

C. HALOL – GODHRA CORRIDOR**C.5 REVIEW OF PRE-FEASIBILITY STUDY****C.5.1 Submittal Referred to**

1. The report¹ available with GSRDC on this corridor was the 'Interim Report'. This report was submitted by consultants in November 2001. As this was an Interim Report, the coverage of analysis was limited. What report included was defining sections, traffic characteristics, environmental and social assessment. Brief appreciation of same is given in ensuring sections.

C.5.2 Project Sections

2. The Halol – Godhra – Shamlaji project corridor extends over 170 km. It 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 this section is limited to Halol – Godhra project corridor.

C.5.3 Base Year Traffic Volume Levels

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

Section	Total (ADT)		Goods Vehicles
	Vehicles	PCU	
Halol – Godhra	8114	14659	3020

C.5.4 Traffic Desire Pattern

5. The broad picture as reported with respect to traffic desire is given under:

Section	Percentage through traffic	
	Goods/Commercial Vehicles	Passenger Vehicles
Halol – Godhra	79	27

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

C.5.5 Engineering Surveys

6. The interim report only included strips prepared and the notes on the road and bridge inventory data collected. It does not report any data base related to engineering elements.

C.5.6 Environmental and Social Aspects

7. The report in detail reports the aspects related to environmental and social issues. The social impacts reported include – impacts to cultural properties and the settlements that could be impacted. They are:

Settlement Type	Name of Settlement
Urban Areas	Godhra and Halol
Villages	Vejalpur and Bedhiya

8. It is reported that there are encroachments in these settlements that would be impacted.

C.5.7 Traffic Forecasts and Other Efforts

9. At interim state, the report does not include the traffic forecast, project cost, economic and/or financial analysis.

C.6 OUR EFFORTS AND FINDINGS

C.6.1 Salient Corridor Characteristics

10. The Halol – Godhra road falls in the district of Panchmahals, and passes through the major settlement of Kalol. This link forms a section of the corridor which is an alternative route to NH-8, for traffic moving between Vadodara and Shamlaji. Figure C.6-1 presents road network map of the project corridor falling within the influence area.

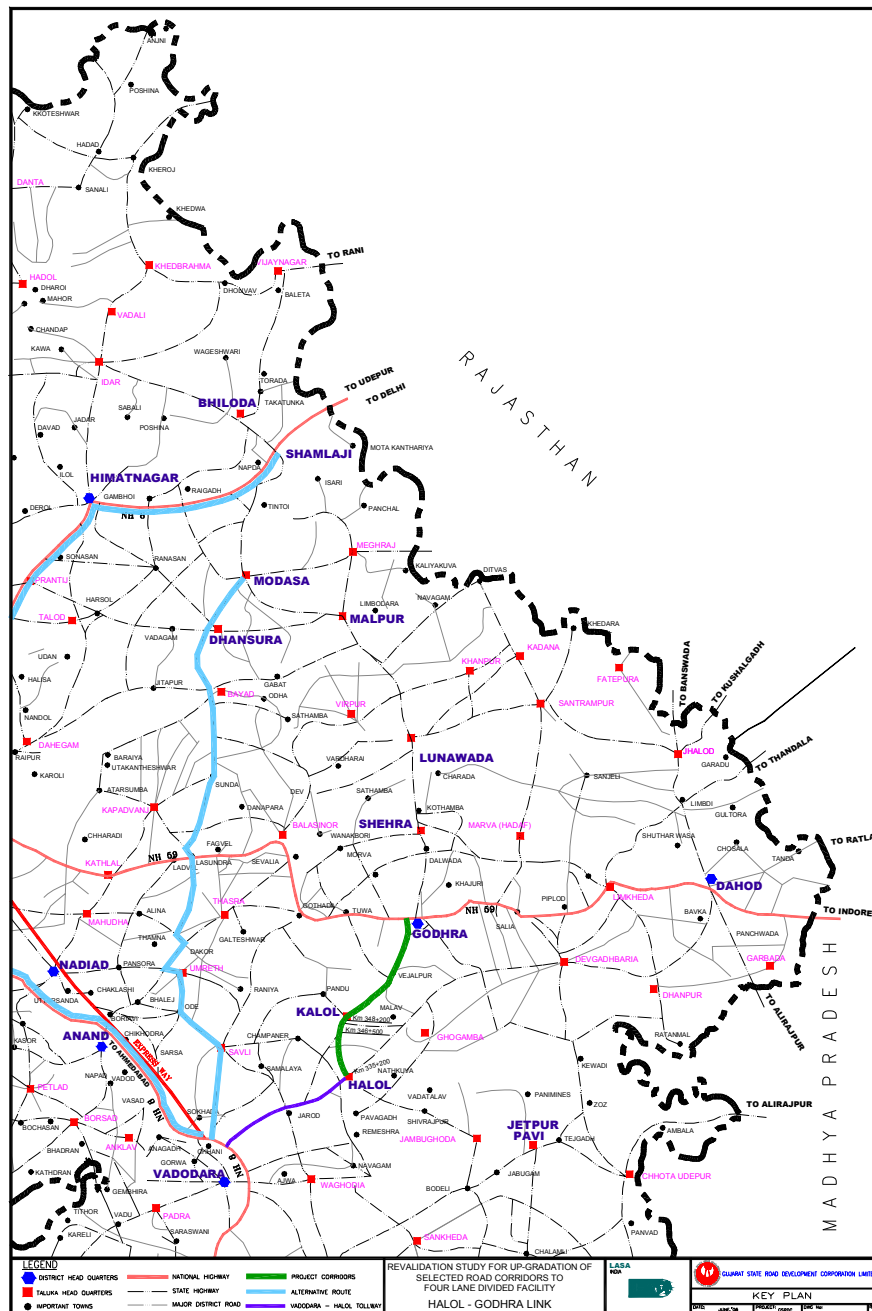


Figure C.6-1: Project Key Plan

11. The project corridor takes off from the intersection of Halol bypass and Vadodara – Halol toll road. This corridor has been widened to two-lane with paved shoulders, with World Bank funding under the GSHP.

C.6.2 Traffic Studies and Forecast

C.6.2.1 Traffic Survey Locations

12. The classified traffic volume survey, Origin-Destination survey and axle load survey (at same location) as per the details given below (Map given at Annexure C-1) were conducted to establish base year traffic volume, desire patterns and axle load spectrum.

Location	Chainage	Survey Detail	Survey Duration
CORRIDOR 2: km 335/200 to 373/000 km, Halol-Godhra			
Alindra Road (Near Punjab Hotel)	at 346/500km	Traffic Volume	7 Days
		Origin Destination	1 Day
		Axle Load	1 Day

C.6.2.2 Traffic Volume Leves¹-2006

13. The average daily traffic volume levels recorded by sections on project corridor (Table C.6-1-(1) to C.6-1-(4)) were converted annual average traffic volume levels² (Table C.6-2) are as given under:

Table C.1: Halol – Godhra Corridor : Traffic volume levels by sections

Table C.1-(1.1): Average Daily Traffic Volume (ADT in VEHs)

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)
Halol-Godhra	Halol-Godhra	3104	1395	329	1853	191	569	517	2745	1451	527	123	79	405	19	12	1	13321

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

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)
Halol-Godhra	Halol-Godhra	3073	1381	326	1834	189	564	512	2718	1436	521	122	78	401	19	12	1	13188	23730

Table C.1-(1.2): 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)
Halol-Godhra	Halol-Godhra	23.3%	10.5%	2.5%	13.9%	1.4%	4.3%	3.9%	20.6%	10.9%	4.0%	0.9%	0.6%	3.0%	0.1%	0.1%	0.0%	100%

Table C.1-(1.2): Peak Hour share of Traffic by 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)
Halol-Godhra	Halol-Godhra	08:00-09:00	206	95	22	96	9	29	28	116	76	30	7	3	39	4	0	0	760	1238

² Seasonal Correction factor of 0.9 was applied

Table C.6-2: Traffic Volume-Salient Aspects

S. No.	Section	Traffic Volume			PCU Factor
		ADT (veh)	AADT (veh)	AADT (pcu)	
1	Halol-Godhra	13,321	11,989	21,573	1.8

14. Traffic composition (Table C.6-1-(3)) reveals that goods traffic share vary from 35% to 40% or even more. It is evident from the PCU factor derived. The peak traffic share was observed to be about 5.2% (Table C.6-1- (4)). The details of traffic volume data collected are given in Annexure C-2.

15. The pre feasibility study traffic levels were revisited. Comparison³ was made, as locations for conduct of surveys were same. It is important to note in this context that there has been growth in traffic levels. From Table C.6-3 passenger vehicles-scooters and auto / chakada shown high growth rate compared to other passenger vehicles, multi axle trucks shown relatively high growth rate, animal drawn vehicles recorded negative growth rate. Overall the traffic volume recorded growth of about 10% per annum. This is high⁴. May continue or may not continue to grow like this. The important reason being on completion of up gradation of this corridor as part of GSHP the traffic which was expected to get diverted may have already got diverted on to this corridor. One important point to be noted is that this is an important corridor which will record high traffic levels with significant share of commercial traffic.

Table C.6-3: Comparative study of present study and prefeasibility study

Type of Vehicles	Present Study-2006	Pre-feasibility Study-2001	Growth Rate ⁵
Sc/Mc	3104	1938	10
Auto Rickshaw/Chakda	1395	798	12
Car/Jeep (Old Tech)	2182	1434	9
Std. Bus	761	581	6
Tempo/LCV	517	542	-1
2-Axle Trucks	2745	1864	8
3-Axle Trucks	1451	376	31
M-Axle Trucks	527	158	27
Tractor with Trailer	202	80	20
Cycle	405	363	2
Cycle-Rickshaw	19		
Animal Drawn Vehicles	12	25	-14
Others	1		
ADT (VEHs)	13321	8114	10
ADT (PCUs)	23730	14659	10

³ The value reported were ADT not AADT.

⁴.The Halol – Godhra was part of GSHP. It was implemented. It is part of Eastern State Highway of Gujarat. It is expected to meet part of north south traffic movements. High growth of traffic in last few years is due to the diversion of traffic from National Highway 8 and other major roads catering to such movement needs.

⁵ .The high growth rates recorded in last few years are not likely sustain over a long period of time.

C.6.2.3 Traffic Desire Pattern

16. The Origin-Destination data by mode was analyzed. The trip ends by mode type were seen with respect to immediate influence area zones, traffic originating and terminating within Gujarat state and traffic which has one of the trip ends (either origin or destination) outside Gujarat. The mode wise breakup of trips internal to Gujarat and external (to and from Gujarat) is given at Table C.6-4. The desire lines are given at Maps C.6-1 & C.6-2 suggest that very high proportion of tollable amongst the tollable modes. From the Table C.6-3 and Maps C.6-1 & C.6-2 clearly indicates that 71% of the trips have one of the trip ends outside the Gujarat.

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

Table C.6-4: Break-up of trips internal to Gujarat and external (to and from Gujarat)

Section		Cars			Goods Traffic		
		Both Trip ends on Corridor	With one trip ends on Corridor-Second generated in Gujarat	With one trip end outside Gujarat	Both Trip ends on Corridor	With one trip ends on Corridor-Second generated in Gujarat	With one trip end outside Gujarat
Halol-Godhra	Vehicles	647	1361	174	416	1119	3704
	%	30%	62%	8%	8%	21%	71%

18. The desire line diagrams further clearly indicate that the corridor is acting as connecting link between north and south parts of the country. This shows the national importance of the corridor.

C.6.2.4 Traffic Forecast

The traffic volume on the project corridor is forecasted under various considerations. The trend based forecast is based on the assumption that the state shall implement the development of roads and there shall be no imposition of road user charges. 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 suppressed 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 C.6-5).

Table C.6-5: Projected Traffic Volume by Alternate Considerations

Corridor 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)
Halol-Godhra	Revalidation Study-Trend Based	2006	2793	1256	296	1668	172	513	465	2471	1305	474	111	71	365	17	11	1	11989	21574
		2010	3800	1481	349	2105	192	600	570	3178	1723	641	129	83	401	17	11	1	15282	27500
		2020	7132	2234	527	3771	243	838	928	5827	3359	1320	187	120	509	18	12	2	27026	49406
		2030	11617	3152	747	6192	303	1151	1484	10436	6364	2646	266	170	620	19	13	2	45180	86401
		2040	18923	4446	1059	10174	378	1582	2371	18689	12059	5303	379	243	756	20	13	2	76396	152911
	Revalidation Study-Supressed Demand	2006	2793	1256	224	1269	131	363	367	1761	921	334	111	71	365	17	11	1	9995	16511
		2010	3473	1410	256	1496	143	412	423	2052	1091	401	124	79	394	17	11	1	11783	19289
		2020	5419	1884	356	2258	172	538	597	2965	1636	622	160	102	476	18	12	1	17220	27920
		2030	7644	2400	471	3202	205	694	831	4223	2413	950	205	131	558	19	12	2	23962	39364
		2040	10783	3058	624	4542	245	895	1156	6015	3558	1450	264	169	654	20	13	2	33447	55687

19. The traffic volume by sections is forecasted by suppressed demand growth rate approach. The growth rates considered are moderate⁶. They are considered by based on findings of Updated SOS of GSHP. The traffic volume is categorized and forecasted by components. The growth rates adopted are given at Table C.6.6

Table C.6-6: Trend Based Growth Rates

Mode	Region	CENTRAL GUJARAT				India			
		2006-10	2010-15	2015-20	2020-25	2006-10	2010-15	2015-20	2020-25
Scooter/Motor Cycle		5.6	4.9	4.2	3.5	4.2	4.2	4.2	4.2
Auto Rickshaw/ Chakda		2.9	2.9	2.9	2.5	2.9	2.9	2.9	2.9
Car/ Jeep (OT)		3.4	3.4	3.4	2.8	3.4	3.4	3.4	3.4
Car/ Jeep (NT)		4.2	4.2	4.2	3.5	4.2	4.2	4.2	4.2
Mini Bus		2.2	2.0	1.7	1.7	2.2	2.2	2.2	2.2
Standard Bus		3.2	2.8	2.4	2.4	3.2	3.2	3.2	3.2
Tempo/ LCV		3.6	3.6	3.4	3.4	3.6	3.6	3.4	3.4
2-Axle Truck		3.9	3.9	3.6	3.6	3.9	3.9	3.6	3.6
3-Axle Truck		4.3	4.3	4.0	4.0	4.3	4.3	4.0	4.0
MAV		4.7	4.7	4.3	4.3	4.7	4.7	4.3	4.3
Tractor with Trailer		2.7	2.7	2.5	2.5	2.7	2.7	2.5	2.5
Tractor without Trailer		2.7	2.7	2.5	2.5	2.7	2.7	2.5	2.5
Cycle		1.9	1.9	1.9	1.6	1.9	1.9	1.9	1.9
Cycle Rickshaw		0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.5
Animal Drawn		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Others		2.1	2.1	2.1	1.8	2.1	2.1	2.1	2.1

20. The forecasted Traffic Volume levels suggest that by the year 2020 the overall AADT on corridor shall grow to 17220 Vehicles as compared to 3995 Vehicles in 2006. The year wise forecast is given at Annexure C-3 and summary of the same is given below Table C.6-7.

Table C.6-7: Traffic Volume Levels Projected

		2006	2010	2020	2030
Halol-Godhra	Vehicles	3995	11783	17220	23962
	PCU	16511	19289	27920	39364
	Growth Rate		4.0%	3.9%	3.1%

C.6.3 Engineering Studies and Investigations

C.6.3.1 Alignment Verification

21. The alignment verification for Halol – Godhra road corridor was carried out. For this purpose all the available alignment details from earlier studies along with GSHP documents were studied.

22. The pre-feasibility report was not of much use.

⁶ .The Growth rates considered are moderate as project is expected to be implemented on commercial format. The road user behaviour and perceived dis-utility because of the tolls imposed can be an issue. User tries to maximise the perceived benefits. Hence the growth rates considered are very moderate.

23. The team inspected corridor with GSHP designs. Considering GSHP investments which are already made the capacity augmentation to four lane road corridor was conceptualised, looking to present ground condition.

C.6.3.2 Strip Mapping

24. The latest field data was gathered through detailed strip mapping survey. Elaborate strip maps based on GSHP design drawings were prepared indicating existing and proposed scenario.

25. As desired by GSRDC, strip maps were got prepared early and submitted for further needful actions during project study.

C.6.3.3 Highway Geometrics

26. After reviewing the earlier study details the geometrics as provided in GSHP, are adopted for new proposed four-lane facility.

C.6.3.4 Pavement Design

27. The GSHP pavement design details were collected and reviewed. Taking these as reference new pavement design is carried out considering latest traffic volumes and the VDF values computed for this corridor based on fresh studies.

C.6.4 Design and Project Cost

C.6.4.1 Geometric Design

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

29. The adopted typical cross sections are placed at Annexure B-5.

C.6.4.2 Pavement Design

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

LCV	–	0.54
Bus	–	1.13
2-Axle Truck	–	8.11
3-Axle Truck	–	7.89
Multi Axle Truck	–	4.52

31. **CBR:** Design CBR values are adopted from GSHP pavement design:

Section Name	Design CBR
Halol – Godhra	8%

32. **New Pavement Design:** For design of new pavement design IRC-37:2001 was followed. The design life is taken as 20 years. Average growth of commercial vehicles is considered as

5.2%⁷. For two different sections respective maximum, directional, traffic is considered for calculation of design lane MSA. Lane distribution factor as stipulated was considered.

33. New pavement design crust for Halol – Godhra road corridor is tabulated as under:

Halol – Godhra		
CBR – 8%		
MSA – 208		
Adopted Design for CBR 8%, MSA – 150 ⁸		
	Required	Recommended
BC	50	50
DBM	160	100
WMM	250	390 ⁹
GSB	200	200
Total	660 mm	740 mm

C.6.4.3 Overlay and Profile Correction

34. Wherever GSHP improved facility is in place it was thought appropriate to have only profile corrective course to get unidirectional camber¹⁰. Given that there are minor/major distresses, the inputs from BBD investigations shall be used for design of adequacy in structural strength and accordingly pavement design.

35. In the absence of BBD data the following scheme has been adopted:

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

⁷ .Although the assessed growth rate was lower compared to assumed growth rate for MSA calculation.

⁸ . 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.

⁹ . Substitution of pavement layers as per IRC:37-2001 and IRC:81-1997.

¹⁰ . However during the discussions with Secretary it was decided to conduct BBD survey. The findings of BBD survey shall be used and incorporated in the Final Report. The cost may go minor change.

C.6.4.4 Structures Design

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

SI. 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 \geq 0.90m	Rm	7,500/-
b	Diameter $>$ 0.75m & $<$ 0.60m	Rm	6,500/-
c	Diameter \leq 0.60m	Rm	5,500/-

Rates Adopted: As desired by GSRDC, the National Highway – Ahmedabad Division (NH-Ahmedabad) schedule of rates were used for costing purposes.

37. Where required escalation was applied, also for some of the items realistic rates were evaluated and used.

C.5.1.1 Project Cost

38. Base year construction cost worked out is given under:

SI. No.	Description of Item	Total Amount (in million Rs.)
1	Highway Cost	803.59
2	Intersections, Toll Plaza, Bus Bay/Bus Shelters	44.17
3	Structure Cost	108.07
4	Existing Road Maintenance	9.51
Total Construction Cost		965.34

39. Details pertaining to quantity and cost calculation are placed at Annexure C-5.

C.6.5 Environmental and Social Impact Assessment

40. The Project Corridor Halol-Godhra is spread out in three talukas of Panchmahal district over a length of 38 km with a total population of 0.78 million and area of 1672 km² as per 2001 Census. Halol and Kalol are the talukas which are likely to be affected the most and Godhra (4 km of the Project corridor passes through this taluka) - the least (Table C-6.8).

Table C.6-8: Propensity of Impacts (By Taluka)

District	Taluka	Area (km2)	Length of Corridor (km)	Population
Panchmahal	Halol	517.03	11	195300
	Kalol	397.99	23	191985
	Godhra	757.28	4	393663
Total		1672.3	38	780948

41. Godhra is a major town and is spread over an area of 757 km² (45.28% of total area of Talukas being traversed) and Kalol with is spread over an area of 398 km² (23.80%). Population distribution Ranges between 191 thousand in Kalol to 393 thousand in Godhra which shows a wide variation. Godhra has the highest share of population (50.40 % of all Talukas being traversed) covering three Talukas.

42. **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 C.6-1).



Figure B.6-1: Typical Roadside Plantation

43. To prevent single-vehicle collision with the roadside trees, trees very close to the road need 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 C.6-9)

Table C.6-9: Tree Plantation along The corridor

Name	No. of Trees	No. of Trees to be impacted
Halol-Godhra	3950	2500
Total	3950	2500

44. **Reserve Forest within the Study Area:** Strip plantations of trees within the RoW of all State Highways have been declared as Protected Forests. Except for the roadside plantation, no reserve forest flora will be impacted by this project.

45. **Social forestry:** Plantation through Social Forestry Programme¹¹ (Figure C.6-2) occurs along the corridor from Halol to Godhra in four to six meter strip both sides.

46. **Bio-diversity and endangered species:** Only one of the 53 endangered species has been recorded as local to a district Panchmahals The particular rare species, *Ceropegia odorata* Nimmo ex Hook f. (ASCLEPIADACEAE) is local to a



Figure C.6-2: Typical Community Plantation

¹¹ . The initiative taken by the MoE&F 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.

place called Pavagadh, about 7 km south of the closest node Halol on the project road. Evidently, it is unlikely that the present project is going to have any impact whatsoever on the endangered species of flora.

47. **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.

48. **IMPACTS ON CULTURAL ENVIRONMENT:** Strip mapping carried out on the project corridor was the main source of identification of the affected cultural properties falling within and just outside the RoW of the project corridor. A temple of Goddess Mahakali based at Pavagadh hill is about 7 km away from the northern end of Halol-Godhra corridor. A hill town with the remains of several forts and palaces, Pavagadh, known to be an ancient capital of Gujarat is about 5 km away from the corridor (Table C.6-10).

Table C.6-10: Archaeological Monuments/Sites within 10 km of Project Corridor

Location	Taluka	District	Name of Monuments/Sites
Pavagadh	Halol	Panchmahal	Pavagadh (Remains of Forts & Palaces ancient Capital)
Pavagadh Hill	Halol	Panchmahal	Mahakali Temple
Champaner	Halol	Champaner	Mosques and Palaces
Kankanpur	Godhra	Panchmahal	Kankeshwara Mahadev Temple
Ratanpur	Godhra	Panchmahal	Ratneshwara Old Temple

49. 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 C.6-11)

Table C.6-11: Cultural Properties along Project Corridor

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
Kalol	Temple	Good	346.06	2	Right	Urban	A,B,C
Vejalpur	Jalaram Mandir	Average	357.6	10.0	Right	Inside	A,B

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

50. **Land Acquisition:** Design considerations and limiting the proposed road widening within the existing RoW, led to limited land acquisition¹² that is required for capacity augmentation of the Project corridor from two lane to four lanes. The details of such land types along with the extent acquisition needs are given in Table C.6-12.

Table C.6-12: Properties Likely to be impacted in Project

Type of Land Acquisition	Area in Ha
Agricultural	21.95
Residential	0.27
Commercial	0.46
Open	1.83
Barren	2.2
Industry	0.5
Plantation	7.65
Total area in Ha	34.86

51. **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.

52. **Impact on Water resources along the project corridor¹³:** Table C.6-13 presents the limited number of such categories of water bodies likely to be impacted by the project.

Table C.6-13: Water bodies likely to be impacted by Project

Link Name	Water Bodies			Likely impacts
	W1	W2	W3	
Halol-Godhra	2	1	-	Sedimentation and part filling. Impact is minor for all W1 and W2
Total	2	1	-	

Note: W1 = Dry ponds; W2 = Water bodies with no vegetation; W3 = Water bodies with emergent vegetation

53. Only one open well is with in ROW and need to be taken care of during the project implementation.

Table C.6-14: Number of Water Supply Sources Likely to be impacted

¹² . 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.

¹³ . 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 labour camps. Removal of trees and vegetation can lead to erosion of soil and siltation of water bodies. 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.

Link Name	Water Supply Sources			Likely impacts
	OW	TW	BW	
Halol-Godhra	1	-	-	Reversible, replaceable impacts.
Total	1	-	-	

OW = Open well; TW = Tube well; BW = Bore well

C.6.6 Tollable Traffic

54. The vehicles which are tollable¹⁴ as per the Concession agreements are considered for assessment of tollable traffic. From the road side interview conducted, the desire of traffic is elicited. Towards assessing the tollable traffic all the intra zonal and inter-zonal trips of the zones lying on the corridor are excluded. This exclusion may lead to slightly under estimation of tollable traffic. Further it is considered prudent to drop by 30% of the assessed traffic from tollable traffic¹⁵ (from trend based approach). This drop is considered in tollable traffic to overcome all uncertainties on realisation of predicted traffic levels on the project corridor, as the suppressed demand.

55. The assessed tollable traffic by sections and by mode is given in Annexure C-6. Table C.6-15 Assessed tollable traffic.

Table C.6-15: Assessed Tollable Traffic

Corridor Name	Composition	Link Name	Car/Jeep (Old Tech)	Car/Jeep (New Tech)	Mini Bus	Std. Bus	Tempo/ LCV	2-Axle Trucks	3-Axle Trucks	M-Axle Trucks	AADT (VEHs)
Halolo-Godhra	Total	Halolo-Godhra	224	1269	131	363	367	1761	921	334	5370
	Non-Tollable	Halolo-Godhra	57	340	34	13	137	105	25	6	717
	Tollable	Halolo-Godhra	167	929	97	350	230	1656	896	328	4653

56. The forecasted tollable traffic, by mode and time period at 10 year interval is given at Table C.6-16.

Table C.6-16: Summary of Tollable Traffic

Corridor Name		Halol-Godhra											TOTAL AADT (VEH)	TOTAL AADT (PCU)
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)	TOTAL AADT (PCU)	
Halol-Godhra	1	356/000	2006	167	929	97	350	230	1656	896	328	4653	11815	
Halol-Godhra	1	356/000	2010	191	1096	105	397	265	1930	1061	394	5439	13830	
Halol-Godhra	1	356/000	2020	266	1653	128	519	374	2788	1592	611	7932	20186	
Halol-Godhra	1	356/000	2030	352	2349	153	670	520	3972	2348	933	11296	28952	
Halol-Godhra	1	356/000	2040	466	3338	183	864	724	5657	3462	1424	16118	41613	

57. In addition to above, estimated tollable traffic is forecasted at 2% p.a. up to “COD” and 5% thereafter¹⁶ the forecasted traffic by mode is given as Annexure C-7.

¹⁴ Only cars and commercial vehicles (which include buses) are tollable.

¹⁵ Part of the traffic that is already diverted on to project corridor may get re-diverted because of imposition of tolls. User perception is very complex. Unless network wide analysis is made and modelling done in case of project like this it is difficult to arrive at near accurate. However we feel the figures arrived by us can be considered as the best estimate.

¹⁶ This is based on new model concession agreement of Gol.

C.6.7 Financial Analysis

58. The financial analysis of the project has been undertaken to assess the viability of the projects 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: Halol Godhra Corridor (38km);

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

C.6.7.1 Inputs and Assumption

Revenue Model

- a. **Tollable Traffic:** The tollable traffic, by each toll plaza, has been estimated and presented in Sub-Section C-6.6. This traffic forms an input to the financial analysis.
- 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 C.6.17.

Table C.6-17: Toll Structure (at 2006 prices)

Mode	Toll Rate (Rs./km at 2006 price)	Toll Rates (Rs./Trip at 2006 price)	
		Halol Godhra	Halol Godhra Shamlaji
Car/Jeep	0.61	25	100
Mini Bus	1.07	40	175
Bus	2.13	80	355
LCV	1.07	40	175
2-Axle Truck	2.13	80	355
MAV	3.43	130	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.

59. Annual Toll Collection: The annual toll revenue realisation, over the project period, at current prices, has been given in Table C.6-18:

Table C.6-18: Annual Toll Revenue

Year	Annual Toll Collection (Mill Rs at current Prices)	
	Halol Godhra	Halol Godhra Shamlaji
2010	190.7	697.8
2015	289.7	1111.2

Year	Annual Toll Collection (Mill Rs at current Prices)	
	Halol Godhra	Halol Godhra Shamlaji
2020	448.4	1752.2
2025	689.1	2779.0
2030	1049.2	4400.8
2035	1612.5	6996.8

Cost of Project

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

Scenario 1 : Rs 965.3 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	Halol Godhra	Halol Godhra Shamlaji
Civil Construction Cost	965.3	4523.44
Contingency (10%)	96.5	452.34
Construction Supervision (3%)	31.85	149.27
Inflation During Construction	145.26	680.7
Total Cost of Project	1238.94	5805.75

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

Routine Maintenance – Rs. 40,000/km

Periodic Maintenance – Rs. 3 mill/km

Assumptions for Analysis

62. 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.

- (f) The disbursement of VGF has been taken during the construction period. It is to be disbursed after the equity draw-down by the concessionaire in over. The phasing of VGF/capital grant has been linked to the debt draw-down.
- (g) The Corporate Tax is taken at 33.66%¹⁷. In the event of the tax rebate, a Minimum Alternative Tax of 11.22 %¹⁸ 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.

C.6.7.2 Results of Financial Analysis- Base Case: Realistic Traffic

63. The financial analysis for the base case has been presented in the Table C.6-19. The details of financial analysis are presented through Annexure C-8.

Table C.6-19: Results of the Analysis in Base Case

Indicators	Halol Godhra		Halol Godhra Shamlaji	
	20 Yrs	30 Yrs	20 Yrs	30 Yrs
Viability Gap Funding mill Rs	148.7	-	1567	870.9
% of Project Cost	12%	-	27%	15%
Pre-Tax IRR (%)	18.46	18.90	17.99	18.47
Post-Tax IRR (%)	17.11	17.20	16.84	17.13
Return on Equity (%)	21.36	20.13	20.90	19.45
Minimum DSCR	0.51	0.45	0.37	0.32
Average DSCR	1.44	1.29	1.41	1.20
Payback Period	11 yrs	11 yrs 4 mths	11 yrs 1 mths	12 yrs 3 mths

64. The project road section between Halol and Godhra is a part of a longer corridor, which connects Halol-Godhra-Shamlaji. Consultants feel that in order to get the benefit of reduced travel distance, the total corridor needs to be taken up together, it may be under a single contract, or two different ones. The analysis, therefore explores both the options. Halol Godhra section of the road, carries a fairly high volume of traffic, therefore the project is viable with 12% VGF from the government, if the concession period is fixed at 20 years. However, if the same is increased to 30 years, then the project becomes viable on a stand alone basis.

¹⁷ The breakup is 30% Corporate Tax, with 10% surcharge and 2% education cess.

¹⁸ The MAT is 10% with 10% surcharge and 2% education cess.

65. The total corridor if taken as one contract package, requires a VGF in both cases of 20 and 30 years of concession period.

C.6.7.3 Sensitivity Analysis: Variation in Revenue and Cost Levels

66. 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 C.6-20.

Table C.6-20: Sensitivity Analysis: Case of Revenue and Cost Variation (30 Year)

Indicators	Halol Godhra			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	156.7	185.8	398	1669	1741.7	2670.6
% of Project Cost	11%	15%	28%	25%	30%	40%
Pre-Tax IRR (%)	18.49	18.41	18.53	18.16	18.32	18.28
Post-Tax IRR (%)	17.03	16.95	17.12	16.93	17.09	17.15
Return on Equity (%)	19.60	13.37	19.82	19.01	19.31	19.48
Minimum DSCR	0.43	0.27	0.27	0.31	0.13	0.13
Average DSCR	1.24	1.23	1.25	1.17	1.19	1.19
Payback Period	12 yrs 3 mths	12 yrs 8 mths	13 yrs 5 mths	12 yrs 8 mths	12 yrs 9 mths	13 yrs 1 mths

67. The project corridor, between Halol and Godhra, is a robust corridor, reflecting commercial viability with 28% of project cost as VGF, in the worst case, with the concession period of 30 years. With total corridor as one, the viability goes down, but the project still remains attractive with requirement of 40% of project cost as the VGF.

C.6.7.4 New Model Concession Agreement as Base

68. 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.

69. The results of the analysis have been presented in Table C.6-21.

Table C.6-21: Results under New MCA Assumptions

Indicators	Halol Godhra	Halol Godhra Shamlaji
Requirement of Six Lane	2026	2026

Maximum Concession Period	19 Yrs	19 Yrs
Viability Gap Funding		
mill Rs	123.9	2322
% of Total Project Cost	10%	40%
Pre-Tax IRR (%)	18.11	17.70
Post-Tax IRR (%)	17.0	16.50
Return on Equity (%)	21.06	20.70
Minimum DSCR	0.51	0.25
Average DSCR	1.41	1.38
Payback Period	11 yrs	11 yrs 4 mths

C.6.7.5 Conclusions

70. The road corridor is a viable venture and should be taken up under the VGF, under the BOT scheme. If the section between Halol and Godhra is taken independently, then the concession period can be fixed at about 20 years. However if the full corridor is planned to be implemented as one, then the concession period needs to be between 20 and 25 years, as the traffic on the balance section between Godhra and Shamlaji is relatively low, and the former needs to cross subsidise the latter.

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