GUJARAT INFRASTRUCTURE DEVELOPMENT BOARD

EXECUTIVE SUMMARY

Regional Rail System for Ahmedabad

prepared by **Delhi Metro Rail Corporation Ltd.**

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EXECUTIVE SUMMARY

0.1 INTRODUCTION

0.1.1 Background

Gujarat Infrastructure Development Board (GIDB) engaged Delhi Metro Rail Corporation for preparation of the Detailed Project Report for Metro Rail System for Ahmedabad and Gandhinagar and Regional Rail System for Ahmedabad. This report deals with Regional Rail system only. Both the systems are complimentary to each other.

The study has been divided into two stages. Stage-I was to prepare feasibility report for selecting the corridors to be taken up for Metro construction and Regional Rail system. The report was submitted in August, 2004 and was accepted by Gujarat Government in October, 2004.

Based on Stage-I study the Detailed Project Report is prepared for Phase-I of Ahmedabad Metro and the report for Regional Rail System is in progress.
The report deals with the following:

- Estimation of travel demand and projection of sectional and station traffic loads for the horizon years.
- Appropriate technical solutions to carry the projected volume of traffic.
- Social and Environmental Impact Assessment and Environmental Management Plan.
- Estimation of Construction and completion cost.
- Financing plan
- Implementation strategy.

The Executive Summary of DPR for Regional Rail System covering all these aspects is presented here.

0.1.2 Approach

To carry out the study, the first task to be carried out is the traffic survey and assessing the transport demand for the identified corridors for the Regional Rail System.

Simultaneously, the engineering surveys comprising Topographic survey, Geo-technical investigations, utility identification and land surveys for the route were carried out. Various alternative alignment options were developed for locations with constraints and best options are adopted. Meetings were held with officials of Indian Railways and Gujarat Govt. to appraise the options available and to get decisions.

The design norms and parameters for system planning have been developed to cater for the transport demand, and engineering feasibility. Care has been taken to adopt railway's design norms as far as possible.

Station locations have been finalised based on the transport demand, availability of land and road approaches. At certain locations development of new approaches is recommended. The land requirement has been then worked out for the alignment, stations and traffic integration areas. The integration schemes for passenger interchange with Metro Rail System were also developed.

Cost estimating (at April, 2005 prices), Economic and Financial analysis, Financial planning along with the suggested implementation schedule followed thereafter.

The study is based on the following key parameters:

- The alignment to be kept along the existing tracks of the Western railways as far as possible.
- Railway and other Government land are to be utilised as far as possible so as to minimise the acquisition of private land.
- Indian Railways parameters to be followed as far as possible for track layout, design of structures and system planning including the coaches.
- Minimum disturbance to railway operations during construction.
- Interconnectivity with Indian Railways to be provided at identified locations.
- Utilisation of the surplus and spare infrastructure of Indian Railways.
- Merging with ongoing and planned Railway projects in the influence area.
- The system shall be owned by an SPV comprising State Government and Indian Railways while operation and maintenance of the system shall be carried out by the Indian Railways for the SPV at agreed rates.

0.1.3 Study Area

The study area consists of influence area of Barajedi, Geratpur, Vatva, Vinzol, Jashoda Nagar, Maninagar, Ahmedabad, Shahibaug, Sabarmati, Chandkheda, Khodiyar and Kalol corridor –1 and Asarva, Chamanpura, Sardargram, Kubarnagar and Naroda for Corridor - 2. The road network in the influence area along with the existing transport system within these towns has been studied in detail to work out the route as well as station locations. Integration of various modes of transport is vital for evolution of an efficient transport system. Proposal for passenger interchange facilities with Metro Rail System has been proposed at Ahmedabad and Sabarmati.

Barajedi – Ahmedabad – Kalol corridor is about 43.487 km in length (between center lines of terminal stations) while the Ahmedabad – Naroda corridor is 9.459 kms (between center lines of terminal stations).

0.2 TRAFFIC DEMAND FORECAST

Four stage transport planning process has been adopted to carry out transport demand forecasts. This comprises of trip generation, trip distribution, modal split and trip assignment.

Projected Per Capita Trip Rate (PCTR) for motorised mode for the years 2003, 2010, 2025 and 2035 are given in **Table 0.1**.

Table 0.1 Vehicular PCTR Values

Year	PCTR Value
2003(Observed)	0.72
2010	0.80
2025	0.90
2035	1.00

The observed modal split in favour of public transport is just 28% which shows deficiency in Public Transport System in major routes of the city. With the introduction of Mass Transport System, the modal split in favour of public transport is expected to increase and likely to be 70% & 75% in the years 2025 & 2035 respectively.

Various alternative corridors were considered during the feasibility stage to work out the most desired network for Regional Rail System and Metro System. These alternatives were discussed in details in the feasibility report.

Based on the Techno – Economic (Traffic forecast and reconnaissance of engineering feasibility) considerations the following corridors are identified for the Regional Rail System.

Regional Rail System

- **Corridor – 1** (Barejadi – Ahmedabad – Kalol) - 43.487 km (between center lines of terminal stations).
- **Corridor – 2** (Ahmedabad – Naroda) - 9.459 kms (between center lines of terminal stations)

Ridership of Regional Rail with phase – I of Metro Rail Corridors have been worked out.

Metro Rail Corridors of phase – I

- APMC Vasna –Aayakar Bhawan – Sabarmati – Motera – Koba Circle – Gandhinagar- Akshardham
- Kalupur – Prem Darwaja – ITO – Manav Mandir – Drive in Cinema – Thaltej

Corridor wise details of transport demand forecast is given in Table - 0.2 & 0.3

Table 0.2 SUMMARY OF TRANSPORT DEMAND – 2010

Section	**Length (Km)**	**Number of Passengers (lakhs)**	**Pass-Km (lakhs)**	**Pass-Km/km (lakhs)**	**Average Lead (km.)**
Regional Rail System					
Line – 1: BAREJADI – AHMEDABAD JN. – KALOL JN.	43.49	2.80	34.39	0.79	
Line – 2: AHMEDABAD – NARODA	9.47	1.75	14.15	1.49	
TOTAL	**52.96**	**4.55**	**48.54**	**0.92**	**10.66**

Table 0.3 SUMMARY OF TRANSPORT DEMAND – 2035

Section	**Length (Km)**	**Number of Passengers (lakhs)**	**Pass-Km (lakhs)**	**Pass-Km/km (lakhs)**	**Average Lead (km.)**
Regional Rail System					
Line – 1: BAREJADI – AHMEDABAD JN. – KALOL JN.	43.49	5.97	81.99	1.89	
Line – 2: AHMEDABAD – NARODA	9.47	2.83	23.52	2.48	
TOTAL	**52.96**	**8.80**	**105.51**	**1.99**	**11.98**

0.3 PLANNING AND DESIGN PARAMETERS

0.3.1 The norms and standards are conforming to IR and IRC as relevant in planning for various components of the Regional Rail system and specially IR norms suitable for suburban trains. Initially, the Regional Rail system had been conceived as stand alone system with no interference to railway operation and the alignment was to be in railway land as far as possible to reduce the cost and problems of private land acquisition. However, for optimal utilisation and to keep the cost low it is proposed that in Sabarmati – Kalol area only two lines are provided initially as single broad gauge line is also underutilised at present. This can be upgraded to four lines in future to provide two separate dedicated systems.

0.3.2 Basic Philosophy of planning and major constraints

Planning Philosophy and constraints are listed below:

(i) Land availability for alignment, station buildings circulating areas, maintenance depots, substations, New ROB's, RUB's etc.
(ii) Swapping with existing tracks of Indian Railway.
(iii) Remodeling of yards, Signalling etc.
(iv) Relocation of some of the existing installations of Indian Railway.
(v) Layout of station approaches with integration with other modes of transport such as feeder buses, private vehicles and other road based modes.
(vi) Negotiating existing ROB's/RUB's and construction of new ROB's/RUB's
(vii) Use of available Railway infrastructure viz. circulating areas/FOB's at stations
(viii) Provision of operational linkages with Railway tracks at terminals for emergency requirements.
(ix) Provision of terminal facilities for MG operation at Asarva and Sabarmati, due to closure of MG system between Sabarmati and Ahmedabad, as well as goods link between Sabarmati and Asarva

0.3.3 DESIGN PARAMETERS: The design parameters are primarily based on IR system and are briefly given below:-

Design speed: 80 kmph though track structure is to be fit for 130 kmph due to integration of RRS with IR system.

Track Structure: 60 kg UIC rails with PSC sleeper at 600 mm centre to centre spacing on 300 mm clean ballast cushion and laid as long welded rails.

Track Centre: Normally 5.3 m from existing railway track as well as between new RRS tracks, which could be reduced to 4.725 m due to constraint of space.

Gradient: Maximum gradient 1 in 400 in station yards and 1 in 200 in mid section.

Points and Crossings: On all passenger running lines 1 in 12 thick web curved switches to be provided. Yard lines to be provided with 1 in 8 1/2 thick web curved switches.

All other parameters like curves, cant and cant deficiency, vertical curves, clearances, platforms etc will be as per Indian Railway standards.

0.4 ROUTE ALIGNMENT, YARD REMODELLING AND OTHER ENGINEERING WORKS

0.4.1 Detailed topographic survey has been carried out through Total Station covering a strip of 60 m width in mid sections and 200 m width in station areas. Detailed

survey plans have been prepared to a scale of 1: 1000 such that each plan covers a route length of about 0.75 km with requisite overlap. Major overhead and underground utilities requiring relocation / diversion has been marked on alignment drawings. Levelling was carried out with Auto Level with reference to benchmarks and temporary benchmarks were established at nearly every 500 meters.

Both these corridors run with in the railway boundary and along the existing Railway tracks and planned on surface. Remodelling of yards at Sabarmati and Khodiyar is a necessity. The MG platform No. 11 & 12 is proposed to be taken for operation of RRS services. The MG line from Naroda side is proposed to be terminated at Asarva and additions / alterations are required for creating terminals facilities. 20 new stations in addition to 11 existing stations are proposed on 1st corridor while 3 additional stations in addition to existing 4 stations are proposed on 2nd corridor with a view to provide stations at almost every 1.2 to 1.5 km distance.

0.4.2 Corridor –1 (Barajedi – Ahmedabad – Kalol)

Barajedi - Ahmedabad : Ahmedabad railway station caters to very heavy long distance passenger traffic from Mumbai, Delhi, Rajkot, Kandla as well as local traffic from Mofussal towns, Mehsana, Kalol, Patan, Viramgam, Naroda, Barejadi, Nadiad etc. The existing railway lines towards Baroda have no spare capacity to deal with suburban traffic, especially between Ahmedabad & Nadiad, this being double line broad gauge, catering to more than 50 passenger trains in each direction, in addition to goods trains, which are increasing, due to increase in activities in the ports in Gujarat. Each line is at present carrying more than 20 G.M.T. of traffic. Hence, it was proposed to provide new pair of Broad gauge double line between Ahmedabad – Barejadi on east side of the existing Corridor. The center line of Ahmedabad station is reckoned as chainage zero and is increasing towards Barajedi. The MG platform No. 11 and 12 is proposed to be converted for RRS services so that alignment will be on the east side and maximum area will be available for Western Railway for their future expansion.

Ahmedabad – Kalol : Ahmedabad – Sabarrmati – Khodiyar – Kalol was a double line MG section, part of Delhi – Ahmedabad MG system carrying very heavy traffic towards North India, serving Gujrat, Rajasthan, Haryana and Delhi. Since Delhi Ahmedabad has been converted to BG, only part of MG remains between Ahmedabad-Khodiyar (Double Line) Khodiyar – Kalol single line, as one MG line has been converted to BG. One of the two MG lines between Khodiyar and Sabarmati is now under conversion to BG, as a part of left out work of Delhi- Ahmedabad conversion and the present BG from Khodiyar is linked to Ahmedabad via Chandlodiya (on Ahmedabad-Sabarmati-Viramgam B.G double line). This is a part of BG line to Gandhinagar (Capital Town) from linked from Chandlodiya to Gandhinagar via Khodiyar.

For the RR System, the proposal for this Corridor is to convert MG double lines between Ahmedabad and Sabarmati to BG and convert the 2nd MG line between Sabarmati and Kalol, thus making a double line corridor by using the BG line, which will be available right from Sabarmati to Kalol, after completion of the present conversion work, (between Khodiyar and Sabarmati) in progress.

It has become necessary to convert both MG lines between Ahmedabad-Sabarmati, due to constraints of availability of land between Ahmedabad and Shahibag right up to south bank of Sabarmati Bridge. Moreover due to conversion of MG to BG, under policy of gauge conversion, MG traffic has already reduced considerably and a few services for local passengers are being run which can be taken care of by RRS.

For the proposed alignment between Ahmedabad and Kalol, the chainage zero is reckoned from center line of Ahmedabad station and is progressively increasing towards Kalol.

Facilities for transfer of IR trains to RRS and vice versa have been provided at Barajedi and Girdhar Nagar. Further future provision has also been kept in Ahmedabad yard.

There are two major bridges over river Khari and Sabarmati. The Khari bridge has been proposed at a distance of 12 metres from the existing bridge on its upstream side with 5 spans of 16.12 m where as Sabarmati bridge has been planned at a distance of 20 metres from the existing bridge on its upstream side with 11spans of 35 m (385 m overall) through PSC Girders Bridge is to be built.

0.4.3 Corridor – 2 (Ahmedabad – Naroda)

General Alignment design for this rail corridor has been planned to avoid / minimise land acquisition, as followed for other RRS corridors. Chainage 0.00 has been reckoned from centre line of Ahmedabad station, increasing towards Naroda. Alignment for this forms part of rail corridor between Ahmedabad – Khodiyar – Kalol and is common between km 0.00 to km 1.220, where it takes off with two 1 in 12 right hand turn outs, outside the curves of radius 660 m, just after Saraspur station at km 1.100, North of Kalupur ROB. This station will be common for both corridors i.e. Ahmedabad – Kalol and Ahmedabad – Naroda. The M. G. Lines including M. G. goods bypass line from Sabarmati have to be dismantled to accommodate the R. R. Lines. B G goods line to Asarva also gets dismantled. Asarva MG yard will need additions and alterations to make fit for the MG terminals. The alignment passing through Chamunda ROB where space is available to accommodate the RRS lines. Alignment further runs on North side of existing MG track up to Naroda.

0.4.4 Geo Technical Investigation

Detailed geo-technical investigations were carried out for both these corridors. The area falls in seismic zone III. The strata generally comprises of sandy silt in loose to dense state with very low plasticity upto the exploration depth of boreholes with SPT 'N' values varying from 6 to more than 100. No hard rock has been encountered. The water table is not met except at few locations like river & nallah where water table is 0.5 m to 2.0 m. It will be possible to have shallow foundations of suitable depth for RRS structures like station buildings. The bridge across Sabarmati & Khari River will be on pile foundations. Strip isolated foundations may be adopted for highly loaded structures.

0.4.5 Utilities

The proposed RRS alignment is crossing major arterial roads of the city road network, which are serving institutional, commercial and residential areas. At very few locations some surface and sub-surface utility services viz. sewers, water mains, storm water drains, and telephone cables, electric poles, etc. are there along the proposed alignment. Details of existing utility services along the proposed alignment have been collected from the site and concerned authorities. The affected portion of the services with reference to the proposed alignment were identified and proposals for temporary diversion, if required and / or relocation proposals of the affected services have been made.

0.4.6 Land requirement

Since land is a scarce commodity especially in Metropolitan areas, every effort has been made to keep land requirement to the barest minimum. Land is mainly required for route alignment of rail tracks, station buildings, platforms, entry/exit structures, traffic integration, car shed, power sub-stations, administrative buildings etc.

For EMU maintenance depot at Vatva, about 30.53 hectares of private agricultural land is required. The overall land requirement for the project is assessed to be about 40.74 hectares except railway land. It comprises of 5.80 hectares of Govt. land (other than railway) and 34.94 hectares of private land. No temporary acquisition of land for construction depot sites is proposed. Indian Railways will make railway land available for the project, free of cost. The state governments will also make available other land (required for the project) whether private or government, at their cost.

0.4.7 Rehabilitation & Resettlement

The project involves the displacement of Jhuggies, houses and few other shops / structures at a few locations along the alignment. Suitable measures have to be taken to ensure proper rehabilitation of all the project affected persons as per extant Government policies. The state governments will be responsible to

remove the encroachments from the required land and to carryout required rehabilitation works, at their cost.

0.4.8 Property Development

There is potential of raising finances from property development on the railway and other government land, which in any case has to be used for this project. No land is to be specially acquired for property development and only surplus air space above the stations is to be utilised for development. It is recommended that this may be kept in view.

0.5 STATION PLANNING

0.5.1 Corridor 1 (A) runs south eastwards from Ahmedabad to Barajedi. The corridor is appox. 16.5 kms long. Total twelve stations (including Ahmedabad) have been proposed which are on an average, 1.50 km apart, the inter-station distance although varies between 0.93 kms to 2.29 kms.

0.5.2 Corridor 1 (B) runs from Ahmedabad northwestwards to Kalol, covering a distance of about 27 kms. Twenty stations have been planned on this corridor. Average inter-station distance is 1.40 kms.

0.5.3 Proposed Ahmedabad- Naroda, corridor 2, runs north-eastward from Ahmedabad, to Naroda, covering a distance of about 9.5 km between the two terminals. Nine stations, including terminal stations have been planned along the proposed alignment. All the stations on this corridor are at– grade. Average inter-station distance is 1.20 km. This however varies from 0.93 Km to 1.71 Km depending on site, operational and traffic constraints.

0.5.4 Station planning has been done to provide required facilities for the commuters with minimum expenditure. The required operational areas have been provided for regional rail system exclusively, while the other facilities are integrated with existing facilities wherever feasible.

0.5.5 The services are located so as to eliminate/minimise unnecessary pedestrian movement. Passenger facilities like ticketing, information etc as well as operational areas are provided along with services in station building at points of access to paid areas (platforms). The station building is a 2-storey structure housing ticketing and information at traffic integration level. Connections to existing WR corridors by way of Foot Over Bridges between the two have been proposed wherever necessary. These have been combined with connection to platforms to avoid duplication of services. Ticketing facilities are placed such that users can directly access the FOB / Platforms and are also close to traffic integration areas. Traffic integration area is generally provided abutting major access road, keeping in view the traffic projections.

The list of stations on these corridors is given in following tables:

Corridor 1 A (AHEMDABAD – BARAJEDI)

S. No.	STATION	CHAINAGE		INTER STATION DISTANCE	REMARKS
		RAILWAY	RRS		
1.	AHMEDABAD	ADI/1053A-ADI 1061A	0.000	___	Existing station
2.	KANKARIYA	493/1-493/5	2.158	2.158	
3.	MANI NAGAR	492/1-492/5	3.110	0.952	Existing station
4.	DAKSHINI SOCIETY	491/1-491/3+2	4.180	1.070	
5.	JASHODA NAGAR	489/15	5.761	1.581	
6.	VATVA	487/19-487/21	7.580	1.819	Existing station
7.	VINZOL	486/21-486/23	8.508	0.928	
8.	VATVA DIESEL SHED	485/9-485/11	9.911	1.403	
9.	VIVEKANAND NAGAR	483/1	12.206	2.295	
10.	GERATPUR	482/1-482/3	13.189	0.983	Existing station
11.	BHAIPURA	480/23-480/25	14.397	1.208	
12.	BARAJEDI	478/28-478-29	16.471	2.074	Existing station

Corridor 1 B (AHMEDABAD – KALOL)

S. No.	Station	Chainage		Inter Station Distance	Remarks
		Railway	RRS (km)		
1.	AHMEDABAD		0.000	0.000	Existing station
2.	SARASPUR		1.100	1.100	
3.	GIRDHAR NAGAR	497/25-497/27	2.567	1.467	
4.	SHAHI BAUG	498/21-498/22	3.460	0.893	
5.	NATIONAL MEMORIAL	499/17-499/19	4.312	0.852	
6.	POWER HOUSE		5.462	1.150	

7.	SABARMATI		6.232	0.770	Existing station
8.	RANIP	778/11-779/10	7.522	1.290	
9.	KALI ROAD		8.832	1.310	Existing station
10.	"D" CABIN	776/40-776/30	9.917	1.085	
11.	CHAND KHEDA ROAD	775/40-775/30	10.929	1.012	Existing station
12.	TRAGAD	776/60-776/50	12.788	1.859	
13.	KHORAJ	771/30-771/20	15.065	2.277	
14.	KHODIYAR	769/13-769/12	16.309	1.244	Existing station
15.	DANTALI	767/20-767/10	19.121	2.812	
16.	DHANEJ	765/13-764/12	21.346	2.225	
17.	SAIJ SERTHA ROAD	763/80-763/70	22.761	1.415	Existing station
18.	SAIJ VILLAGE	762/20-762/10	24.079	1.318	
19.	GIDC KALOL	760/60-760/50	25.793	1.714	
20.	KALOL	759/20-759/10	27.016	1.223	Existing station

Corridor 2 (AHMEDABAD – NARODA)

S. No.	STATION	CHAINAGE		INTER STATION DISTANCE	REMARKS
		RAILWAY	RRS		
1.	AHEMDABAD	ADI/1053 A-ADI 1061A	0.000	___	Existing station
2.	SARASPUR	496/19-496/21	1.100	1.10	
3.	ASARVA		2.818	1.718	Existing station
4.	CHAMANPURA	405/4-405/3	4.056	1.238	
5.	MEGHANI NAGAR	404/3-404/2	4.993	0.937	
6.	SAIJPUR	403/1-402/11	6.300	1.307	Existing station
7.	SARDAGRAM	402/01-401/11	7.293	0.993	Existing station
8.	KUBER NAGAR	400/11-400/10	8.365	1.072	
9.	NARODA	399/11-399/8	9.459	1.094	Existing station

0.6 TRAIN OPERATION PLAN AND SYSTEM PLANNING

0.6.1 Rolling Stock and Train Operation Plan

The coaches for RRS will be 3.20 metre wide, modern light weight, made of stainless steel with 3 phase AC drive having VVVF control and with regenerative braking. The coaches will be suitable for 25 kV ac single phase, 50 Hz flexible OHE system. The train will comprise of three coaches initially with one motor car and two driving trailer cars. This can be increased to 6 and 9 car configuration later on. The other features of proposed coaches shall be similar to the ones proposed for Mumbai suburban services under modernisation plan.

Based on traffic volume, train operation plan has been worked out for the two corridors for the year 2010. It is proposed to provide 3 coach operation in the year 2010 which will have a capacity of 700 passenger. The frequency of trains during peak period and the number of coaches required in the year 2010 is given in the following table.

Corridor	Length (km)	Peak Hr. Headway (mts)	Schedule Speed (kmph)	No. Cars
Barejadi - Kalol	43.49	10	35	57
Barejadi - Naroda	25.93	10	35	36

The above plan will result in a train frequency of 5 minutes in Barejadi – Ahmedabad section. Trains shall operate from 6.00 to 23.00 hrs. A minimum train frequency of 15 to 20 minutes during off peak period to be provided for high level of attraction.

0.7 POWER SUPPLY AND TRACTION SYSTEM

0.7.1 Traction System and substations.

The RRS has been planned as completely electrified section with 25 kV ac traction system integrated with the Indian Railway system for efficiency and emergencies. Thus the present non electrified sections towards Kalol as well as Ahmedabad – Naroda sections are to be electrified. Two Receiving/Traction sub stations are proposed, one each at Sabarmati & Barejadi. These RSS's will get 132 kV input power supply from Sabarmati and Vinzol sub-stations of Torent AEC Power limited respectively. The 132 kV input power supply will be stepped down to 33 kV three phase and 25 kv single phase supply for meeting auxiliary and traction requirements of the proposed RRS Network.

0.8 SIGNALLING AND TELECOMMUNICATION

0.8.1 Signalling for the two corridors has been planned so as to meet the required safety and technological standards compatible with the Western Railway's adjacent routes appropriate to train frequencies.

0.8.2 Train control and Signalling system

To cater for the requirement of Design Headway of 3 minutes with adequate factor of safety, Modern Signalling arrangements are proposed for Regional Rail Corridors are as under:

Description	Specifications/ Standards
▪ Interlocking	Computer Based Interlocking provided at stations having switches and crossing. Depot will be interlocked except for lines mainly used for shunting, workshop/inspection shed areas
▪ Point Machine	IRS Point Machine on Main line and depot(s)
▪ Track Circuit	DC Track circuits or AFTC on running section and in depot
▪ Power Supply	Integrated Power Supply based on IRS specifications
▪ Signalling along the line.	Automatic signalling with MACLS. LED type signals for reliability and reduced maintenance cost
▪ Train Protection	Train Protection and Warning System (ETCS Level-1) in future
▪ Train Supervision	Train movement monitored/controlled from Station Control Room.
▪ Cables	Outdoor Cables will be armoured and as per IRS specifications
▪ Fail Safe Principles	SIL-4 safety level for the interlocking system as per CENELEC standards for signal application
▪ Immunity to External Interface.	All data transmission on telecom cables/ OFC. All Signalling and telecom cables will be separated from power cables. CENELEC standards to be implemented for EMC
▪ Environmental Conditions	Air-conditioning for Signalling equipment room

Train Protection and Warning System (Future)

It is envisaged that the signalling system shall be augmented in future to support the driver with a Train Protection and Warning System on main line with track to train communication through beacons/ balises (Level-1) to ensure safety in train operations. However, this is not covered in present cost analysis.

0.8.3 Depot Signalling

All depot lines except the ones used for shunting and in workshop will be interlocked. Workstation shall be provided in the Depot Control Centre for electrical operation and monitoring of points, signals and routes of the depot yard.

0.8.5 Telecommunication System

The Telecom system shall cater to the following requirements :

i. Train Traffic Control
ii. Emergency control
iii. Dedicated communication between stations
iv. Telephone Exchange System
v. Maintenance control
vi. Centralized control system
vii. Train destination indicator
viii. Passenger announcement system
ix. Telemetry system for power control
x. Instant on-line Radio Communication between moving cars and maintenance personnel
xi. Data channels for Signallng

The Telecom system shall comprise of following subsystems :

i. Fibre Optic Transmission System (FOTS)
ii. Telephone System
iii. Radio System
iv. Passenger Information System (PIS)

The standards proposed to be adopted for telecommunication systems are shown in Table below:

System	Standards
• Transmission System	**SDH based** for the entire telecom network.
• Transmission Media	**Optical Fibre system** as the main bearer for bulk of the telecommunication network
• Telephone Exchange	Small exchanges at main stations.
• Train Radio System	**Analog Train radio** communication between train drivers, stations, maintenance personnel and central control.
• Clock system	Standalone analog clocks at platforms.
• Passenger Announcement System	**Standalone Passenger Announcement System** at major stations.
• Environmental Conditions	Telecom equipment rooms to be air-conditioned.

0.9 MAINTENANCE FACILITIES

One EMU Maintenance Depot for both the corridors has been planned at Vatva having facilities of IOH, POH. This site is the only one suitable/available for the purpose on the entire route. The Depot is located in vacant space just opposite to Vatva diesel shed. The Depot site is nearly 600m in length and 500 m in width. Area of the plot is 30.53 Hact. The entry for the Depot has been provided from the both sides. Depot is bounded by Vatva diesel shed, Sardar Patel Ring Road, Vinzol village and AMC quarters. The Depot shall be provided with solid state interlocking (SSI) System independent of main line system.

Apart from the stabling facility in the Maintenance Depot proposed at Vatva, Stabling lines have been planned at Barajedi, Ahmedabad, Kalol and Naroda to start morning services.

0.10 ENVIRONMENTAL IMPACT

The objective of the study is to identify and determine as precisely as possible the likely environmental impacts which can be anticipated as a result of the proposed regional rail system in Ahmedabad and to suggest suitable measures for mitigating the adverse impacts on the environment.

Except for a few rocky features in the extreme southern portion of Ahmedabad, as a whole it forms a level plain. Average gradient of terrain is gentle, of the order of 1 to 3-m/km. The climate in Gujarat ranges from humid in the coastal regions to extreme in the interiors. Depth of water table in the project area fluctuates between 40m to 50 m below ground level and the common ground water structures are bore wells and dug wells. The results of Ground water analysis show that most of the parameters are within the limits for drinking purpose except the Total dissolved Solids (TDS). Sub soil and underground water are unlikely to undergo any deteriorating effect due to proposed Railway structures and foundation. As such, no forest area exists along the project alignment or its corridor. No rare or endangered species of trees have been noticed during field studies. About 1698 trees exist along the proposed alignment from Ahmedabd - Kalol (27 km) Section, 1190 trees on the Ahmedabad – Barejadi (16.5 km) section and 449 trees on the Ahmedabad – Naroda (8.5km) Section. It is assumed that most of trees (total 3337 on all the three sections) will be lost due to the proposed construction of regional rail system. The ambient air quality data indicates slightly higher values of suspended particulate matter, than the prescribed limits established by CPCB at all the monitoring stations. However the values of SO_2, NOx and CO are within the permissible limits. The project area falls in **Zone-III** of Seismic Zoning Map of India. The noise levels recorded at various places are higher than prescribed permissible levels of 65-dBA (day) and 55-dBA (night).

0.10.1 SOCIAL IMPACT

For different components of this corridor, out of total requirement of land of 40.73 ha, about 5.80 ha of government land and 34.93 ha of private land shall be acquired. The proposed regional rail alignment is mostly is passing through the railway land. But the depot site is located in agricultural land of area 30.53 ha. opposite Vatva diesel shed. It is learnt that the land is to be taken over by Ahmedabad Municipal Corporation for development of new township. On the basis of alignment drawings it was noted that about 232 families would be affected as the plots of these families are touching the regional rail alignment. During the household survey, it was observed that about 218 families are squatters, which need relocation/compensation. About 16 %(37 families) of total affected families along the alignment were randomly selected for analysing their socio-economic conditions. The primary data for the study was collected through interviews with the project-affected people by using structured household questionnaire. As many as 55.3% people are male as against 44.7 % female. About 23.3 % each falling in the age group of 6-15 and 40-60 years, closely followed by 22.7% in16-25 years, 20.7% in 26-40 years. Remaining 6% and 4 % people belong to the age of below 5 years and above 60 years, respectively. Majority of population are Hindus (91.9%) followed by Muslims (8.1%). 32.4% of people belong to General Caste, followed by Scheduled Castes (27%), other Backward Castes (21.6%). There was no Schedule Tribes amongst the surveyed families. 13.3% of project affected people have studied up to primary school, 33.3% up to high school, and 15.4 % up to college level. 62.2% families are nuclear consisting of husband, wife and children, while 37.8% are joint families. The percentage of nuclear families is more in Ahmedabad-Barajedi (78.6%) whereas the percentage of joint families is more in Ahmedabad-Kalol corridor (50%). Most of the families are small 51.4%, 21.6 % are medium, 27% are large in size. The average size of the affected family is 5 persons. About 37.8% of families have their income less than Rs. 25,000/-, 29.73% of them have an income of Rs.25001-50,000/- per annum. About 16.22 % of the families have an income range between Rs.50,001 to 1,00000 per annum. Remaining 16.22% of the families have an income between Rs.1,00,000 to 200,000/- per annum.

0.10.2 MITIGATION MEASURES:

- 3337 trees likely to be lost due to the project. The total value of these trees is Rs. 23.36 lakhs. At least 2 trees for ever tree cut are to be planted.
- The project does not encroach or interfere with any nature reserve or wild life habitat; hence, no mitigation measures are required.
- All the structures of proposed line shall be designed adopting the seismic factors as required for Zone III.
- No historical/cultural monuments will be affected as a result of the proposed development.
- Vegetation (turfing) of side slopes of embankment may be taken up immediately after completion of earthwork in embankment, leaving minimum scope for erosion.

- About 1.21 million cum of earthwork would be involved in the construction of the embankment, which shall to borrow from outside the railway land. About 80.53 hectares of area would be required to borrow the earth. Excavation of earth from the borrow area, if not managed properly, would lead to loss of productive soil, disruption of drainage pattern and water logging/ponding problems.
    - Top soil of the borrow pit, in case of agricultural area, shall be removed and saved. On completion of excavation, this topsoil shall be replaced back over the borrow area to restore its productivity.
- Dust generation is involved in all construction activities in general and during transportation of earth in specific. 360 truck trips would be made every day for the entire length of the alignment. No soil spill shall take place during transportation of soil to construction site.
- Daily inspection of haul roads and at construction site. Dust sealed trucks to be used for the transportation of earth.
- Unscientific disposal of waste from contractor's camp may lead to contamination of both ground and surface water. The solid waste generated in contractor's camp, if not treated properly, may cause leaching and environmental pollution.
- Migration of labour from one place to another may lead to cultural conflicts due to difference in habits of the local and migrated people.
- The individual sewerage disposal systems through septic tank will be adopted for sewage disposal at contractor's office and worker's camps.
- The water during construction phase shall be made available by making bore well or using existing wells within the vicinity of the project site as per requirement of the construction activities. The contractor shall arrange water required for construction in such a way that the water availability and supply to nearby communities remains unaffected.
- The construction of bridges would involve extension of existing bridges in general and does not pose any problem, since the existing waterway shall remain unaffected.
- Ballast and aggregate from existing quarries to ongoing railway projects in the area shall be obtained for the project. Only licensed quarrying operations shall be used for obtaining the material.
- Better maintenance of the railway track and the rolling stock shall reduce the noise pollution.
- The construction and operation of the proposed project will not have any major impact on the surface/ ground water quality in the area.
- Refuse collection and disposal facility shall be provided at each station by the project authorities.

The positive environmental impacts are:

- Quick service and safety
- Employment opportunities
- Benefits to Economy and
- Reduction in Air Pollution

0.10.3 ENVIRONMENTAL MANAGEMENT and MONITORING PLAN:

It is proposed to prepare the Environmental Management Plan for the following: Compensation for loss of land, Compensation for Loss of Trees, Compensatory Afforestation and Fencing, Compensation for loss of agricultural land & crops, Compensation for Relocation/Resettlement, and Water Supply & Sanitation.
The following parameters need to be monitored: - Rehabilitation and Resettlement Program, Afforestation, Soil conservation, Borrow Area Conservation, and Sanitation and Waste Disposal.

0.10.4 COST ESTIMATES FOR MITIGATION MEASURES

All costs involved in environmental mitigation, management and monitoring to be put on the account of the proposed project are summarised in below:

ENVIRONMENTAL COSTS

S. No.	ITEM	Rs. (Lakhs)
1	Compensation for loss of trees	23.36
2	Compensatory Afforestation & fencing	21.90
3	Compensation for Resettlement	60.72
4	Establishment of Environment Division	30.60
5.	Compensation for agricultural land	Considered under project cost
6.	Provision of bins for Railway Station Refuse	3.30
7.	Provision for water supply and sanitation	15.00
	Sub total	154.88
	Miscellaneous items @10%	15.49
TOTAL		**170.37**

0.11 PROJECT COST ESTIMATES

0.11.1 Cost estimates for RRS corridors (1) Barajedi – Ahmedabad – Kalol and (2) Ahmedabad - Naroda have been prepared covering civil, electrical, signalling and telecommunication works, rolling stock, rehabilitation, utility diversions etc. considering 25 KV AC Traction at April, 2005 price level for capital costs and, operation & maintenance costs.

0.11.2 In order to arrive at realistic costs of various items, units costs have been worked out, by adopting prevalent rates of Western Railway for their on going works in Ahmedabad area & have been duly updated to April 2005 price level. Traction & Power Supply, other electrical works at stations, Signalling & Telecommunication works provision has been made at route Km. basis, as per assessment done by DMRC.

0.11.3 Land costs have not been included in the project estimate, since railways will provide the railway land free of cost and Gujarat state Governments have to bear

the cost of Govt. (other than railway) and private land themselves. The state governments will have to acquire the same at their cost and hand over to SPV.

0.11.4 The capital cost for corridor (1) Barajedi – Ahmedabad – Kalol (Route Km 43.487) is Rs. 874.17 crores (For Ahmedabad – Barajedi, it is Rs. 387.33 crores and Ahmedabad – Kalol is Rs. 486.84 crores). The capital cost for corridor (2) Ahmedabad – Naroda (route Km 9.459) is works out to 176.35 crores. Thus overall capital cost of the project worked out to be **Rs. 1050.52 crores**. These costs include general charges @ 8 % on all items except rolling stock and contingencies @ 3 % on all items including general charges. These costs do not include cost of land. The abstract cost estimate is given in table below.

0.11.5 The completion cost with 5% escalation every year works out to Rs. 1322.89 crore.

Abstract Capital Cost Estimate for (i) Barejadi - Ahmedabad - Kalol and (ii) Ahmedabad – Naroda Corridors

S. No.	Description	Cost (Rs. In Crores)		
		Corridor 1-A	Corridor 1-B	Corridor 2
1.0	Civil Engineering works			
1.1	Alignment & Formation			
1.1.1	At-grade Section	35.66	15.96	16.37
1.1.2	Utilities (Civil Works), Rehabilitation & Resettlement	16.74	18.40	6.31
1.2	Important bridge over Sabarmati khari	4.83	17.64	
1.3	Station Buildings, including station infrastructures, FOBs, Platforms, watering arrangement circulated areas	20.04	27.08	11.18
1.4	P. Way	39.11	44.88	22.07
	Sub Total (1)	**116.39**	**123.96**	**55.93**
2.0	Electrical Works			
2.1	Traction Power Supply & other electrical works at stations diversion / modification to HT, LT lines, etc.	**56.00**	**89.80**	**27.20**
3.0	S & T works including Cable diversion Excl. AFC	**80.81**	**129.58**	**39.26**
4.0	Maintenance Depot at Vatva	**17.23**	**27.63**	**8.37**
5.0	Rolling Stock	**84.00**	**72.00**	**30.00**
	Total (except Rolling Stock)	**270.42**	**370.98**	**130.75**
6.0	General Charges @ 8 % on all items excluding Rolling Stock	**21.63**	**29.68**	**10.46**
	Total	**376.05**	**472.66**	**171.21**
7.0	Contingencies 3 % on all items	**11.28**	**14.18**	**5.14**
	Grand Total	**387.33**	**486.84**	**176.35**

0.12 FINANCIAL EVALUATION

0.12.1 FINANCIAL ANALYSIS

Financial analysis is done based on the passenger traffic forecast for RRS trains. The Financial internal rate of return is worked out on the basis of total project costs and generation of revenues.

The costs stream includes:

i) Total project cost
ii) Year-wise additional capital cost required to cater for incremental traffic
iii) O & M cost of RRS system.

The revenue stream includes:

i) Fare Box revenue
ii) Revenue from other sources e.g.
   a) Advertisement
   b) Parking rights
   c) Property development etc.

In absence of any data for other revenue, 5 % of revenue from Fare Box collection is assumed in this case.

0.12.2 The detailed financial analysis is being carried out.

0.13 ECONOMIC EVALUATION

0.13.1 Economic Analysis

The economic analysis of the project is done for both the corridors together as the traffic demand is worked out for the system as a whole. The analysis is carried out on the basis of benefits accrued due to the project by computing the scenario “with project” and “without project”.

The cost and benefits related to the project are worked out as follows:

Cost	Benefits
1. Capital cost of the project including Land cost	1. Saving in Capital cost of existing Transport Modes a) On buses b) Other modes

2. Operation and maintenance cost	2. Saving in O & M cost due to decongestion on roads.
3. Additional capital cost during next 25 years e.g. additional Rolling Stock	3. Passenger time saving 4. Saving in Transport infrastructure and development cost. 5. Saving due to reduced environmental pollution.

All costs / benefits are converted into prices at base year (April, 2005). The cash flow statement indicating the cost and benefits streams are prepared for a period of 25 years.

The EIRR is being worked out.

0.14 IMPLEMENTATION PLAN

0.14.1 IMPLEMENTATION PROGRAMME

The project is proposed for commissioning by March 2010.

For the purpose of implementation the civil and general services works are proposed to be executed in following seven packages :

Package I	Sabarmati Bridge – Khodiyar (except Sabarmati Bridge)
Package II	Khodiyar - Kalol
Package III	Sabarmati Bridge – Vatva
Package IV	Vatva – Barajedi (Except Khari Bridge)
Package V	Saraspur - Naroda
Package VI	Khari Bridge and Sabarmati Bridge
Package VII	Vatva Depot

In addition, 5 separate contract packages are recommended for :

1. Track works
2. Traction and Power supply
3. Signalling and Telecommunication
4. Depot equipment supply and installation
5. Rolling stock procurement

Advance action need to be taken regarding formation of SPVs, arranging finances, land acquisition, rehabilitation of project affected persons, rebuilding of railways offices and quarters proposed for dismantling and preparation of detail design/drawings and tender documents for timely commission of the project.

0.14.2 Implementation strategy and Financing Plan

For the purpose of implementation of project, it is proposed to form special purposes vehicles (SPV) comprising representatives from Ministry of Railways (MOR) and Government of Gujrat (GOG). Recommended Project financing is on the basis of debt: equity ratio of 1: 1. Debt component may be a combination of soft loan and market borrowings with an average interest rate of 8 % per annum. The equity component will be shared by MOR and GOG in equal proportion. Thus the share of each stakeholder shall be Rs. 331 crore which is to be invested over 4 years.

0.15.1 RECOMMENDATIONS

i) Formation of SPV to be done on priority, so that the project can be started immediately.
ii) Land acquisition has to be given top most priority so that no delay is there in the execution of the project.
iii) Some staff quarters and railway offices falling on the RRS alignment are getting affected. Priority to be given for construction of alternative accommodation for rehabilitation.
iv) Since construction of major bridges like Sabarmati Bridge, Khari River would take long time, top most priority has to be given in deciding the design and awarding the contract for the same.
v) Dialogue with Railway Board to be started for early implementation of the project.

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