

D. GODHRA – SHAMLAJI CORRIDOR**D.7 REVIEW OF PRE-FEASIBILITY STUDIESSTUDY****D.7.1 Submittal Referred to**

1. The Interim Report¹ made available to us by GSRDC was submitted by consultants in November 2001. The report coverage of analysis was limited².

D.7.2 Project Sections

2. The project corridor extending over 170 km has been divided into four sections. They are:

- | | | | |
|----|-------------------|---|-------|
| 1) | Halol – Godhra | : | 43 km |
| 2) | Godhra – Lunavada | : | 42 km |
| 3) | Lunavada – Modasa | : | 55 km |
| 3) | Modasa – Shamlaji | : | 30 km |

3. The focus of this review shall be on the last three project section, extending over 130 km.

D.7.3 Base Year Traffic Volume Levels

4. The study presented analysis of the traffic studies undertaken. The base year traffic volumes reported by sections are given under:

Section	Total (ADT)		Goods Vehicles
	Vehicles	PCU	
Godhra – Lunavada	4384	8656	1955
Lunavada – Modasa	4153	8912	2042
Modasa – Shamlaji	4617	12216	3120

D.7.4 Traffic Desire Pattern

5. The broad picture with respect to traffic desire by sections as reported in the document is given under:

Section	Percentage through traffic	
	Goods/Commercial Vehicles	Passenger Vehicles
Godhra – Lunavada	91	11
Lunavada – Modasa	86	33

¹ . The 'Preparation of Feasibility Report and Bid Documents for Capacity Augmentation of Halol – Godhra – Shamlaji' was undertaken by Louis Berger Group, USA.

² .Understandably as it was Interim Report one would not expect final findings of the study. The data and information provided was limited.

Section	Percentage through traffic	
	Goods/Commercial Vehicles	Passenger Vehicles
Modasa – Shamlaji	93	16

D.7.5 Engineering Surveys

6. The interim report only included strips prepared. The report suggests that the road and bridge inventory data is collected. It does not report any further on this aspect.

D.7.6 Environmental and Social Aspects

7. The aspects related to environmental and social issues are presented. The social impacts reported include – impacts to cultural properties and the settlements that could be impacted³. The settlements identified wherein the encroachments could be impacted and land acquisition requirements to be there are:

Settlement Type	Name of Settlement
Urban Areas	Modasa, Malpur, Lunavada, Shehera, Godhra
Villages	Devadaevada, HanselarHanselav, Baria, Aniklav, Doria, Khanpur, Govindpur, Dugarvada, Charnvada

D.7.7 Traffic Forecasts and Other Efforts

8. The report does not include the traffic forecast, project cost, economic and/or financial analysis.

³. The settlements which may have direct and/or indirect impact due to capacity augmentation of the corridor are identified.

D.8 OUR EFFORTS AND FINDINGS

D.8.1 Salient Corridor Characteristics

9. The corridor between Godhra and Shamlaji, falls in the districts of Panchmahals and Sabarkantha. It passes through the major settlements of Shehra, Lunavada, Malpur, Modasa, besides Shamlaji and Godhra. The total length of this section is 130 km. Figure D.8-1 presents the alignment of the study corridor, with respect to the road network falling within the influence area.

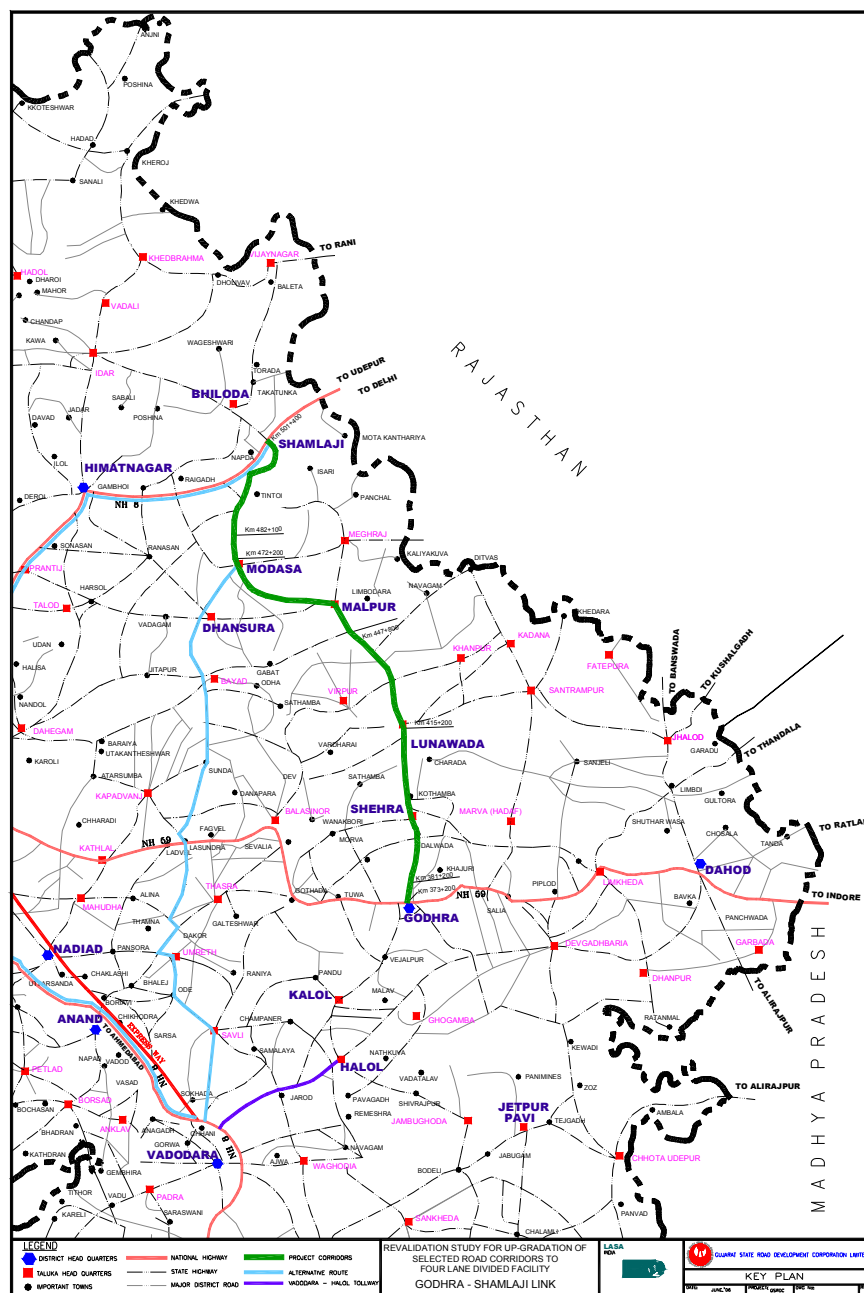


Figure D.8-1: Project Key Plan

10. The study section is a part of the corridor which forms as alternative route to NH-8, between Shamlaji and Vadodara. A substantial level of commercial traffic uses this road for north-south movement in the state. Modasa to Shamlaji section of the study corridor, however, caters to a number of competing routes – this link is common to the alternative routes. The section between Godhra and Shamlaji has been widened to two-lanes with paved shoulders under the World Bank funded the GSHP.

D.8.2 Traffic Studies and Forecast

D.8.2.1 Traffic Survey Locations

11. The classified traffic volume survey (at three locations), Origin-Destination survey (at 1 location) as per the details given below (Map given as Annexure D-1) was conducted to establish base year traffic volume levels and appreciate desire patterns.

Location	Chainage	Survey Detail	Survey Duration
CORRIDOR 3: km 373/200 to km 501/400 Godhra-Shamlaji			
at Pompatpura Village	at 381/200km	Traffic Volume	7 Days
at Galiadathi Village	at 447/800km	Traffic Volume	3 Days
Mardia Village	at 482/100km	Traffic Volume	7 Days
		Origin Destination	1 Day

D.8.2.2 Traffic Volume Leves-2006

12. The average daily traffic volume levels recorded by sections on project corridor (Table D.8-1- (1)) were converted annual average traffic volume levels⁴ (Table D.8-1- (2)).

Table D.1 (2) Traffic Volume-Salient Aspects.

S. No.	Section	Traffic Volume			Peak hour Factor
		ADT (veh)	AADT (veh)	AADT (pcu)	
1	Godhra-Lunavada	9,153	8238	14167	1.7
2	Lunavada-Modasa	8,802	7922	17174	2.2
3	Modasa-Shamlaji	7,145	6430	14283	2.2

13. Traffic composition (Table D.8-1 (B3)) reveals that goods traffic share vary form 35% to 55% or even more. The PCU factor derived ranges from 1.7 to 2.2 as can be seen in above tableTable D.8-2. The peak traffic share was observed to be about 6.0% across the study sections (Table D.8-1- (4)). The details of traffic volume data collected are given in Annexure D-2.

⁴ Seasonal Correction factor of 0.9 was applied

Table D.8-1 (1) : Godhra – Shamlaji Corridor : Traffic Volume Levels

Table D.1 8-1-(1.1): Average Daily Traffic Volume (ADT in VEHs)Average Classified Traffic Volume (ADT in Vehicles)

Corridor Name	Link Name	Sc/Mc	Auto Rickshaw / Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo / LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rickshaw	Animal Drawn	Others	ADT (VEH)
Godhra-Shamlaji	Godhra-Lunawada	2345	688	415	1008	84	309	329	1533	1228	357	99	148	609	0	1	1	9153
	Lunawada-Modasa	1231	573	590	862	108	298	632	1992	1577	576	189	122	46	1	1	3	8802
	Modasa-Shamlaji	1226	578	244	681	24	209	162	1633	1685	476	121	48	40	5	10	2	7145

Table D.8-1 -(1.2): Annual Average Traffic Volume (AADT in VEHs and PCU)Annual Average Traffic Volume (AADT)

Corridor Name	Link Name	Sc/Mc	Auto Rickshaw / Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo / LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rickshaw	Animal Drawn	Others	AADT (VEH)	AADT (PCUs)
Godhra-Shamlaji	Godhra-Lunawada	2322	681	411	998	83	306	326	1518	1215	353	98	147	603	0	1	1	9061	15584
	Lunawada-Modasa	1219	567	584	854	106	295	626	1972	1561	571	187	121	46	1	1	3	8714	18892
	Modasa-Shamlaji	1214	572	241	674	24	207	161	1617	1668	472	120	47	40	5	10	2	7073	15711

Table D.8-1- (1.23): Traffic Composition

Corridor Name	Link Name	Sc/Mc	Auto Rickshaw/Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rickshaw	Animal Drawn Vehicles	Others	AADT (VEHs)
Godhra-Shamlaji	Godhra-Lunawada	25.6%	7.5%	4.5%	11.0%	0.9%	3.4%	3.6%	16.8%	13.4%	3.9%	1.1%	1.6%	6.7%	0.0%	0.0%	0.0%	100%
	Lunawada-Modasa	14.0%	6.5%	6.7%	9.8%	1.2%	3.4%	7.2%	22.6%	17.9%	6.5%	2.1%	1.4%	0.5%	0.0%	0.0%	0.0%	100%
	Modasa-Shamlaji	17.2%	8.1%	3.4%	9.5%	0.3%	2.9%	2.3%	22.9%	23.6%	6.7%	1.7%	0.7%	0.6%	0.1%	0.1%	0.0%	100%

Table D.8-1- (1.24): Peak Hour share of Traffic by Sections and Mode types.

Corridor Name	Link Name	Peak hour	Sc/Mc	Auto Rickshaw /Chakda	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/ LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	Tractor with Trailer	Tractor without Trailer	Cycle	Cycle-Rickshaw	Animal Drawn Vehicles	Others	AADT (VEHs)	AADT (PCUs)
Godhra-Shamlaji	Godhra-Lunawada	18:00-19:00	167	47	28	76	5	20	19	106	69	21	8	11	51	0	0	0	628	1031
	Lunawada-Modasa	20:00-21:00	55	25	21	35	5	16	48	117	99	39	17	4	0	0	0	0	481	1145
	Modasa-Shamlaji	11:00-12:00	93	51	19	44	1	12	7	66	79	26	13	4	3	0	0	0	418	827

Table D.8-2: Traffic Volume-Salient Aspects.

S. No.	Section	Traffic Volume			Peak hour Factor
		ADT (veh)	AADT (veh)	AADT (pcu)	
1	Godhra-Lunavada	9,153	8238	14167	1.7
2	Lunavada-Modasa	8,802	7922	17174	2.2
3	Modasa-Shamlaji	7,145	6430	14283	2.2

14. The pre-feasibility study traffic levels were revisited. Comparison⁵ was made, as locations for conduct of surveys were nearly the same. The corridor is observed to be experiencing fairly high traffic growth (Table D.8-3). The passenger vehicles recorded fairly high growth rates. In case of goods vehicles LCVs / Tempos recorded less growth but multi axle vehicles growth is observed to be high. On the corridor⁶ the overall ADT of vehicular observed to have recorded growth rate between 9%-16%⁷.

Table.D.8-3: Comparison Traffic Levels - Present and Pre-feasibility studies.

Type of Vehicles	Godhra-Lunawada			Lunawada-Modasa			Modasa-Shamlaji		
	Present Study-2006	Prefeasibility Study-2001	Growth Rate (%)	Present Study-2006	Prefeasibility Study-2001	Growth Rate (%)	Present Study-2006	Prefeasibility Study-2001	Growth Rate (%)
Sc/Mc	2345	938	20	1231	526	19	1226	460	22
Auto Rickshaw / Chakda	688	166	33	1163	349	27	578	188	25
Car/Jeep	1423	857	11	1452	619	19	925	530	12
Std. Bus	393	290	6	406	218	13	233	275	-3
Tempo/LCV	329	317	1	632	495	5	162	285	-11
2-Axle Trucks	1533	1242	4	1992	1186	11	1633	1944	-3
3-Axle Trucks	1228	298	33	1577	301	39	1685	641	21
M-Axle Trucks	357	50	48	576	48	64	476	155	25
Tractors	247	48	39	311	112	23	169	95	12
Cycle	609	152	32	46	266	-30	40		
Cycle-Rickshaw	0			1			5		
Animal Drawn	1	24	-49	1	32	-50	10	16	-9
Others	1			3			1.857143		
ADT (VEH)	9153	4384	16	8802	4153	16	7144.667	4617	9

D.8.2.3 Traffic Desire Pattern

15. The Origin-Destination data by mode has analyzed. The trip ends by mode type were seen with respect to immediate influence area zones, traffic originating and terminating within

⁵ The value reported were ADT not AADT.

⁶ Halol – Godhra was also experiencing high traffic growth. Logically this corridor also is experiencing growth in volumes. There seem to be continuity in flow patterns from Halol-Godhra, leading to Shamlaji. The investments made under GSHP are getting realised by catering to high traffic needs and demand. From this what one can infer is that the project corridor is important part of need system from state and national movement perspectives and needs to be further developed.

⁷ The growth rates are high. It is because of the diversion from other corridors. The development of corridor under GSHP led to this diversion of traffic. The growth rates may not be sustainable. But there shall be growth. It can certainly be considered to be moderate to has high in coming years. The imposition of tolls may lead to not achieving high traffic levels as the road users' behaviour is unpredictable. The road is important and high component of commercial traffic.

Gujarat state and traffic which has one of the trip ends (either origin or destination) outside Gujarat. The broad analysis of same given below.

Table D.8-24 : Traffic Desire Pattern : Breakup of Cars and Goods Trips

Section		Cars			Goods Traffic		
		Both Trip ends on Corridor	With one trip end on Corridor-Second generated in Gujarat	With one trip end outside Gujarat	Both Trip ends on Corridor	With one trip end on Corridor-Second generated in Gujarat	With one trip end outside Gujarat
Godhra-Lunawada	Vehicles	384	454	585	89	185	3175
	%	27%	32%	41%	3%	5%	92%
Lunawada-Modasa	Vehicles	384	459	609	89	306	4382
	%	26%	32%	42%	2%	6%	92%
Modasa-Shamlaji	Vehicles	384	162	378	89	170	3698
	%	42%	17%	41%	3%	4%	93%

16. The mode wise breakup of trips internal to Gujarat and external (to and from Gujarat) is given at Table D.8-42. The desire lines shown Maps D.1& D.2 suggest that very high proportion of tollable traffic amongst the modes of traffic that are tollable. The Table D.8-42 also shows that high proportion of goods vehicles travelling on the corridor have one of the trip ends external to Gujarat suggesting the importance of corridor from state and/or national development perspective.

17. The traffic zoning scheme and maps are placed at Annexure B-3.

Draft Final Report

*Revalidation Study and Overall Appraisal of the Project for
Four-Laning of Selected Road Corridors in the State of Gujarat*

D. GODHRA – SHAMLAJI CORRIDOR

Draft Final Report

*Revalidation Study and Overall Appraisal of the Project for
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D.8.2.4 Traffic Forecast

18. The traffic volume on the project corridor is forecasted under various considerations. The trend based forecast assumes that the state shall implement the development of roads and there shall be no imposition of road user charges was assumed. In these conditions the normal traffic shall grow at fairly high growth rates. Further, to this the latent demand for travel will be realised leading to induced and generated traffic levels. If projects are implemented under commercial format, their perceived to be disutility by the road users, as need to pay user fee. This phenomenon is observed across several road projects in India, where an alternate route is available. The project roads are state roads. It is important to implicitly consider alternative routes for road users' are available. Hence, in this revalidation study, the traffic volume levels forecasted explicitly consider likely diversions and suppression of demand, as road users shall maximise benefits by performing less trips. With these considerations alternative traffic forecasts were made. The adopted forecast for financial analysis is suppressed demand alternative (Table D.8-5).

Table D.8-5: Projected Traffic Volume by Alternate Considerations

Link Name	Study	Year	Sc/Mc	Auto / Temp / Chakada	Cars (OT)	Cars (NT)	Mini Buses	Buses	Lcv/ Tempo	2-Axle	3-Axle	M-Axle	Tracto with trailer	Tractor Without Trailer	Cycle	Cycle-Rickshaw	Animal Drawn Vehicles	Others	TOTAL (AADT Veh)	TOTAL (AADT PCU)
Godhra-Lunavada	Revalidation Study-Trend Based	2006	2111	619	374	907	75	278	296	1380	1105	321	89	133	548	0	1	1	8238	14172
		2010	2872	730	440	1145	84	325	363	1775	1459	434	104	155	603	0	1	1	10491	18110
		2020	5391	1101	664	2051	107	456	591	3255	2843	894	150	224	764	0	1	2	18493	32707
		2030	8781	1553	967	3470	135	628	944	5829	5388	1792	213	319	931	0	1	2	30954	57589
		2040	14303	2191	1410	5885	171	866	1509	10439	10209	3591	304	454	1135	0	1	2	52470	102584
	Revalidation Study-Suppressed Demand	2006	2111	619	310	750	65	212	219	981	775	225	89	133	548	0	1	1	7039	10997
		2010	2625	695	354	884	71	241	253	1143	917	270	99	148	591	0	1	1	8294	12865
		2020	4096	929	492	1334	86	315	356	1652	1376	419	128	192	715	0	1	1	12095	18668
		2030	5778	1183	663	1925	104	406	496	2353	2030	640	165	246	838	0	1	2	16830	26407
		2040	8150	1507	894	2781	125	525	690	3352	2993	977	211	316	982	0	1	2	23505	37481
Lunavada-Modasa	Revalidation Study-Trend Based	2006	1108	516	531	776	97	269	569	1793	1419	519	170	110	41	1	1	2	7921	17172
		2010	1507	608	626	980	108	314	697	2307	1874	700	198	128	45	1	1	2	10097	21995
		2020	2829	918	944	1754	138	440	1135	4229	3652	1444	286	185	57	1	1	3	18017	40093
		2030	4609	1295	1375	2969	174	606	1814	7574	6920	2893	408	264	70	1	1	4	30975	71630
		2040	7507	1826	2004	5034	219	836	2898	13564	13112	5799	581	376	85	1	1	5	53849	129297
	Revalidation Study-Suppressed Demand	2006	1108	516	441	642	84	205	420	1275	995	363	170	110	41	1	1	2	6373	12981
		2010	1378	579	503	756	92	232	485	1486	1178	436	189	123	44	1	1	2	7486	15170
		2020	2150	774	700	1141	111	304	684	2147	1768	677	245	159	54	1	1	3	10919	22037
		2030	3033	986	942	1647	133	392	952	3058	2607	1033	315	204	63	1	1	3	15370	31391
		2040	4278	1256	1270	2379	160	506	1325	4355	3844	1578	404	261	74	1	1	4	21696	44847
Modasa-Shamlaji	Revalidation Study-Trend Based	2006	1104	520	219	613	22	188	147	1470	1516	429	109	43	36	5	9	2	6431	14286
		2010	1394	581	251	739	24	217	180	1891	2002	580	127	50	38	5	9	2	8089	18285
		2020	2325	819	365	1253	31	305	293	3467	3901	1195	184	72	47	5	10	3	14272	33554
		2030	3787	1156	533	2129	39	420	468	6208	7391	2395	261	103	57	6	10	4	24964	60794
		2040	6169	1630	778	3624	49	579	747	11118	14005	4800	372	147	69	6	11	5	44108	111092
	Revalidation Study-Suppressed Demand	2006	1104	520	182	507	19	143	108	1045	1063	301	109	43	36	5	9	2	5195	10733
		2010	1373	584	207	597	20	163	125	1218	1259	361	121	48	39	5	9	2	6131	12578
		2020	2142	780	288	901	25	213	176	1760	1888	560	157	62	47	5	10	3	9018	18387
		2030	3022	994	388	1301	30	275	245	2506	2784	855	202	80	55	6	10	3	12756	26331
		2040	4262	1266	523	1879	36	355	342	3570	4106	1306	259	102	65	6	10	4	18089	37816

17.19. The traffic volume by sections is forecasted⁸. The growth rate approach is adopted. The growth rates considered are moderate (Table B.8-63).

Table BD.8-63: Adopted Traffic Growth Rates

Please change the table.....

Mode	Region	South Central Gujarat				India			
		2006-10	2010-15	2015-20	2020-25	2006-10	2010-15	2015-20	2020-25
Scooter/Motor Cycle		5.67.0	4.96.0	4.25.5	3.55.0	4.26.0	4.26.0	4.26.0	4.26.0
Auto Rickshaw/ Chakda		2.94.9	2.94.9	2.94.9	2.54.9	2.94.2	2.94.2	2.94.2	2.94.2
Car/ Jeep (OT)		3.44.9	3.44.9	3.44.9	2.84.9	3.44.2	3.44.2	3.44.2	3.44.2
Car/ Jeep (NT)		4.27.0	4.27.0	4.27.0	3.57.0	4.26.0	4.26.0	4.26.0	4.26.0
Mini Bus		2.23.5	2.03.2	1.72.8	1.72.8	2.22.8	2.22.8	2.22.8	2.22.8
Standard Bus		3.25.0	2.84.5	2.44.0	2.44.0	3.24.0	3.24.0	3.24.0	3.24.0
Tempo/ LCV		3.64.4	3.64.8	3.44.8	3.44.8	3.65.2	3.65.2	3.44.8	3.44.8
2-Axle Truck		3.95.5	3.96.0	3.66.0	3.66.0	3.96.5	3.96.5	3.66.0	3.66.0
3-Axle Truck		4.36.1	4.36.6	4.06.6	4.06.6	4.37.2	4.37.2	4.06.6	4.06.6
MAV		4.76.6	4.77.2	4.37.2	4.37.2	4.77.8	4.77.8	4.37.2	4.37.2
Tractor with Trailer		2.73.3	2.73.6	2.53.6	2.53.6	2.73.9	2.73.9	2.53.6	2.53.6
Tractor without Trailer		2.73.3	2.73.6	2.53.6	2.53.6	2.73.9	2.73.9	2.53.6	2.53.6
Cycle		1.92.8	1.92.8	1.92.8	1.62.8	1.92.4	1.92.4	1.92.4	1.92.4
Cycle Rickshaw		0.50.7	0.50.7	0.50.7	0.40.7	0.50.6	0.50.6	0.50.6	0.50.6
Animal Drawn		0.40.7	0.40.7	0.40.7	0.40.7	0.40.6	0.40.6	0.40.6	0.40.6
Others		2.13.5	2.13.5	2.13.5	1.83.5	2.13.0	2.13.0	2.13.0	2.13.0

20. The traffic volume levels thus derived are (Table D.8-7) given under:

Table D.8-7: Traffic Volume Levels Projected

		2006	2010	2020	2030
Godhra-Lunavada	Vehicles	7039	8294	12095	16830
	PCU	10997	12865	18668	26407
	Growth Rate		4.2%	3.9%	3.5%
Lunavada-Modasa	Vehicles	6373	7486	10919	15370
	PCU	12981	15170	22037	31391
	Growth Rate		4.2%	3.9%	3.5%
Modasa-Shamlaji	Vehicles	5195	6131	9018	12756
	PCU	10733	12578	18387	26331
	Growth Rate		4.1%	3.8%	3.5%

21. The detailed statements on mode wise traffic levels by locations and their forecast are given at Annexure D-3.

⁸ . The traffic forecast is made considering the likely users' perception of disutility on imposition of tolls. The growth rates hence adopted are moderate. The findings of Updated SOS done recently by consultants formed the base in firming up the growth rates.

D.8.3 Engineering Studies and Investigations

D.8.3.1 Alignment Verification

18.22. As per the stipulated scope of this revalidation study the alignment verification was carried out. For this purpose all the available alignment details from earlier studies along with GSHP were studied.

19.23. The Pre-Feasibility Study's Interim Report did not provided for any details on Godhra – Shamlaji corridor alignment details. Hence GSHP details actually formed the base in addressing this task.

20.24. With the GSHP design drawings the corridor was inspected. Considering GSHP developments, capacity augmentation's improvement scheme was finalised considering the present ground condition.

D.8.3.2 Strip Mapping

21.25. The GSHP design drawings formed the base. Further the latest field data was gathered. Strip maps⁹ were prepared indicating existing and proposed scenario.

D.8.3.3 Highway Geometrics

22.26. After reviewing the earlier study details the geometric design standards as provided in GSHP were adopted for the proposed new four-lane facility.

D.8.3.4 Pavement Design

23.27. Collected and reviewed GSHP pavement design details. Taking these reference new pavement design is carried out considering latest traffic volumes. The VDF values were computed based on inputs derived from the studies.

D.8.4 Design and Project Cost

D.8.4.1 Geometric Design

24.28. Geometric design standards are adopted as per GSHP and IRC standards.

25.29. The adopted typical cross sections are placed at Annexure B-5 through Figure C.6-1 to C.6.....

D.8.4.2 Pavement Design

26.30. VDF: The VDF got computed after fresh Axle Load survey near Alindra. The adopted VDF values for computation of MSA are:

$$\text{LCV} \quad - \quad 0.54$$

⁹ .These Strip maps were submitted to GSRDC for needful action.

Bus	–	1.13
2-Axle Truck	–	8.11
3-Axle Truck	–	7.89
Multi Axle Truck	–	4.52

27.31. CBR: Design CBR values are adopted from GSHP pavement design:

Section Name	Design CBR
Godhra – Lunavada	12%
Lunavada – Shamlaji	10%

28.32. New Pavement Design: For design of new pavement IRC-37:2001 was followed. The design life is taken as 20 years. Average growth of commercial vehicles is considered as 5.2% for design purposes. For two different sections respective maximum, directional, traffic is considered for calculation of design lane MSA. Lane distribution factor as stipulated was considered.

29.33. New pavement design crust for Godhra – Shamlaji road corridor is tabulated as under:

Godhra – Lunavada		Lunavada – Shamlaji	
CBR – 12%		CBR – 10%	
MSA – 135		MSA – 180	
Adopted Design for CBR 12%, MSA – 135		Adopted Design for CBR 10, MSA – 150 ¹⁰	
	Required	Recommended	
			Required
			Recommended
BC	50	50	50
DBM	145	100	150
WMM	250	345 [#]	250
GSB	200	200	200
Total	645 mm	695 mm	650 mm
			710 mm

D.8.4.3 Overlay and Profile Correction

30.34. Wherever GSHP improved facility is in place it was thought appropriate to have only profile corrective course to get unidirectional camber. It is further felt appropriate that ensuring adequate structural strength¹² is important in design and arriving cost there on. But looking to some of the specific minor/major distresses, the Secretary, R&BD advised for conducting BBD surveys just for ensuring adequacy of structural strength and accordingly design of overlays if required.

¹⁰. As stipulated by IRC:37 – 2001, “For traffic exceeding 150 msa, the pavement design appropriate to 150 msa may be chosen and further strengthening carried out to extend the life at the appropriate time based on pavement deflection measurements as per IRC:81.

¹¹. Substitution of pavement layers as per IRC:37-2001 and IRC:81-1997.

¹². This decision was made by the Secretary R&BD looking into some of the specific minor/major distresses. It was advised that conducting BBD surveys(as they were not part of original scope of services) is important for ensuring adequacy of structural strength and accordingly the design of overlays.

31.35. Current practices overlay design has been adopted for cost estimation¹³.

32.36. The following scheme has been adopted:

- i. Profile correction with BM – Average 50mm thick
- ii. Overlay – DBM – 80mm, BC – 40mm

D.8.4.4 Structures Design

33.37. Generally the new structures are proposed similar to that of GSHP. Details pertaining to existing structures and proposed scheme for four laining is placed at Annexure D-4. Based on these rates adopted for various structure items are:

Sl. No.	Description	Unit	Rate (Rs.)
1	Major Bridges	Sqm	26,000/-
2	ROB	Sqm	26,000/-
3	Minor Bridges	Sqm	24,000/-
4	Slab Culverts	Sqm	18,000/-
5	Box Culverts	Sqm	18,000/-
6	Pipe Culverts (Single Row)		
a	Diameter >= 0.90m	Rm	7,500/-
b	Diameter > 0.75m & < 0.60m	Rm	6,500/-
c	Diameter <= 0.60m	Rm	5,500/-

34.38. **Rates Adopted:** In consultation with R&BD and GSRDC, the National Highway – Ahmedabad Division (NH- Ahmedabad) schedule of rates were adopted for costing purpose. Where required escalation was applied, also for some of the items realistic rates were evaluated and used.

D.8.4.5 D.8.4.5 Project Cost

35.39. Base year construction cost of corridor is estimated to be :

Sl. No.	Description of Item	Total Amount (in million Rs.)
1	Highway Cost	2428.27
2	Intersections, Toll Plaza, Bus Bay/Bus Shelters	433.46
3	Structure Cost	677.03
4	Existing Road Maintenance	30.38
Total Construction Cost		3558.14

36.40. Details pertaining to quantity and cost calculation are placed at AnnexureD-5.

¹³ The Findings of BBD shall be incorporated in the Final Report.

D.8.5 Environmental and Social Impact Assessment

37.41. The Project Corridor Godhra-Lunavada-Shamlaji is spread out in six talukas of two districts with a total population of 1.33 million and area of 3678 km² as per 2001 Census. Project Corridor traverses through three talukas in Panchmahal with a total length of 69.2 km while the corridor traverses through three talukas over a length of 59.1 km in Sabarkantha district. Godhra, Lunavada and Modasa are the talukas which are likely to be affected the most and Bhiloda (8.2 km of the Project corridor passes through this taluka) - the least. Refer Table 1D.8-8.1

Table 1.1D.8-8: Propensity of Impacts (By Taluka)



District	Taluka	Area (km ²)	Length of Corridor (km)	Population
	Godhra	757.28	34.0	393663
	Lunavada	620.66	17.2	229798
	Shehera	610.53	18.0	231325
Panchmahal		1988.47	69.2	854786
	Bhiloda	720.45	8.2	206168
	Modasa	604.39	30.7	191996
	Malpur	365.36	20.2	86063
Sabarkantha		1690.2	59.1	484227
Total		3678.67	128.3	1339013

38.42. Godhra is the largest with an area of 757 km² (20.60% of total area of Talukas being traversed) and Malpur is the smallest, with only 365 km² (9.94% of total area of Talukas being traversed). Population distribution Ranges between 86 thousand in Malpur to 393 thousand in Godhra which shows a wide variation. Godhra has the highest share of population (29.40 % of all Talukas being traversed) covering six Talukas.

39.43. **Impacts on Flora:** The principal impact on flora involves the removal of trees for the creation of a clear zone within the Corridor of Impact. Tree plantations (strip plantations, plantation forests) on or along the RoW are characteristic of this road corridor. Many of these roadside plantations will be impacted by the widening of the road from two lane to four lane. There is no rare or endangered species among these plantations. (Figure 1D.8-12).

40.44. To prevent single-vehicle collision with the roadside trees, trees very close to the road need



Figure D.8-2: Typical Roadside

to be cleared. To ease construction of the embankment for the widened road formation and, to permit construction of adequate roadside drainage structure, trees located within the area between the pavement and the “daylight line” need to be removed. (Table 1.2D.8-9).

Figure 1.1: Typical Roadside Plantation**Table 1.2D.8-9: Tree Plantation along The corridor**

Name	No. of Trees	No. of Trees to be impacted
Godhra-Lunavada	1985	1150
Lunavada-Malpur	2125	1200
Malpur- Shamlaji	3895	2000
Total	8005	4350

45. **Reserve Forest within the Study Area:** Project corridor passes through 1.2km of Reserve Forest lands between Lunavada and Malpur. A non-protected forest stretch of teak plantations near Lunavada that will be affected by the four lane treatment. Strip plantations of trees within the RoW of all State Highways have been declared as Protected Forests. (Figure D.8-3)

Figure 1.2: Reserve Forest near Lunavada

46. **Social forestry:** For many stretches of the project roads, plantation within the RoW is the only significant vegetative cover, in the whole surrounding. Plantation through Social Forestry Programme¹⁴ (Figure D.81.3-4) occurs along the corridor from Godhra to Lunavada in four to six meter strip both sides.



¹⁴ The initiative taken by the MoEF to increase the forest cover nation-wide to 33% (National Forest Policy, 1952) gave rise to the creation of the Social Forestry Programmes that involve local Communities in the planting and maintenance of plantation forests.



Figure D.8-3: Reserve Forest near Lunavada Figure D.8-4: Typical Community Plantation

43.47. (Please put Fig.// Title and number..)Bio-diversity and endangered species:



Evidently, it is unlikely that the present project is

going to have any impact whatsoever on the endangered species of flora.

44.48. **Impacts on Fauna:** There are no recorded rare and endangered fauna habitats along the Project Corridor, since they primarily pass through agricultural lands. Land acquisition will not result in destruction of precious fauna habitats. Thus, there will not be an increase in severance of any wild fauna habitat due to the proposed road widening measures. No endangered or precious fauna was recorded within the RoW. None of the wildlife (protected) area is situated within 10 km of the Project corridor. All such areas are beyond 30 km from Corridor.

45.49. **IMPACTS ON CULTURAL ENVIRONMENT:** Strip mapping carried out on the project corridors was the main source of identification of the affected cultural properties falling within and just outside the RoW of the project corridors. A prominent pilgrimage centre Shamlaji is about 2 km away from the northern end of Modasa-Shamlaji corridor. *The Prachin Temple, the Vav, the Harishchandra's Chori* is the protected properties located in Shamlaji. (Table 1.3D.8-10).

Table 1.3D.8-10: Archaeological Monuments/Sites within 10 km of Project Corridors

Location	Taluka	District	Name of Monuments/Sites
Shamlaji	Bhiloda	Sabarkantha	Prachin Temple, Vav, Harishchandra's Chori

Location	Taluka	District	Name of Monuments/Sites
Larana	Lunavada	Panchmahal	Arjun Chori, Kund, Tran Pravesh, Dwarwali Temple, Prachin Temple, Bhim Chori, Vahu's Vav, Shikar Madhi, Shilalekh's Temple, Sasu's Vav
Kankanpur	Godhra	Panchmahal	Vanzari Vav, Temple Block (Mandir Samuh)
Kankanpur	Godhra	Panchmahal	Kankeshwara Mahadev Temple
Ratanpur	Godhra	Panchmahal	Ratneshwara Old Temple

46.50. Cultural properties lying along the highways are most susceptible to impacts due to construction activities depending upon the access to the property, distance between the road pavement and the cultural property, the condition and scale of the built structure. Road construction machinery operating during the construction phase is likely to require a belt of about 4-5m from the edge of the carriageway. In such instances cultural properties located within a distance of 5m from the edge of the carriageway, risk being damaged by the heavy machinery (Table 1.4D.8-11).

Table 1.4D.8-11: Cultural Properties along Project CorridorsCorridor

Place	Name	Condition	Location (Ch.)	Distance from Edge of Pavement (m)	Direction and Siting w.r.t. RoW		Environment, Annual Gathering and Other Details	Impacts During Construction
	Kodiyar Maa Temple Complex	Good	381.1	2.0	Right	Inside	Settlement. School and Institute.	A,B,C
	Shrine	Poor	397.7	12.2	Left	Inside	Rural Area	B
Shehra	Shiv Mandir	Average	397.9	5.0	Left	Inside	Commercial Activity	B,D
	Shiv Mandir	Average	412.9	7.0	Left	Inside	Settlement	B,C,D
Lunavada	Satyanarayan Temple	Good	416.0	10.0	Left	Inside	Urban Area	B
Lunavada	Amba Ma Temple	Average	416.0	2.0	Right	Inside	Urban Area	B
	Mahisagar Ma Temple	Good	426.0	6.4	Left	Inside	Mahi Riverfront	A,B,C,D
	Shrine	Average	430.7	7.8	Left	Inside		A,B
	Shrine	Average	445.6	22.0	Right	Outside	Agricultural Area	-
	Shrine	Average	447.6	25.9	Right	Inside		-
	Amba Mata Temple	Good	448.3	16.3	Right	Outside	Settlement	-
	Kodiyar Ma Temple	Good	449.8	23.8	Right	Outside		-
Malpur	Shiv Mandir	Good	452.3	24.5	Right	Outside	Wetland	-
Malpur	Raksheshwar Mandir	Good	454.0	20.0	Right	Outside	Urban Area	-
Malpur	Jalaram Mandir	Good	454.0	22.0	Left	Outside	Settlement	-
	Temple	Good	459.2	25.0	Left	Outside	Agricultural Area	-
	Shrine	Average	465.5	12.0	Right	Inside	Agricultural Area	C,D
Anantpur	Hanuman Temple	Good	470.5	30.0	Right	Outside	Settlement	-
Khodamba	Mahadev Temple	Good	496.2	9.0	Left	Outside		A,B,C
Khodamba	Ramji Bhagwan Temple	Average	496.6	1.0	Left	Inside	Village. Rest point for pilgrims. Water available	A,B,C,D
Shamlaji	Shrine	Average	500.3	1.0	Right	Inside	Agricultural Area	A,B,C,D

Impacts during Construction include (A)→ Damage to structure due to operation vehicles, (B)→Contamination of site, (C)→Pollution and (D)→Interrupted Access to Site.

47.51. **Land Acquisition:** Widening from two lane to four lane of the roads might require acquisition and clearing of various types of properties. Land acquisition involves land take of

legal lands for the larger interests of the society, like the creation of road infrastructure, as is the case in the four laning project. However, due to the design considerations and limiting the proposed road widening within the existing RoW, limited land acquisition is required. The details of such lands by use type are as given in Table 1.5D.8-12.

Table 1.5D.8-12: Properties Likely to be impacted in Project

Type of Land Acquisition	Godhra-Lunavada	Lunavada-Malpur	Malpur-Shamlaji	Total Area in Ha
Agricultural in Ha	22.2	20.22	36.55	78.97
Residential in Ha	0.3	0.04	0.25	0.59
Commercial in Ha	0.14	0.12	0.03	0.29
Open in Ha	1.75	2.87	4.07	8.69
Barren in Ha	1.02	5.23	6.23	12.48
Plantation in Ha	6.2	2.91	1.15	10.26
Community in Ha	0	0.02	0.15	0.17
Total area in Ha	31.61	31.41	48.43	111.45

48.52. **Impacts on Water Resources:** A road project can significantly alter the hydrological setting of an area and add to the siltation and pollution level in water sources. The identification and mitigation of such adverse impacts assume greater significance in water scarce regions such as Gujarat.

49.53. **Surface water:** The project corridorscorridor largely fall in the region of alluvial plains and traverse across two major river basins Mahi and Sabarmati .Both the two rivers originate from the Aravalli ranges in the north-eastern part of the state. The Tributaries of these basins that cut across the project corridorscorridor are given in Table 1.6D.8-13.

Table 1.6D.8-13: River Basin and Tributaries in the Project Area

River Basin	Catchment Area (km ²)	Rainfall (mm)	Tributaries	CorridorsLink
The Mahi (perennial)	2385	1097.4	The Mahia, The Kum, The Chikna	Godhra – Lunavada
			The Panam, The Veri	Lunavada - Shamlaji
The Sabarmati	5936	965.2	The Vatrak, The Majham, The Meshwa	Lunavada - Shamlaji

Source: Planning Atlas of Gujarat, 1987.

50.54. **Water resources along the project corridorscorridor:** Widening of road can have a wide range of effects on water resources stemming from activities such as earth-moving, removal of vegetation, vehicle/machine operation and maintenance, handling and laying of asphalt, sanitation and waste disposal at labor camps. Removal of trees and vegetation can lead to erosion of soil and siltation of water bodies. Refer Table 1.7D.8-14 for the numbers and categories of water bodies likely to be impacted by the project.

Table 1.7D.8-14: Water bodies likely to be impacted by Project

Link Name	Water Bodies			Likely impacts
	W1	W2	W3	
Shamlaji – Lunavada	-	4	3	Sedimentation and part filling. Impact is minor for all W2, and major for all W3.
Lunavada – Godhra	1	2	-	Sedimentation. Impact is minor.
Total	1	6	3	

Link Name	Water Bodies			Likely impacts
	W1	W2	W3	
Note: W1 = Dry ponds; W2 = Water bodies with no vegetation; W3 = Water bodies with emergent vegetation				

51.55. Water supply sources other than surface water sources are open wells, tube wells, bore wells, etc. Due to the road expansion project, certain water supply sources close to the existing carriageway might be dislodged. Table 1.8D.8-15 gives the some of water supply sources that are likely to be removed from the RoW in each Link and the associated impacts.

Table 1.8D.8-15: Number of Water Supply Sources Likely to be impacted

Link Name	Water Supply Sources			Likely impacts
	OW	TW	BW	
Shamlaji – Modasa	1	-	-	Reversible, replaceable impacts.
Modasa – Malpur	2	2	-	Reversible, replaceable impacts.
Malpur – Link to Birpur	-	5	-	Reversible, replaceable impacts.
Link to Birpur – Lunavada	2	1	-	Reversible, replaceable impacts.
Lunavada – Shehra	1	3	-	Reversible, replaceable impacts.
Shehra – Godhra	1	1	-	Reversible, replaceable impacts.
Total	7	12	-	
OW = Open well; TW = Tube well; BW = Bore well				

D.8.6 Tollable Traffic

52.56. The vehicles which are tollable¹⁵ as per the Concession agreements are considered for assessment of tollable traffic in the base year. From the road side interview conducted the tollable traffic is estimated. In assessment of the tollable traffic all the intra zonal and inter-zonal trips of the zones lying on the corridor are excluded. Further on the assessed tollable traffic (on trend based approach) a drop of 30% is considered because the likely diversions¹⁶ from the corridor on imposition of tolls. This level exclusion may lead to slightly under estimation of tollable traffic. It is felt prudent to consider this as best estimate than over predicting traffic, although the corridor has exhibited its attractiveness by diversions it caused on being improved to wide two lane facility under GSHP.

53.57. The assessed tollable traffic by sections and by mode is given under Table D.8-16:--

Table D.8-16: The Assessed Base year Tollable traffic by Modes and Sections

Corridor Name	Composition	Link Name	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Temp/ LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	AADT (VEHs)
Godhra-Shamlaji	Total	Godhra-Lunawada	310374	750907	6575	212278	219296	9811380	7751105	225321	35374736

¹⁵ Only cars and commercial vehicles which include buses are tollable.

¹⁶ The imposition of tolls may lead to re-diversion of traffic to alternate routes. Road Users' behaviour predictability is complex issue. Perceived benefits govern the route choice. Being conservative on proposition of this nature when project is proposed to be developed under commercial format is felt appropriate.

	Non-Tollable	Godhra-Lunawada	162162	383383	4242	5858	3939	5151	44	00	738738
	Tollable	Godhra-Lunawada	148212	367524	2333	15422 1	180258	9301329	7701100	225321	27983998
Godhra-Shamlaji	Total	Lunawada-Modasa	441531	642776	8497	20526 9	420569	1275179 3	9951419	363519	44245972
	Non-Tollable	Lunawada-Modasa	230230	328328	5454	5656	7474	6666	66	00	813813
	Tollable	Lunawada-Modasa	211301	314448	3043	14921 3	346495	1209172 7	9891413	363519	36115159
Godhra-Shamlaji	Total	Modasa-Shamlaji	182219	507613	1922	14318 8	108146	1045147 0	1063151 6	301429	33674602
	Non-Tollable	Modasa-Shamlaji	9595	259259	1212	3939	1919	5454	66	00	484484
	Tollable	Modasa-Shamlaji	87124	248354	710	10414 9	89127	9911416	1057151 0	301429	28834118

54.58. The forecasted tollable traffic, by mode and sections at 10 year interval is given at Table B.....D.8-17. This forecast is based on growth rate approach. Annexure D-6 provides link wise tollable traffic projections.

Table BD.8-17:..... : Section wise and Mode wise Forecasted Tollable Traffic

Corridor Name	Godhra-Shamlaji												
	Link Name	TOLL PLAZA .No	Chainage (Km)	Year	Cars(OT)	Cars(NT)	Mini Buses	Buses	Lcv/ Tempo	2-Axle	3-Axle	M-Axle	Total AADT (VEH)
Godhra-Lunawada	1	401/800401/800	2006 2006	148212	367524	2333	154221	180258	9301329	7701100	225321		27983998
Godhra-Lunawada	1	401/800401/800	2010 2010	169249	432661	2537	175258	208316	10841710	9121453	270434		32775119
Godhra-Lunawada	1	401/800401/800	2020 2020	235376	6521184	3148	230363	294514	15673135	13692832	419894		47989347
Godhra-Lunawada	1	401/800401/800	2030 2030	324561	9632059	3963	299503	409822	22325615	20185366	6401792		692416780
Godhra-Lunawada	1	401/800401/800	2040 2040	447837	14243586	4882	389698	5691313	317910055	297610168	9773591		1000830330
Lunawada-Modasa	2	447/000447/000	2006 2006	211301	314448	3043	149213	346495	12091727	9891413	363519		36115159
Lunawada-Modasa	2	447/000447/000	2010 2010	240355	370566	3348	169249	400606	14092222	11721867	436700		42286612
Lunawada-Modasa	2	447/000447/000	2020 2020	334535	5581013	4062	222350	564987	20364074	17583637	6771444		619012103
Lunawada-Modasa	2	447/000447/000	2030 2030	461797	8241761	5081	289485	7841578	29007296	25926892	10332893		893321784
Lunawada-Modasa	2	447/000447/000	2040 2040	6351189	12193067	61105	375674	10922521	413013066	382213060	15785799		1291239482
Modasa-Shamlaji	3	481/000481/000	2006 2006	87124	248354	710	104149	89128	9911416	10571510	301429		28834596
Modasa-Shamlaji	3	481/000481/000	2010 2010	99144	292436	711	118173	103156	11551821	12511994	361580		33875959
Modasa-Shamlaji	3	481/000481/000	2020 2020	138215	441759	914	156243	145255	16693339	18783885	5601195		499511233
Modasa-Shamlaji	3	481/000481/000	2030 2030	190321	6511325	1118	202336	202407	23775980	27697362	8552395		725720805
Modasa-Shamlaji	3	481/000481/000	2040 2040	261480	9622315	1423	263467	282651	338510709	408213949	13064800		1055638727

53. In addition to above, estimated tollable traffic is forecasted at 2% p.a up to 'COD' and 5% there after¹⁷. The forecasted traffic by sections by mode is given at Table-____(Annexure) D-7.

59.

¹⁷ This is based on new model concession agreement of Gol.

D.8.7 Financial Analysis

56.60. The financial analysis of the project has been undertaken to assess its viability under a commercial format. A number of options/scenarios of project have been worked out to aid in decision-making process. The following scenarios have been considered for undertaking the financial analysis:

Scenario 1: Godhra Shamlaji Corridor (128.2km);

Scenario 2: Halol Godhra Shamlaji Corridor as one (166.2km).

D.8.7.1 Inputs and Assumption*Revenue Model*

- b.a. **Tollable Traffic:** The tollable traffic, by each toll plaza, has been estimated and presented in Sub-Section _____ D.8.16.7. This traffic forms an input to the financial analysis.
- c.b. **Toll Rates:** The toll rates are those which have been recommended by the Ministry, vide a notification in the year 1997. These have been escalated to prices as on 31st March 2006. The per km toll rates as well as the toll rate for the project corridor, at 2006 prices, have been given in Table _____ D.8-18.

Table ____: D.8-18: Toll Structure (at 2006 prices)

Mode	Toll Rate (Rs./km at 2006 price)	Toll Rates (Rs./Trip at 2006 price)	
		Godhra Shamlaji	Halol Godhra Shamlaji
Car/Jeep	0.61	80	100
Mini Bus	1.07	135	175
Bus	2.13	275	355
LCV	1.07	135	175
2-Axle Truck	2.13	275	355
MAV	3.43	440	570

For future, the toll rates have been assumed to increase at an inflation rate of 5% p.a. For estimation of corridor level toll rate, this has been rounded to nearest five rupee.

- d.c. **Annual Toll Collection:** The annual toll revenue realisation, over the project period, at current prices, has been given in Table _____:D.8-19.

Table ____: D.8-19: Annual Toll Revenue

Year	Annual Toll Collection (Mill Rs at current Prices)	
	Godhra Shamlaji	Halol Godhra Shamlaji
2010	495.3	697.8
2015	776.2	1111.2
2020	1188.9	1752.2
2025	1838.8	2779.0

2030	2827.5	4400.8
2035	4348.0	6996.8

Cost of Project

57.61. The initial civil cost of project has been estimated as follows by each scenario:

Scenario 1 : Rs 3558.14 mill

Scenario 2 : Rs 4523.44 mill

The construction activities have been assumed to be undertaken in the years 2008 and 2009. The total cost of project is as follows:

(in Mill Rs)

Type of Cost	Godhra Shamlaji	Halol Godhra Shamlaji
Civil Construction Cost	3558.14	4523.44
Contingency (10%)	355.81	452.34
Construction Supervision (3%)	117.42	149.27
Inflation During Construction	535.44	680.7
Total Cost of Project	4566.81	5805.75

58.62. Routine and periodic maintenance have been taken as follows:

Routine Maintenance – Rs. 40,000/km

Periodic Maintenance – Rs. 3 mill/km

Assumptions for Analysis

59.63. A number of assumptions have been considered for the analysis. They have been listed below:

- The base debt-equity ratio has been taken as 7:3.
- The analysis period has been taken as 30 years.
- The rate of interest considered for the analysis has been assumed as 12% p.a. This is looking at the present increase in interest rates.
- With respect to the increased interest rates, the expected post-tax return on investment has also been taken at a value of 15 – 17%.
- The subsidy/grant component has been limited to 40% of the total project cost. Under the VGF scheme, a maximum of 20% of the total project cost is expected to come from the central government and the balance, if any, needs to be given by the state government. has been treated as the equity-support to the project. The balance VGF has been considered as the O&M support.

- (f) The disbursement of VGF has been assumed in the following way taken during the construction period.: It is
- (f) Equity support to be disbursed after the equity draw-down by the concessionaire in over. The phasing of equity support/VGF/capital grant has been linked to the debt draw-down.
 - i. The O&M support is to be disbursed at the rate of 20% of the equity support every year, starting from the COD, till the time it is exhausted.
 - (g) The Corporate Tax is taken at 33.66%¹⁸. In the event of the tax rebate, a Minimum Alternative Tax of 11.22 %¹⁹ has been included in the analysis.
 - (h) The depreciation schedule has been taken as per the IT and Companies Act.
 - (i) Insurance premium has been assumed at 0.7% of the assets/investment.
 - (j) The tax concession on road projects has been taken for the analysis. There is a 10 year, full tax rebate on road infrastructure projects, starting from the first year of operation of the same.
 - (k) The loan repayment period has been assumed as seven years after two years of moratorium.

D.8.7.2 Results of Financial Analysis- Base Case : Realistic Traffic

The financial analysis for the base case has been presented in the Table ____D.8-20. The details of financial analysis are presented through Annexure D-8.

Table ____: D.8-20: Results of the Analysis in Base Case

Indicators	Godhra Shamlaji		Halol Godhra Shamlaji	
	20 Yrs	30 Yrs	20 Yrs	30 Yrs
Viability Gap Funding mill Rs	2283.41735.4	1826.71278 .7	20321567	870.9
% of Project Cost	3850%	2840%	3275%	15%
Pre-Tax IRR (%)	18.17.8201	18.2469	17.998.37	18.47
Post-Tax IRR (%)	16.847	17.0225	16.847.14	17.13
Return on Equity (%)	21.0845	19.4620.95	20.901.93	19.45
Minimum DSCR	0.24	0.2119	0.374	0.32
Average DSCR	1.423	1.2231	1.414	1.20
Payback Period	11 yrs 65 mths	12 yrs 6 mths	11 yrs 1 mth	12 yrs 3 mths

64. The road between Godhra and Shamlaji becomes viable with a viability gap funding of 40% between 38% and 28% of project cost, which is the ceiling grant level for a concession period of 20 years and 30 years respectively. The concession period however needs to be 30 years. If

¹⁸ The breakup is 30% Corporate Tax, with 10% surcharge and 2% education cess.

¹⁹ The MAT is 10% with 10% surcharge and 2% education cess.

the project corridor between Halol-Godhra-Shamlaji is implemented as one BOT contract, then the viability is better established with VGF of 2735% and 15% of total project cost, over a concession period of 20 and 30 years respectively.

D.8.7.3 Sensitivity Analysis : Variation in Revenue and Cost Levels

65. In order to understand the sensitivity of variation in revenue and cost levels on the project viability, a case of increased and reduced cost and toll revenue realisation, respectively, has been worked out and the results are presented in Table __.D.8-22.

Table __: D.8-22: Sensitivity Analysis : Case of Revenue and Cost Variation (30 Year)

Indicators	Godhra Shamlaji			Halol Godhra Shamlaji		
	15% cost Increase	15% Reduced Revenue	15% Increase and Reduced Revenue and Cost	15% cost Increase	15% Reduced Revenue	15% Increase and Reduced Revenue and Cost
Viability Gap Funding mill Rs	2625.91995.7	2557.41918.1	34662625.09	20031669	23221741.7	33382670.6
% of Project Cost	3850%	4256%	5066%	2530%	340%	450%
Pre-Tax IRR (%)	18.1629	18.2246	18.0831	18.1618.26	18.3246	18.0828
Post-Tax IRR (%)	16.9784	17,106.98	17.076.9	16.934	17.092	17.156.89
Return on Equity (%)	19.4420.45	19.5920.86	19.0720.89	19.0120.05	19.3120.40	19.4820.30
Minimum DSCR	0.2017	-ve	-ve	0.3129	0.132	0.130
Average DSCR	1.228	1.223	1.2131	1.1723	1.1926	1.1924
Payback Period	12 yrs 104 mths	132 yrs 61 mths	13 yrs 64 mths	12 yrs 83 mths	12 yrs 92 mths	132 yrs 71 mths

Indicators	Godhra Shamlaji			Halol Godhra Shamlaji		
	15% cost Increase	15% Reduced Revenue	15% Increase and Reduced Revenue and Cost	15% cost Increase	15% Reduced Revenue	15% Increase and Reduced Revenue and Cost
Viability Gap Funding mill Rs	2625.9	2557.4	3466	2003	2322	3338
% of Project Cost	50%	56%	66%	30%	40%	50%
Pre-Tax IRR (%)	18.29	18.46	18.31	18.26	18.46	18.08
Post-Tax IRR (%)	16.84	16.98	16.9	16.94	17.02	16.89
Return on Equity (%)	20.45	20.86	20.89	20.05	20.40	20.30
Minimum DSCR	0.17	-ve	-ve	0.29	0.12	0.10
Average DSCR	1.28	1.3	1.31	1.23	1.26	1.24
Payback Period	12 yrs 4 mths	12 yrs 6 mths	13 yrs 4 mths	12 yrs 3 mths	12 yrs 2 mths	12 yrs 7 mths

66. Godhra to Shamlaji section is sensitive to cost and revenue risks. The project tends to become unviable, if the expected rate of return on project is about 17%. The project as a whole,

if taken up, is more robust. It can absorb the fall in revenue and increase in cost even in the worst case. The VGF, though goes up for a project period of 30 years, but still remains within the permissible limit of 40% of project cost.

D.8.7.4 B.4.7.4 New Model Concession Agreement as Base

67. The Committee on Infrastructure has recently prepared a New Model Concession Agreement, for the upcoming BOT projects. Anticipating the implementation of the same, a set of analysis has been undertaken with the new MCA as the base as well. The major assumptions, beyond the ones already stated, which have been incorporated in this analysis as per the new MCA are:

- The traffic growth has been considered at 5% per annum over the concession period, starting from the COD. However, from the base year to the year when the construction is completed, the traffic growth has been taken as 2% per annum.
- In case the project corridor qualifies for a six-lane, within the project period, the concession period has been limited to a maximum of that many years.

68. The results of the analysis have been presented in Table D.____.8-23.

Table ____: D.8-23: Results under New MCA Assumptions

Indicators	Godhra Shamlaji	Halol Godhra Shamlaji
Requirement of Six Lane	2030	2026
Maximum Concession Period	23 yrs	19 Yrs
Viability Gap Funding		
mill Rs	1826.7	2322
% of Total Project Cost	40%	40%
Pre-Tax IRR (%)	17.79	17.70
Post-Tax IRR (%)	16.42	16.50
Return on Equity (%)	19.87	20.70
Minimum DSCR	0.18	0.25
Average DSCR	1.3	1.38
Payback Period	12 yrs 5 mths	11 yrs 4 mths

D.8.7.5 B.4.7.5 Conclusions

69. The section between Godhra and Shamlaji carries lower volumes of traffic. This results in the project to become unviable less attractive if the concession period is reduced to anything below 230 years. The VGF is close to at a maximum of 40% of total project cost. On the other hand, it has been observed that Halol to Godhra is an attractive investment for a private

entrepreneur. Therefore, it is felt that the total corridor should be bid out as one project on BOT. This will help in reducing the risks of both the sections – if only a part of the road is upgraded, the traffic realisation for even Halol to Godhra may not be as much to maintain the attractiveness of the project. At the same time the cost and revenue risk on the section between Halol to Shamlaji may also be reduced.

D.	GODHRA – SHAMLAJI CORRIDOR	D-1
D.7	REVIEW OF PRE-FEASIBILITY STUDY	D-1
D.7.1	Submittal Referred to.....	D-1
D.7.2	Project Sections	D-1
D.7.3	Base Year Traffic Volume Levels	D-1
D.7.4	Traffic Desire Pattern.....	D-1
D.7.5	Engineering Surveys	D-2
D.7.6	Environmental and Social Aspects	D-2
D.7.7	Traffic Forecasts and Other Efforts.....	D-2
D.8	OUR EFFORTS AND FINDINGS.....	D-3
D.8.1	Salient Corridor Characteristics	D-3
D.8.2	Traffic Studies and Forecast.....	D-4
D.8.3	Engineering Studies and Investigations.....	D-13
D.8.4	Design and Project Cost.....	D-13
D.8.5	Environmental and Social Impact Assessment.....	D-16
D.8.6	Tollable Traffic.....	D-21D-20
D.8.7	Financial Analysis.....	D-23D-22