Table below.

Table E.40: Economic Returns of the Project

SL. No	Sections	Option 1: 148.6 km		Option 2: 153.850 km	
		EIRR (%)	NPV at 12% (Rs Million)	EIRR (%)	NPV at 12% (Rs Million)
1	Aurangabad-Daulatabad	10.1	-1152.56	9.738	-690.213
2	Daulatabad-Kannad	25.7	4135.28	22.200	1940.992
3	Chalishgaon-Shirud	25.8	5849.57	19.565	2671.903
4	Shirud-Dhule	27.7	2944.94	20.744	2505.571
Project		**22.325**	**2944.31**	**18.06%**	1607.063

Source: HDM-4 Output sheets

In case of Option 2 : 153.850km length with bypasses the sections of the project are found to be economically viable except Aurangabad- Daulltabad. The entire project road is found viable *returning* a NPV of Rs 1607.063 million and an EIRR of 18.06%; EIRR is comfortably above the threshold of 12%

Sensitivity Analysis

A sensitivity analysis has been performed under the following scenarios and found that the project is economically viable even under worse condition when all the factors are suppose to happen simultaneously.

- 15% increase in capital cost
- 15% decrease in traffic volume
- 15% reduction in traffic growth rate
- 15% decrease in MT time savings
- All factors together

E15. Toll Strategy

Tolling strategy in the present context is the identification of toll plaza locations and tolling sections, which can fetch maximum revenue with minimum leakage and cost within the given constraints. Open tolling system is to be adopted for the corridor. This means, flat

toll rates calculated for the length of tolling section(s) shall be charged at the respective toll plazas giving concessions/discounts as applicable to local / frequent users as decided by authority.

The corridor existing length is 148.6 km. The toll policy recommends an average distance between two toll plazas should generally be 60 km except where it is not feasible to do so. Considering this, the corridor can be divided into three tolling sections as below.

Table E.41: Tolling Sections

Section No.	From	To	Proposed Lanes	From Design Chainage	To Design Chainagae	Tolling Design Length km
1	Aurangabad#	Daulatabad	4L	290.2	324.4	34.2
2	Daulatabad	Kannaad	4L	324.4	377.0	72.6
3	Chalisgaon*	Dhule	4L	390.0	457.050	67.05
				Total Length		**153.850**

Note:
8 km road section of 2-lane "Nagpur- Mumbai Highway" is being used. This length is deducted from the Toll Revenue Calculations and Financial Analysis as Toll Collection RIGHTS shall remain with MSRDC.

***In case of "NO BUY BACK" of existing Chalisgaon Bypass (BOT Road), 11.67 km road length shall be deducted from Chalisgaon – Dhule toll section.

In order to avoid the congestion in the existing settlements, 5 new bypasses are proposed along the corridor and are produced below.

Table E.42: Bypass Details

S. No.	New Four Lane Bypass	From (Existing km)	To (Existing km)	From (Design chainage)	To (Design chainage)	Design Length (km)	Cost (Rs. Crores)
1	Aurangabad Bypass	-	-	290+200	324+400	34.200	312.00
2	Galleborgaon Bypass	346+800	348+800	348+497	350+929	2.432	22.00
3	Kannad Bypass	364+200	370+420	366+230	371+327	5.097	45.44
4	Mehunbarne Village	411+600	416+100	415+400	419+900	4.500	31.25
5	Garthad Bypass	446+850	450+200	450+639	454+379	3.740	32.60
					Total Length (km)	**49.969**	**443.29**

As per the toll policy all the structures and bypasses costing more than Rs 10 crores need to be charged separately at the toll rates specified in the policy.

Three toll plazas have been proposed in this section respectively at Design Ch. 320+500 of Aurangabad bypass, Design Ch. 363+090 (km 360+480) Hatnur and Design Ch. 446+210 (km 442+400) Junawane. Specifications and other requirements of the toll plazas shall be strictly as per schedule "D".

Table E.43: Toll Plaza Details

Section	Location	Existing Km	Design Chainage	Lane
Aurangabad Bypass	Bypass	Nil	320+500	5+5
Ellora-Kannad	Hatnur	360+480	363+090	5+5
Chalisgaon Bypass - Dhule	Junawane	442+400	446+210	5+5

Aurangabad bypass and Daulatabad road will be charged at Km 320+500 toll plaza. Ellora, Galleborgaon & kannad bypass will be charged at km 360+480 toll plaza. Mehunbare and Garthard bypasses will be charged at km 442+400 Toll plaza.

In addition to above toll plazas, there is one Toll Plaza (2+2 lane) at 10th km of existing 2-lane Chalisgaon Bypass (Design CH 404+400) operated by MSRDC. As per MSRDC records, the Toll start date is 15.05.2010 and concession period is 12 Years 04 Months 25 Days. This Toll Plaza shall be upgraded to 5+5 lane after buy back of this bypass from MSRDC as per MoRT&H/Maharashtra State Government norms. Till that time "Toll collection right" shall be with present concessionaire for 11.67 km bypass

For Present Toll revenue estimation and Financial Analysis, BUY BACK option at Rs 30 Crore is considered.

Table E.44: Tolling sections & Bypasses

Section	Location	Design Chainage	Existing Km	Remarks
Aurangabad Bypass	Bypass	320+500	Nil	5+5 lane
Ellora-Kannad	Kannad	372+300	373+250	5+5 lane
Chalisgaon Bypass -Dhule	Junawne	446+210	442+400	5+5 lane

S.No.	Toll Plaza location Design Chainage	Length in Km for which fees is payable
1	320+500	CH. 290+200 to CH. 324+400, 34.2 km length of Aurangabad bypass.
2	373+250	CH. 324+400 to CH. 377+000; Includes Daulatabad, Ellora Road; Galleboregaon and Kannad bypass
3	446+210	CH. 390+000 to CH. 457+050 , including Mehunbarane and Garthad Bypass

E16. Financial Analysis

The financial analysis for the project road of Aurangabad-Dhule has been conducted from the point of view of assessing its viability for developing the same on commercial basis either by Government/Public Enterprise or through a Public-Private Partnership. In this feasibility stage, the financial feasibility analysis was carried out on new sections with the

assumption that these results will help to assimilate suitable contract sections in subsequent stages and further feasibility analysis will be carried out for the selected contract sections. In addition, the financial viability of the project has been assessed under various scenarios in order to analyse its attractiveness for commercial development under different assumptions.

In order to make the project conducive for commercialisation and /or payment of user charges in the form of tolls, the project corridor has been proposed for a 4-lane Aurangabad Bypass and Daulatabad Bypass and two lane with paved shoulder highway for Ellora bypass, existing NH-211 up to Dhule excluding Ghat section from km 370.875 to km 390.4. Service roads on either side in appropriate lengths are provided in urban sections and VUP/PUP locations. The financial viability analysis has accordingly been carried out on the basis of Model Concession Agreement of DBFO arrangement. The construction and operations & maintenance cost estimates, traffic forecasts, and toll rates are all based upon the report submitted earlier. The requisite data of the earlier report has been suitably updated for the purpose of current analysis. The financial analysis for the project road of Aurangabad - Dhule has been conducted from the point of view of assessing its viability for developing the same on commercial basis either by Government/Public Enterprise or through a Public-Private Partnership. In this feasibility stage, the financial feasibility analysis was carried out on new sections with the assumption that these results will help to assimilate suitable contract sections in subsequent stages and further feasibility analysis will be carried out for the selected contract sections. In addition, the financial viability of the project has been assessed under various scenarios in order to analyse its attractiveness for commercial development under different assumptions.

The present report has considered the following sections as units for financial feasibility analysis. The entire project has been divided into three sections. These sections are assessed for their commercial viability, on stand-alone basis, and finally as a project taking all the sections together for implementation under BOT scheme. The sections considered for the analysis are detailed in Table below.

Table E.45: Toll Sections for improvement

Section No.	From	To	Proposed Lanes	From (Km)	To (km)	Existing Length (km)
1	Aurangabad	Daulatabad	4L	290.2	324.634	34.43
2	Daulatabad	Ellora	4L	324.634	341.907	17.273
3	Ellora	Kannad	4L	340	376	36.000
4	Kannd	Chalisgaon	Excluded	376	390	14.00
5	Chalishgaon	Shirud	4L	390	435	45.0
6	Shirud	Dhule	4L	435	452.8	17.8
Project excluding Ghat (14km)						**148.6**

Factors Assumed

(i) General Assumptions

The General Assumptions considered in financial analysis of this project are as follows:

- Project costs, toll rates and O & M costs have been adjusted to current prices beyond 2011 prices at the rate of 5% per annum
- 3% physical contingency
- 1% IC charges
- Medical Aid post construction included in toll plaza costs
- All toll rates have been obtained under The Gazette of India No. 33004/99 dated December 5, 2008 and subsequent revisions.
- SLM and WDV depreciation methods have been used on book value of asset for income and tax estimation.
- 10% WDA depreciation has been considered.
- SLM rate (4.55%) estimated on the total period excluding construction period.
- 100% of book value of asset is considered for depreciation
- 33.66% tax rate has been considered.
- 11.33 % MAT has been considered.
- 10 years tax holiday has been considered.
- 10 years repayment period has been considered excluding 3 years construction period.
- The rate of interest has been considered as 12%. Interest during construction has been capitalised.
- The debt equity ratio has been taken as 70:30.
- One-time 2% enhancement of debt amount has been made to accommodate up-front and debt syndication charge.
- For the purpose of financial analysis 2-wheelers, auto, agriculture trailer and NMT have been excluded.
- Income from other sources has not been considered.
- The phasing of construction is, 30%,40% and 30%
- 5% has been take as average WPI rate
- The discount rate has been taken as 12%.
- Routine maintenance cost has been taken as Rs .03 cr per km
- The periodic maintenance in case of flexible pavement is considered Rs .25 crore/km
- The cost of insurance is considered 0.01% of project cost at 2014 prices per section.
- No concession fee is considered
- It has been assumed that financial closure will be completed within stipulated time period
- No revenue shortfall loan has been considered
- No construction of additional toll-way has been considered
- It has been assumed that there will be no change of law loaded with cost hike implications.
- Max.40% of project cost as Equity support has been considered
- Project IRR has been estimated taking project cost without the equity support the concessionaire is likely to have from Government as the contribution from the Government is not a cost to the concessionaire.

(ii) Particular Assumptions for "4-laning of Aurangabad – Dhule Project excluding Ghat section

The Following assumptions are made in the Traffic forecast and Financial Analysis

A. Traffic

1. The traffic growth rate considered for the financial analysis is 5% p.a.
2. **Induced traffic of 2%** is considered from the year 2016 from the year in which the project is opened for traffic.
3. **Divertible traffic** is considered from the **Base year 2012.**
4. **Generated traffic** is considered from the **Construction completion year 2016**.
5. **DMIC** (Delhi Mumbai Industrial Corridor) traffic is considered from the **year 2021**.

B. Financial Analysis

1. Base toll rate revision of 3% (simple) rate as per toll policy is considered.
2. The toll rate revision is done at 5% p.a. (40%wpi inflation)
3. An interest rate of 12% is considered.
4. The project implementation period of 3 years with cost expenditure of 30%, 40% and 30% is considered.
5. Cost of the Project is **Rs 1293.4** Crores.
6. **8 km of existing Nagpur-Mumbai toll** road becomes part of the Auranagbad bypass. Hence the toll revenue from the same **is not considered** in the analysis.
7. **The existing Chalisgaon bypass was developed by MSRDC** and is presently in operation. It is proposed to buy back the bypass. **The cost of the bypass considered is Rs 30 Crores in the year 2016. The revenues are being considered in the project**.

Traffic Growth and Traffic Volume

The distribution of toll-able vehicles section-wise 2016 has been shown in **Table below**.

Table E.46: Toll Rate, Highway , Rs. Per km (4Lane)

Year	Car/ Jeep	Mini Bus	Bus	LCV	2 Axle Truck	3 Axle Truck	MAV up to 6 Axle	MAV >6 Axles	HCM/EME
2007-08	0.65	1.05	2.20	1.05	2.20	3.45	3.45	4.20	3.45
2008-09	0.68	1.10	2.31	1.10	2.31	3.61	3.61	4.40	3.61
2009-10	0.72	1.16	2.42	1.16	2.42	3.80	3.80	4.63	3.80
2010-11	0.75	1.21	2.54	1.21	2.54	3.99	3.99	4.86	3.99
2011-12	0.80	1.29	2.71	1.29	2.71	4.24	4.24	5.16	4.24
2012-13	0.85	1.37	2.88	1.37	2.88	4.51	4.51	5.49	4.51
2013-14	0.91	1.46	3.07	1.46	3.07	4.81	4.81	5.85	4.81
2014-15	0.97	1.56	3.27	1.56	3.27	5.12	5.12	6.24	5.12
2015-16	1.03	1.66	3.48	1.66	3.48	5.46	5.46	6.65	5.46
2016-17	1.10	1.78	3.72	1.78	3.72	5.83	5.83	7.10	5.83
2017-18	1.17	1.90	3.98	1.90	3.98	6.23	6.23	7.59	6.23
2018-19	1.26	2.03	4.25	2.03	4.25	6.67	6.67	8.12	6.67
2019-20	1.35	2.17	4.55	2.17	4.55	7.14	7.14	8.69	7.14
2020-21	1.44	2.33	4.88	2.33	4.88	7.65	7.65	9.31	7.65
2021-22	1.55	2.50	5.23	2.50	5.23	8.20	8.20	9.99	8.20
2022-23	1.66	2.68	5.62	2.68	5.62	8.81	8.81	10.72	8.81

Year	Car/ Jeep	Mini Bus	Bus	LCV	2 Axle Truck	3 Axle Truck	MAV up to 6 Axle	MAV >6 Axles	HCM/EME
2023-24	1.78	2.88	6.03	2.88	6.03	9.46	9.46	11.52	9.46
2024-25	1.92	3.10	6.49	3.10	6.49	10.18	10.18	12.39	10.18
2025-26	2.06	3.33	6.99	3.33	6.99	10.96	10.96	13.34	10.96
2026-27	2.22	3.59	7.53	3.59	7.53	11.80	11.80	14.37	11.80
2027-28	2.40	3.87	8.11	3.87	8.11	12.73	12.73	15.49	12.73
2028-29	2.59	4.18	8.76	4.18	8.76	13.73	13.73	16.72	13.73
2029-30	2.79	4.51	9.46	4.51	9.46	14.83	14.83	18.05	14.83
2030-31	3.02	4.88	10.22	4.88	10.22	16.02	16.02	19.51	16.02
2031-32	3.26	5.27	11.05	5.27	11.05	17.33	17.33	21.09	17.33
2032-33	3.53	5.71	11.96	5.71	11.96	18.75	18.75	22.83	18.75
2033-34	3.83	6.18	12.95	6.18	12.95	20.30	20.30	24.72	20.30
2034-35	4.14	6.69	14.03	6.69	14.03	22.00	22.00	26.78	22.00
2035-36	4.49	7.26	15.21	7.26	15.21	23.84	23.84	29.03	23.84
2036-37	4.87	7.87	16.49	7.87	16.49	25.86	25.86	31.48	25.86
2037-38	5.29	8.54	17.90	8.54	17.90	28.06	28.06	34.17	28.06
2038-39	5.74	9.27	19.43	9.27	19.43	30.47	30.47	37.09	30.47
2039-40	6.24	10.07	21.10	10.07	21.10	33.09	33.09	40.29	33.09
2040-41	6.78	10.94	22.93	10.94	22.93	35.96	35.96	43.77	35.96

Table E.47: Mode wise Toll Rates for different Sections

Financial Year	Car/ Jeep/ Van	Mini Bus	Bus	LCV	2 Axle Truck	3 Axle Truck	MAV up to 6 Axle	MAV >6 Axles	HCM/ EME
Tolling Section - 1									
2016-17	75	120	250	120	250	270	390	475	390
2020-21	95	150	320	150	320	345	500	605	500
2025-26	120	195	410	195	410	445	640	780	640
2030-31	155	250	525	250	525	575	825	1,000	825
2035-36	200	325	680	325	680	740	1,065	1,295	1,065
2040-41	260	420	885	420	885	965	1,385	1,685	1,385
Tolling Section - 2									
2016-17	35	55	120	55	120	130	190	230	190
2020-21	45	75	155	75	155	170	240	295	240
2025-26	60	95	195	95	195	215	310	375	310
2030-31	75	120	255	120	255	275	400	485	400
2035-36	95	155	330	155	330	360	515	625	515
2040-41	125	205	425	205	425	465	670	815	670
Tolling Section - 3									
2016-17	35	55	120	55	120	130	190	230	190
2020-21	45	75	155	75	155	170	240	295	240
2025-26	60	95	195	95	195	215	310	375	310
2030-31	75	120	255	120	255	275	400	485	400
2035-36	95	155	330	155	330	360	515	625	515
2040-41	125	205	425	205	425	465	670	815	670

Financial Evaluation Results

The Project is viable with 35% grant and with a concession period of 26 years. The equity IRR for the above combination is 15.09 % which is more than the desirable IRR expected by the market.

Discussion

1. The project is found financially viable with Option 6 and Option 9 for 30 years concession period & with 30% grant; and 26 years concession period and with 35% grant with average DSCR 1.44 & 1.53 respectively.
2. The length of the road increased after improvement.
3. With 26 years concession period, 35% equity support, average DSCR 1.53, the project achieves market equity IRR of >15% (vide Option 9)

Since the attractive Average DSCR is 1.53 for the 35% grant option, option 9 is recommended for implementation. The details of the analysis are presented below:

Table E.48: Results of Financial analysis Aurangabad-Dhule Project

Results of Financial analysis			AURANGABAD-DHULE				
Options	**Equity Support (%)**	**Concession Period**	**Project IRR(pre-tax)**	**Project IRR (post-tax)**	**Equity IRR**	**NPV (Rs, million)**	**Average DSCR**
Option 1	20%	10	-3.53%	#DIV/0!	#DIV/0!	-721.17	0.68
Option 2	20%	20	9.20%	7.99%	8.54%	32.58	1.24
Option 3	20%	30	12.65%	12.10%	13.72%	916.65	1.24
Option 4	30%	10	-1.91%	#NUM!	#DIV/0!	-562.92	0.78
Option 5	30%	20	10.36%	9.28%	10.80%	190.83	1.44
Option 6	**30%**	**30**	**13.59%**	**13.10%**	**15.29%**	**1074.90**	**1.44**
Option 7	35%	10	-1.00%	-6.03%	#DIV/0!	-485.46	0.85
Option 8	35%	20	11.01%	10.00%	11.91%	268.28	1.53
Option 9	**35%**	**26**	**13.17%**	**12.65%**	**15.09%**	**782.44**	**1.53**
Expected IRR as per GOI Circular*			12.0		12.0		
Desirable IRR			14.0		15.0		

Sensitivity Analysis

Sensitivity analyses of Option 9 is done as the Equity IRR is >15% for 35% VGF and 26 years concession period. The results are presented below:

Results of Sensitivity analysis of	Option 9			
Scenarios	**Project IRR (%)**	**Project IRR without tax (%)**	**Equity IRR (%)**	**NPV (Rs, million)**
Base case	**13.17%**	**12.65%**	**15.09%**	**782.44**
15% rise in capital cost	12.19	11.60	13.11	646.13
15% decrease in total toll revenue	11.64	11.03	12.61	454.34
Interest rate increased to 14%	13.17	12.39	14.56	782.44
Maintenance cost increased by 15%	12.89	12.37	14.66	725.14
A combination of 15% rise in capital cost and 15% decrease in toll revenue	10.72	10.05	10.77	318.02

E17. Conclusions & Recommendations

The project is recommended for implementation as the project is likely to leave considerable impact on the economy of the region, which is necessary to put India as a whole in the high growth inclusive trajectory; as evident from the Economic Analysis. The project is economically viable with ensured EIRR >12%. The project can be financially sustainable if "**Option 9: VGF 35% with Concession Period 26 years"** is undertaken which ensures **15.09**% equity IRR and 1.10 Average DSCR, hence an economic-financial equilibrium can be achieved. **Hence, the project is recommended for implementation under BOT (Toll).**

The main features of the project proposal are summarized below:

1. Design Project length- 153.850 km (Excluding Ghat section 14km)
2. Bypass/ Realignment (5 nos.)
3. ROB-3 Nos – 2 Nos of 4 lane and 1 no. of 2 Lane at Chalishgaon bypass
4. Minor Bridges – 63 Nos.
5. Major Bridges –7 Nos.
6. Flyover – 2 No. In Aurangabad Bypass at Paithon SH-60 crossing.
7. Interchange – NIL
8. Vehicular Underpass – 13 Nos.
9. Pedestrian Underpass – 10 Nos.
10. Service Road Length (both side) – 14.911 x 2 = 29.822 km
11. Slip Road Length (both side) – 17.079 x 2 = 34.158 km
12. Major Junction – 10 Nos.
13. Minor Junction – 35 Nos.
14. No. of Toll Plaza – 3 Nos. of 5+5 lanes (CH 320+500; KM 372+300 CH 373+250 & KM 442+400; CH 446+210) and one Toll plaza of 3+3 lane at CH 404+400
15. Bus Bays – 60 Nos. (30 locations; 2 on each side)
16. Truck Parking – 6 Nos. (3 location x 2 on each side)
17. Rest Areas – 4 Locations
18. Culverts – 353 Nos (289 Nos Main Road + 64 nos Cross Roads).