AHMEDABAD BUS RAPID TRANSIT SYSTEM (ART)

DRAFT WORKING PAPER -9
ENVIRONMENTAL IMPACT ASSESSMENT

JUNE 2006

Gujarat Infrastructure Development Board (GIDB)

Ahmedabad Municipal Corporation (AMC)

Ahmedabad Urban Development Authority (AUDA)

Centre for Environmental Planning & Technology University, Ahmedabad

AHMEDABAD bus RAPID TRANSIT SYSTEM (ART)

"Buses, More Buses, Better Buses"

The present initiative of Gujarat Infrastructure Development Board (GIDB),Government of Gujarat, in collaboration with Ahmedabad Municipal Corporation (AMC) and Ahmedabad Urban Development Authority (AUDA), to develop BRTS is in recognition of the fact that no single mode will completely serve the accessibility and mobility needs of the city, and the bus system, both in its basic form (regular bus) and rapid form (Bus Rapid Transit System), makes it a critical and major component in an integrated transit system of any mega city.

Steering Committee

The Bus Rapid Transit Project for Ahmedabad city has been guided by the steering committee chaired by Shri. K. Kailashnathan, (I.A.S), Secretary, Urban Development and Urban Housing Department, Government of Gujarat.

Mr. K. Kailashnathan
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Chairman, Ahmedabad Urban Development Authority (AUDA)

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Preface

BRTS consists of several components designed to function together so as to generate superior services, which are comparable with other mass rapid transit system including metro rail system. Some or all of these elements are integrated to form BRTS, which will ensure fast, reliable, secure, high capacity service, which also has a distinct identity.

Elements of BRT

CHARACTERISTICS	System Performance				
	Travel Time Savings	Reliability	Identity and Image	Safety and Security	Capacity
RUNNING WAY					
Running Way Segregation	•	•	•	•	•
Running Way Marking			•		
Running Way Guidance	•		•	•	
STATIONS					
Station Type	•		•	•	•
Platform Height	•	•	•	•	•
Platform Layout	•	•			•
Passing Capability	•	•			•
Station Access			•	•	
VEHICLES					
Vehicular Configurations	•	•	•	•	•
Aesthetic Enhancement			•	•	
Passenger Circulation Enhancement	•	•	•	•	•
Propulsion Systems	•		•		
FARE COLLECTION					
Fare Collection Process	•	•	•		•
Fare Transaction Media	•	•	•	•	•
Fare Structure	•		•		•
INTELLIGENT TRANSPORTATION SYSTEMS					
Vehicle Prioritization	•	•	•		•
Driver Assist & Automation Technology	•	•	•	•	•
Operations Management	•	•		•	•
Passenger Information	•	•	•	•	
Safety and Security Technology				•	
Support Technologies					•
SERVICE & OPERATING PLANS					
Route Lengths		•			
Route Structure	•		•		
Span of Service		•			
Frequency of Service	•	•		•	•
Station Spacing	•	•			

The system being planned in Ahmedabad will have most of these components. While planning for the system, several issues have to be addressed. These may be with regard to the advantages of inclusion of a component, the way to include the component in terms of its type, magnitude or quality etc., It is necessary that these issues are addressed both at the general principal level as well as at the specific design level for Ahmedabad.

As the BRTS concept for Ahmedabad is being developed, for better decisions a wider debate within the planning and design team as well as with the professional circle is necessary. Wider information dissemination is also required. To facilitate this, a series of working papers have been planned.

We would like to thank Lea Associates South Asia Ltd., New Delhi our partners in planning and design of the project. ITDP New York is providing technical support to CEPT in preparation of BRTS project. We express our gratitude to Mr. Walter Hook, Ms. Shreya Gadepalli and their colleagues.

Prof. H.M. Shivanand Swamy
Team Leader

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1. ENVIRONMENTAL SETTING OF PROJECT CORRIDORS

1.1 NATURAL ENVIRONMENT

In this section an attempt has been made to prepare a baseline environmental setting so as to compare and monitor the predicted negative and positive impacts resulting from the project. Data was collected from secondary sources for the environmental resources relevant to the study. However, the quantity and quality of data varies.

NATURAL ENVIRONMENT

Climate

Ahmedabad City lies between 22 ^{o} 55' and 23 ^{o} 08' North Latitude and 72 ^{o} 30' and 72 ^{o} 42' East Longitude. The city is devoid of any major physical features except for the river Sabarmati, which is a perennial river cutting the city into two parts: eastern walled city and western Ahmedabad on either side of its banks.

Climate plays a vital role in determining the landforms and the productivity of ecosystems as well has an influence on the pollution loads on the environment. Rainfall, temperature, and winds are the principal climatic factors that serve to transport, disperse various forms of pollution into the atmosphere and on the ground.

Temperature:

The temperatures in the city vary from average 14 ^{o} C in the month of January to 42 ^{o} C In the month of May. But the temperatures dip to as much as 5 ^{o} C during December-January and increase to about 45 ^{o} C in May. The highest recorded temperature is 47.8 ^{o} C on 27th May 1916 while the lowest is 2.2 ^{o} C on 6th Feb 1920.

Rainfall:

Ahmedabad has a tropical monsoon climate, which is hot and dry, except in the rainy season. The average annual rainfall of the area is 782mm, although there is a considerable variation from year to year. It occurs generally during the months of June to September. During this period the average rainfall is of the order of 713 mm. while the single day highest rainfall 199.7 cm was recorded in 1918 while the minimum was 21.4 cm. The average relative humidity is 60% which ranges from 80% to 90% during rainy season.

The state of Gujarat exhibits a variety of climatic characteristics. Principally, it is a transition between the heavy monsoon rainfall areas of the Konkan and the arid areas of Rajasthan. In general the state exhibits a Tropical Composite or Monsoon climate. The principal seasons are shown in **Table 1.1** below

Table 1.1: Broad Seasonal Duration in Gujarat

Seasons	Months (from)	Months (to)
Winter	November	February
Summer	March	May-June
Monsoon	June-July	October

Source: Planning Atlas of Gujarat

Wind:

Wind direction, speed, and seasonal variation determine the manner in which air pollutants from vehicle emissions are dispersed. High wind velocities may also cause soil erosion both, during the dry and the wet season.

- During the dry months high wind speeds, above 16km/h, are liable to cause soil erosion in areas of loose soil.
- Heavy rain, which is a function of rainfall intensity and wind velocity, is one of the major causes of soil erosion during the rainy season.

During summers, especially in the month of May, south-west Gujarat experiences very high; wind speeds, more than 20km/hr Appropriate drainage in high rainfall areas is required to protect the pavement surface and the road embankments.

1.1.1. Physical setting

The physical environment of a region is a direct result of the geologic history, the resulting landforms and the processes of nature, which shape the terrain. The design of roads should utilise the landforms, lithological character and structural details of the areas through which they pass.

The geographical boundaries of Gujarat incorporate a mosaic of landforms evolved through the interplay of endogenetic processes of mountain building and vulcanism and then modified by exogenetic forces of weathering often under various types of sedimentary environments. Ahmedabad lies in Central Gujarat Plateau

Seismology and Geology

Geologically, the project area forms part of the Cambay Sedimentary basin and is underlain by Post-Miocene alluvium, both Aeolian and fluvial, composed of sand , silt, gravel and clay. The surface cover is mainly fine sand and silt of blown nature and has about 25-40 m thickness. Ahmedabad falls within the type IV zone with a moderate seismic coefficient. Major rock types available in project area are Calcareous sandstone and shales. The associated minerals are Silica, sand and Fire Clay. Topographically, the area is characterised by flat terrain with a very gentle slope towards river Sabarmati. Elevations range from 60 m north of the city to 40 m south of the city.

1.1.2 Hydrological Setting

A highway project can significantly alter the hydrological setting of an area. It can add to the siltation and the pollution level in the water sources. At the same time it may act as an impediment to the natural drainage pattern. The identification and mitigation of such adverse impacts assumes greater significance in water scarce regions such as Gujarat.

Surface water

Surface water bodies include drainage channels (rivers, streams and canals) and water bodies (lakes, ponds, tanks and impounded water bodies). River Sabarmati is the main water body and the principal feature around which Ahmedabad city has developed. It is a seasonal river with freshwater flows occurimg during the monsoon (June to September) only. A riverfront development project is underway.

Ground Water

Groundwater constitutes a major source of water supply for Ahmedabad City. AMC has been operating about 336 tube wells. However, with the recent availability of water from Raska weir, 75 of the tubewells are going to be decommissioned. Constant and large withdrawals of groundwater have resulted in a rapidly depleting water table level at the rate of 2.0-2.5 meters per year.

Groundwater potential

The Groundwater estimation committee of CGWB has estimated the ground water potential of Ahmedabad city is as under:

Utilizable ground water recharge (ham/year)	12635
Gross draft (ham/year)	15555
Net irrigation requirement (m)	0.48
Irrigation potential created (Ha)	32406
Ground water balance (ham/year)	-2920
Stage of Development	123.11
Category	Over Exploited

As seen from the above, the ground water in the area has been over-exploited and there is an urgent need to augment the same by artificial methods.

Water Quality

Groundwater is being developed extensively by means of tube wells from deep confined aquifers for water supply both in domestic and industrial sector. A road project can significantly alter the hydrological setting of an area and add to the siltation and pollution of adjacent water sources.

Ground Water quality of Ahmedabad city is given in **Table 1.2.**

Table 1. 2: Groundwater Quality of Ahmedabad

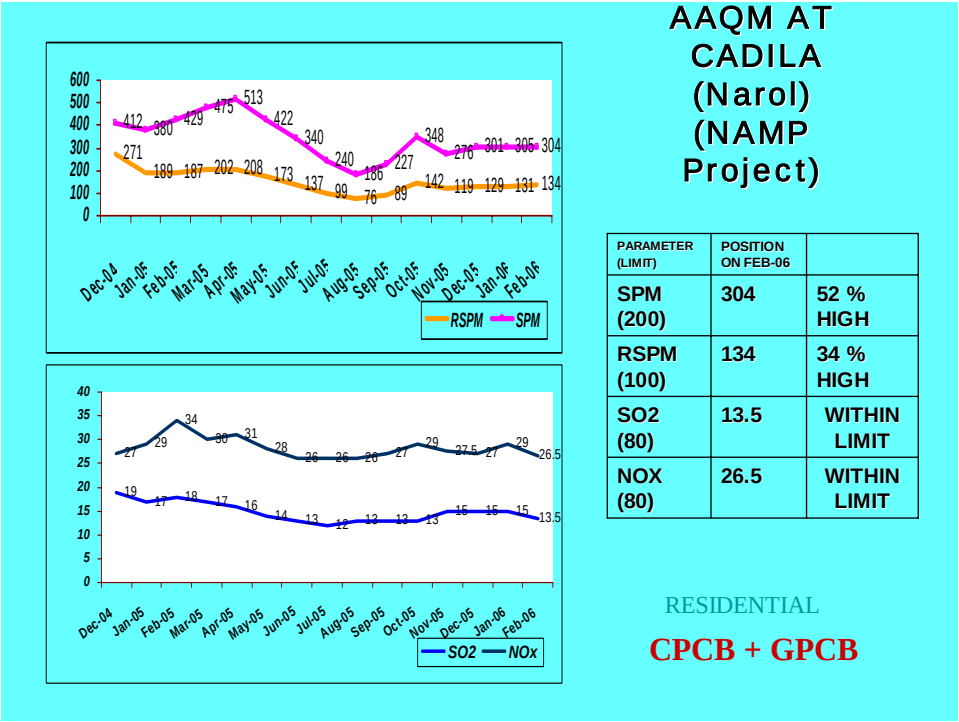
Parameter	Range
pH	7.9-8.2
Electrical Conductance (EC)	1500-3000
CO3	Nil
HCo3	200 - 787
CL	284 -709
NO3	40 - 217
SO4	149 - 470
F	0.65 - 1.2
Ca	12-86
Na	140-750
Total hardness	80-675

1.1.3 Ambient Air Quality

Ambient air quality refers to the background air quality levels in a region, characterised by concentrations of various pollutants in the atmosphere. The presence of air pollutants and their concentrations depends on the type of polluting sources, and other factors that influence their flow and dispersion.

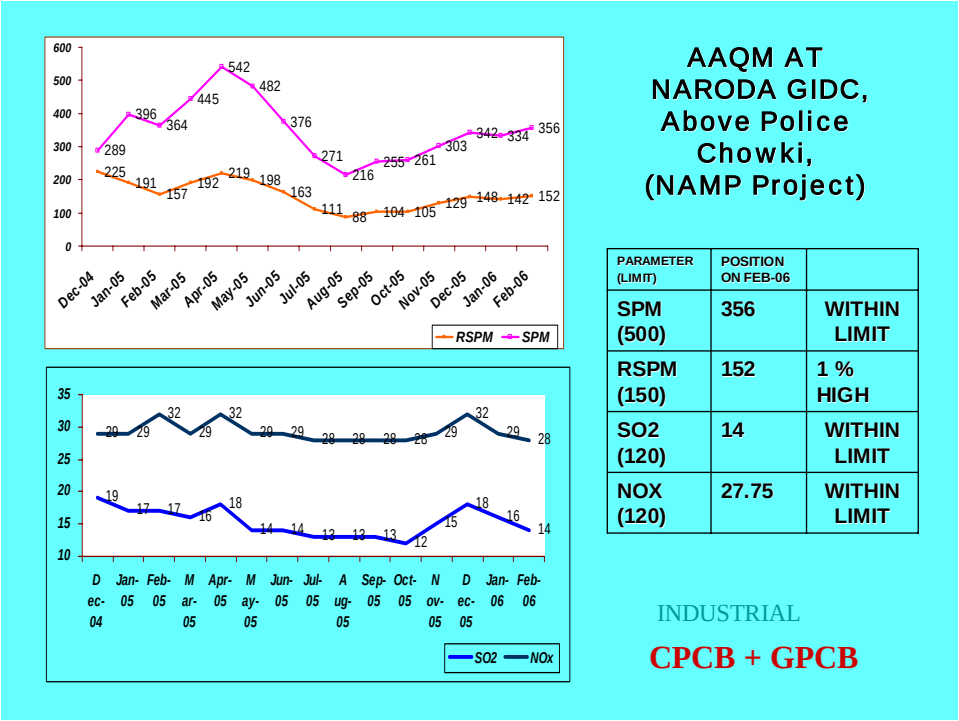
The activities, which generate major atmospheric pollution, are transportation (i.e., motor vehicle emissions, which are addressed in this study); industry; domestic and construction. The major pollutants of significance to roadside air quality, on account of vehicular emissions, are suspended particulate matter (SPM), respirable particulate matter (RPM), sulphur dioxide (SO_2), nitrogen oxides (NO_x), hydrocarbons (HC), carbon monoxide (CO) and lead `(Pb).

Ambient air quality data is monitored by GPCB for various stations. Monthly averages of SPM, NOx and SOx levels for CADILA (Narol) and fof GIDC-Naroda are shown in Figs 1.1 and 1`.2



PARAMETER (LIMIT)	POSITION ON FEB-06	
SPM (200)	304	52 % HIGH
RSPM (100)	134	34 % HIGH
SO2 (80)	13.5	WITHIN LIMIT
NOX (80)	26.5	WITHIN LIMIT

Fig 1.1 Ambient Air Quality at CADILA



PARAMETER (LIMIT)	POSITION ON FEB-06	
SPM (500)	356	WITHIN LIMIT
RSPM (150)	152	1 % HIGH
SO2 (120)	14	WITHIN LIMIT
NOX (120)	27.75	WITHIN LIMIT

Fig 1.2 Ambient Air Quality at GIDC-Naroda

Emission factors of vehicles

Vehicles commonly found in the project corridor are 2-wheelers, 3-wheelers, cars, light commercial vehicles (LCVs), tractors, mini-buses, buses, and the trucks, which include 2 axle, 3 axle, multi-axle ones. Mass emission factors are dependent on the fuel type consumed (say, petrol or diesel) and the type of vehicles. Of the above, petrol consuming vehicles are 2-wheelers, 3-wheelers and cars, whereas the rest consume diesel.

Emission factors formulated by the Government of India are revised periodically. From April 1996, the vehicles were required to comply with some stringent emission standards. The 1996 standards have been used for computations in this project. The emission factors for different types of vehicles are given in the **Table 4.3.**

Table 1.3: Emission Factors for Vehicles[1]

Vehicle Type		Pollutant Emission Factors (g/km)				
		CO	HC + No_x	SPM *	Pb*	SO_2*
Petrol driven	2 wheelers	4.5	3.6	0.1	0.006	–
	3 wheelers	6.75	5.4	0.1	0.006	–
	Cars	8.68-12.4	3.0 - 4.36	0.04	0.016	0.1
Diesel driven	Buses	17.92	4.0	1.45	–	2.0
	Trucks	17.92	4.0	1.45	–	3.0

Source : GoI, CPCB, 1997.

1.1.4 Ambient Noise

Noise is defined as the unwanted sound that adversely affects the quality of human life by way of interference with speech, communication, disturbance of sleep, distraction from work and causing annoyance. Noise is generated during both, road construction as well as road operation activities. Ambient noise is the noise, which persists, in the surrounding ambient environment. Ambient noise is the result of the various ongoing routine and general activities in the area. Noise levels are rarely steady due to the various activities taking place in the area.

Road construction results in increase in noise levels due to movement and operation of machinery, heavy vehicles, loading and unloading of construction materials, apart from high noise levels at the asphalt plants (90 - 100 dB (A). These activities are intermittent and localised. During the operation phase, noise is generated from vehicle movement in three ways, namely from the vehicle body parts, from the tyre-roadway system (also known as the rolling noise) and from the driver behaviour, such as use of horns.

Ambient Noise Standards

Ambient noise standards were established as per the CPCB/MoEF Gazette Notification dated 26th December 1989. It is based on the 'A' weighted equivalent noise level, L_{eq} **(Refer Table 1.4).**

Table 1.4: National Ambient Noise Standards[2]

Area Code	Category of Zones	Day* limits of L_{eq} (dB(A))	Night* Limits of L_{eq} (dB(A))
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence Zone **	50	40

Source: GoI, CPCB, 1989

Noise Levels in various parts of the city are shown in **Table 4.5**. The maximum noise levels in the city were as high as 110 dBA at Relief Road during peak hours. Noise levels in the University area were around 72 dBA, which is higher than the prescribed limit of 50 dBA for silence zones.

Table 1.5 Noise on Major Roads of Ahmedabad

	Time	Ashram Road	Drive in Road	C.G.Road	Gandhi Road
Permissible Limits for Noise as per CPCB Guidelines					
Residential Area : Day Time -55 Night Time - 45					
Commercial Area: Day Time – 65 Night Time - 55					
L-max	9-11 a.m.	101	99	102	105
L-max	5-7 p.m.	105	99	99	108
L10	9-11 a.m.	84	78	81	84
L10	5-7 p.m.	82	79	82	85
L50	9-11a.m.	87	68	67	79
L50	5-7 p.m.	79	69	70	80
L90	9-11 a.m.	60	58	57	74
L90	5-7 p.m.	73	58	60	71
All units are in dBA					

1.1.5 Flora

Gujarat contains a great diversity of natural ecosystems ranging from desert, semi-arid lands, mangroves and coral reefs in the west, to dry deciduous forests in the central and northern zone and moist deciduous and evergreen forests in the south. To stop rapid depletion of the residual forests, the GoG has initiated a number of afforestation and conservation programmes in recent years.

Tree plantations within the RoW

Trees occur very close to the existing road pavement. The reason for such occurrence is twofold: first, the trees become closer to the pavement due to the sequential widening of pavements/roads. As a sum total 195 numbers of trees are existing in the RoW of Narol to Thakkarnagar Corridor while 225 numbers of trees are existing in the RoW of Thakkarnagar to Chiloda Corridor.

The initiative undertaken by the MoEF to increase the forest cover nation-wide to 33 percent (National Forest Policy, 1952) gave rise to the creation of the Social Forestry Programmes which involve local communities in the planting and maintenance of plantation forests. Community plantation has been done at various places in the corridor.

Forests/Reserve Forest

No restricted /reserve forest is located within the study area.

1.2 Social Environment

1.2.1 Demographic Trends

The Greater Ahmedabad Urban agglomeration covering an area of about 4200 sq. Km is an amalgam of:

- an area of 190 square kilometres under the jurisdiction of Ahmedabad Municipal Corporation (AMC) and
- 150 villages in the periphery of the city under the jurisdiction of Ahmedabad Urban
  Development Authority (AUDA)5,
- Municipalities in the periphery of the city under the jurisdiction of Ahmedabad Urban Development Authority (AUDA),
- Gandhinagar and the surrounding villages,
- Chatral, Bhopal and other surrounding villages adjoining AUDA limits

The population in the AMC limits increased to 35.15 lakh in 2001 from 28.77 lakh in 1991.The population of AUDA area in 1991 was 38.75 lakh. The Ahmedabad Urban Agglomeration (AUA) housed 23.25 % of the State's urban population in 1991, which has gone up to about 25% in 2001. Compared to metropolises in India Ahmedabad has a lesser degree of primacy and urban population is spread evenly across other metropolitan and class I cities in the State.

The AMC area is spread over 190.84 sq km, the AUA area is about 350 sq km and AUDA area is 1330.08 sq km. Spatial distribution of this population within the city over the decades shows that up to 1981 most of the new population added to the city was concentrated within the old AMC limits itself, especially in the eastern part. Expansion of the peripheral areas began in the 1980s and has continued. Earlier only the eastern parts especially the eastern periphery registered faster growth rate, but since the 1980s even the western periphery has grown rapidly. The population growth of city is shown in **Table 1.6.**

Table 1.6 Population Growths – Greater Ahmedabad

Spatial Unit	Population		
	1981	**1991**	**2001**
1. Ahmedabad Municipal Corporation (AMC)	**2159127**	**2876710** (2.9)	**3520085** (2.0)
1.a Walled City	476138	398410 -1.8	372633 - 0.7
1.b. East AMC	1122073	1902868 5.4	2521013 2.9
1.c West AMC	463922	575433 2.2	675362 1.6
2. A.U.D.A.	**2721925**	**3756246** 3.3	**4709180** 2.3
2.a East AUDA	101144	128999 2.5	202494 4.6
2.b West AUDA	204923	457271 8.4	701424 4.4
2.c AUDA (Rural)	209826	246560 1.6	274391 1.1
3. Kalol	78407	92550 1.7	112013 1.9
4. Mehemdabad	22309	26103 1.6	30768 1.7
5. Dehgam	24868	31378 2.4	38082 2.0
6. Sanand	22465	25674 1.3	32417 2.4
7. Other areas outside AUDA	**264555**	**309871** 1.6	**334531** 0.8
8. Gandhinagar	**199353**	**280234** 3.5	**373663** 2.9
8.a. Gandhinagar (GNA)	62443	123359 7.0	195926 4.7
8.b. Rest of Gandhinagar	136910	156875 1.4	177737 1.3
GREATER AHMEDABAD	**3185833**	**4346351 3.2**	**5417374 2.2**

Source: Respective Census Documents

Note: Figures in parenthesis indicate annual compound growth rate

The greater Ahmedabad area has grown at a moderate rate. Growth rates have declined from 3.2 and 2.2 percent compounded per annum during the past two decades. However, the rates vary across different spatial units. The population within the AMC limits appears to approach stabilization level. The areas adjoining AMC, falling within AUDA limits have shown rapid growth. Gandhinagar is also experiencing relatively high rate of growth.

Table 1.7: Population Density

Spatial Unit	Persons Per Hectare		
	1981	1991	2001
1. Ahmedabad Municipal Corporation (AMC) Spatial Unit	113	151	184
1.a Walled City	716	599	560
1.b. East AMC	79	134	178
1.c West AMC	109	135	159
2. A.U.D.A.	11	61	77
2.a East AUDA	6	7	11
2.b West AUDA	13	28	43
2.c AUDA (Rural)	12	14	16
3. Kalol	27	31	38
4. Mehemdabad	19	22	26
5. Dehgam	11	13	16
6. Sanand	6	7	9
7. Other areas outside AUDA	8	9	10
8. Gandhinagar	5	7	9
8.a. Gandhinagar (GNA)	24	47	75
8.b. Rest of Gandhinagar	4	4	5
GREATER AHMEDABAD	12	16	20

1.2.2 Land-use in AUDA area

Of the total AUDA area of 1294.65 sq. km, 50 percent is built up area. Water bodies and wastelands cover 12 percent and 17 percent of area respectively. Industries cover 9 percent of the area. As per the State Government Policy, no major industrial development within 24 kms of AMC limit is permitted in AUDA area. Considering existing development conditions certain area for industrial use is designated forlight industry as well as for general industry, along with existing industries at Vatwa, Naroda and Odhav (all lying within AMC), which forms nearly 10.38 percent.

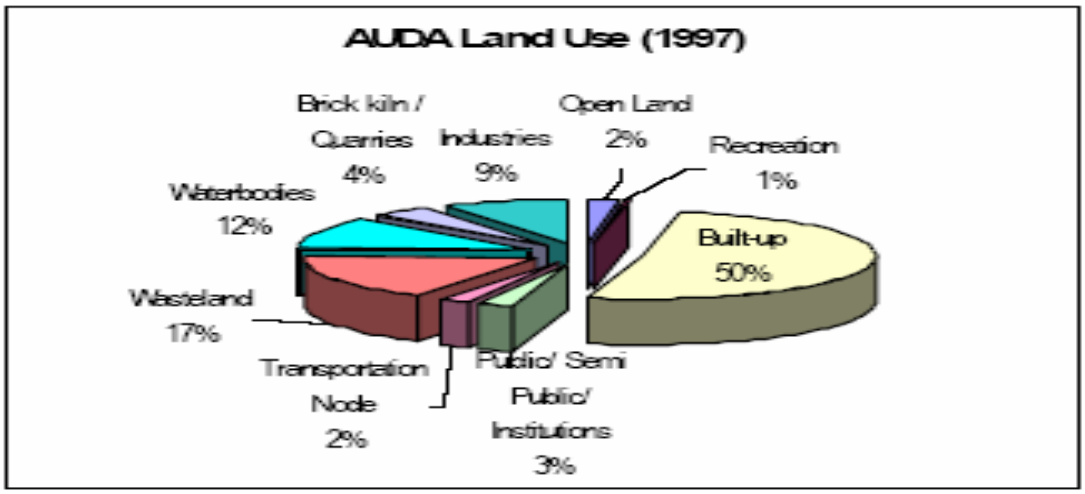


Fig1.3 Land Use of AUDA area (1997)

Land Use in AMC area

As per existing land use (1997), more than one third (36%) of total area is under residential use, followed by 15 percent of the area under the industries. Large tracts of land (23.44%) are lying vacant, mostly in the newly acquired area of the AMC. Only 9.5 percent of the total area is under transportation network as against the norm of 15-18 per cent as
Specified by UDPFI norms.

Table 1.8 Land Use in AMC Area

Existing land use for AMC area (1997)				Proposed land use for AMC (2011)		
Sr No	Use/ Designation	Total Area (Ha.)	% Of Total Area	Use/ Designation	Total Area (Ha.)	% Of Total Area
1	Residential	6664.44	34.92	Residential	8340.22	43.70
2	Commercial	472.64	2.47	Walled City and Village Sites(Gamtal)	645.56	3.38
3	Industrial	2932.78	15.37	General Industrial	2006.51	10.51
4	Open / Vacant Land	4473.36	23.44	Special Industrial	786.72	4.12
5	Village Site / Gamtal	895.59	4.69	Commercial	263.06	1.38
6	Education	344.19	1.80	Agricultural / Recreational / Open Space / Gardens	1643.60	8.61
7	AMC Plots	467.18	2.45	Education	387.30	2.03
8	Hospitals	98.36	0.52	Area Under Reservations now designated as special development area	1955.37	10.25
9	Burial Ground / Grave Yard	86.54	0.45	Roads and railways	2117.67	11.10
10	Water bodies	850.55	4.46	Water bodies (including rivers)	937.97	4.92
11	Roads	1426.65	7.47			
12	Railway land	372.00	1.96			
	Total	19084.00	100.00	Total Area	19084.00	100.00

Source: Revised Draft Development Plan of AUDA – 2011AD Part I ,Vol 2

1.2.3 Employment Distribution

The Ahmedabad Urban Agglomeration has a population of 45 lakhs (2001) of which 78 per cent of the population is residing within the municipal area. Ahmedabad has been theprimate city of Gujarat, being the largest in terms of the population size. It presently holds 23 Percent of state's urban population and holding sixth position in the entire country in terms of
Population size (2001). The city continues to be relatively compact. Some industrial activity
has spilled over to the periphery. Containing sprawl tendency is a necessity. Transit oriented
development needs exploration. Central and eastern zones have lost employment opportunities. Focus on these areas would be an additional contribution.

The major employment zones in the study area are primarily located in the industrial belts of
Naroda, Odhav and Vatva. Old city continues to be a major trading area. C.G. road and Ashram road have emerged as important commercial hubs in the city. Now SG highway and
132ft ring road have started showing similar development trends.

Table 1.9 Occupational status of Ahmedabad (1991)

Category of Workers	Persons	Male	Female
A. Category of Main Workers			
1. Cultivators	3589	3181	408
2. Agricultural Labourers	2755	2223	532
3. Livestock, Forestry, Fishing, Hunting and Plantations, Orchards and Allied Activities	5740	5166	574
4. Mining and Quarrying	2085	1992	93
5. Manufaturing, processing, Servicing and Repairs			
(a) In Household industry	6811	3813	2998
(b) Other than Household Industry	318352	306503	11849
6. Constructions	38966	35913	3053
7. Trade and Commerce	215950	203692	12258
8. Transport, Storage and Communication	77636	74087	3549
9. Other Services	182817	140435	42382
Total Main Workers	854701	777005	77696
B. Marginal Workers	10323	3756	6567
C. Non-Workers	2089502	783926	1305576

Source: Census 1991

1.3 Cultural Environment

There are local community cultural resources such as temples and shrines, which share mutual interests with highways that enhance the quality of experience of highway travelling. Cultural properties give a direct indication of the social quality of a place. The number and typology of religious structures can be directly co-related to the religious value of the place while the structures themselves can be indicators of the religion prevailing in the area. Strip mapping carried out on the project corridor was the source of identification of the affected cultural properties falling within and just outside the RoW of Corridor

Table 1.10 summarizes the principal features of the laws that form the basis of planning, construction and operation of the Project in relation to the social and cultural environment.

Table 1.10: The Legal Framework – Social and Cultural Environment

Laws / Regulations	Relevance
The Land Acquisition Act, (Amended up to 1984)	Governs acquisition of land under eminent domain for defined public purposes and compensation therefor.
The Environmental Impact Assessment Notification, 1994	Makes the preparation of a project-specific RAP mandatory. The RAP must address, among other things; protection against loss of livelihood; community support systems and infrastructure; loss of productive resources and minimization of displacement. The GoI, MoEF Notification of 10 April 1997 empowers the State Pollution Control Board to hold public hearing for all projects requiring environmental clearances from the MoEF.
The Ancient Monuments and Archaeological Sites and Remains Act, 1958.	Area within 100m of protected property is protected and within 300m is a zone of controlled development; any development within such areas requires prior authorization of the ASI.

Table 1.11 Cultural Properties along Corridor

Place	Location (Ch)	Distance from edge of pavement (m)	Direction w.r.t RoW(Thakkarbapanagar to Narol)
Lilanagar(Bapunagar approach road)	26.848	3	Right
Lilanagar	26.85	0.5	Left
Chamundanagar	26.09	12	Left
Biratnagar	25.76	12	Right
Biratnagar	25.635	13	Left
Rajratna Society	25.425	16	Right
Rajratna Society	25.405	15	Right
Rabari Colony	23.09	13	Right
Ajay Tenament	22.935	12	Right
Kanhaiya Apartment	22.78	3	Left
Jashoda Nagar	2.5	16	Left
Jashoda Nagar	2.52	3.50	Right

Cadila Bridge	2.82	7.5	Right
Cadila Bridge	2.9	0.5	Left
Madhuvan park Society	3.58	2.6	Left
Jay Bhimnath Society	4.025	1.8	Right
Darmadev Nagar Society	4.19	3.5	Right
Darmadev Nagar Society	4.22	3.5	Right
Vatva Cross Road	4.7	2	Left
Vatva Cross Road	4.725	11.28	Right

1.3.1 Relocation of the cultural property

Depending upon design imperatives such as available width of the carriageway, requisite design speeds at vertical and horizontal curves cultural properties in close proximity in the road corridor are subjected to hazard from speeding vehicles. Relocation of the cultural property is to be carried out in consultation with the concerned community.

1.3.2 Redefining access of the cultural property from the road

In case of some cultural properties it has been observed that by virtue of their being located on the edge of the carriageway, these properties are being accessed from the road thereby endangering the safety of the users. In such cases, the project proposes to redefine the accesses.

2. ASSESSMENT OF POTENTIAL IMPACT

Impacts, in the case of this project, can occur at any one of three stages the road development project:

- the planning and design stage;
- the construction stage and;
- the operational stage,

2.1 POSITIVE ENVIRONMENTAL IMPACTS

Based on project particulars and existing environmental conditions, potential Impacts have been identified that are likely to result from the proposed BRTS project.

The positive environmental impacts are listed below:

- Reduction in Traffic congestion,
- Reduction in road accidents
- Quick and improved service and safety,
- Less fuel consumption,
- Reduction in Air Pollution,
- Faster city traffic movement for all modes.

2.2 NATURAL ENVIRONMENT

New road construction may involve little to large alterations in physiography and drainage. The impacts on physiography include destabilisation of slopes due to cut and fill operations. For a clarification of the inter-relation between road project activities, the project cycle and their related effects on the natural environment is shown in Table 5.1

Table 2.1: Impacts on the Natural Environment

Project Activity	Planning and Design Phase	Pre-construction Phase		Construction Phase					Road Operation	Indirect effects of operation or Induced development
Env. component Affected	Land acquisition	Removal of Structures	Removal of trees and vegetation	Earth works including quarrying	Laying of pavement	Vehicle & Machine operation & maintenance	Asphalt & crusher plants	Sanitation & Waste (labour campus)	Vehicle operation	
Soil	Loss of productive soil	Generation of debris	Erosion and loss of top soil	Erosion and loss of top soil		Contamination by fuel and lubricants Compaction	Contamination Compaction of soil	Contamination from wastes	Spill from accidents Deposition of lead	Change in cropping pattern
Water		Siltation due to loose earth	Siltation due to loose earth	Alteration of drainage Break in continuity of ditches Siltation, Stagnant water pools in quarries.	Reduction of ground water recharge area	Contamination by fuel and lubricants	Contamination by asphalt leakage or fuel	Contamination from wastes Overuse	Spill Contamination by fuel, lubricants and washing of vehicles	Increased contamination of ground water
Air		Dust generation during dismantling	Reduced buffering of air and noise pollution, Hotter, drier microclimate	Dust generation	Asphalt odour	Noise, dust, pollution	Noise, soot, odour, dust, pollution	Odour / smoke	Noise, dust, pollution	Noise and other pollution
Flora		Loss of Biomass		Lowered productivity Loss of ground for vegetation		Removal of vegetation	Lower productivity Use as fuel wood	Felling trees for fuel	Impact of pollution on vegetation Lowered productivity Toxicity of vegetation.	
Fauna			Disturbance Habitat loss	Disturbance		Disturbance	Disturbance	Poaching	Collision with traffic	Distorted habitat

2.2.1 Climate

Although there are no adverse effects on the macro-climatic conditions (precipitation, temperature and wind) within the road corridors, microclimate maybe temporarily modified by vegetation removal and the addition of increased pavement. The negative impacts are mainly restricted to the areas adjacent to the road. There may be an increase in daytime temperatures on the road surface and soil due to the loss of shade trees. However, replanting of trees will eventually result in the re-establishment of canopy in 10 to 15 years.

2.2.2 Physiography

Road construction may involve some alterations in the local physiography and drainage patterns. The impacts on physiography may include destabilisation of slopes due to cut and fill operations. Only a slight increase in the height and width of the current highway cross-section will occur. Minor cut-and-fills will be designed for improvement to the road geometry, and parallel cross structure will be added to improve drainage. Any negative impacts arising out of these activities will be minor, long term, but reversible.

2.2.3 Drainage

The drainage improvements can, in some corridors be considered a positive impact to local residents and villages. Longer-term negative minor impacts may arise if these fill slopes are not re-vegetated or stabilised. No disruption to, or diversion of, existing regional drainage systems is proposed, but there will be slight alterations in drainage characteristics due to the

above-mentioned topographical changes.

2.2.4 Impacts on soil

Soils, within and outside the RoW, may be negatively impacted due to the proposed widening and strengthening of the roads. Within the RoW, any adverse impact is due to the actual construction; whereas, areas outside may be only temporarily affected if they serve as traffic detours, borrow areas, quarries and for hot mix plants.

Contamination of soil can take place both during the construction and operational phases of any road project. The sites wherein construction vehicles are parked and serviced are usually contaminated because of leakage or spillage of fuel and lubricants. Pollution of soil can also occur in areas where hot-mix plants are located because of leakage or spillage of asphalt or bitumen. Refuse and solid waste from labour camps can also contaminate the soil. During the operation phase of the road, soil pollution, due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment should they occur. Contamination of soil may be considered a major long-term residual negative impact.

2.2.5 Impacts on Water Resources

Water resources may be adversely impacted in a number of ways during the various phases of a road project. Road projects can reduce water quality in nearby surface water bodies through construction and operation phases. The water quality may be degraded during construction due to the disposal of solid and liquid waste from labour camps, fuel and lubricant spills or leaks from construction vehicles, fuel storage and distribution sites and from bitumen or asphalt storage at hot-mix plants. In the operational stage, pollutants from vehicles and accidental fuel spills may also make their way into the receiving environment. The major pollutants of concern are suspended solids salts, oil and grease, lead and other metals.

Removal of trees and vegetation can lead to erosion of soil and the siltation of water bodies. Contamination of water resources by fuel and lubricants can also occur as a result of operation and maintenance of vehicles and machinery. Contamination from solid and liquid wastes may result from improper sanitation and waste disposal in construction camps or other areas of construction activity along the roads. **Table 5.2** lists the major adverse impacts on the water resources and the indicators chosen to assess the impacts for this study.

Table 2.2: Impacts on Water Resources due to Construction Activities

Impacts Due To Construction	Indicators
Loss of water bodies	Area of water bodies affected
Loss of other water supply sources	Number of wells affected
Alteration of drainage, run off, flooding	No. of cross drainage channels
Depletion of Ground Water recharge	Area rendered impervious
Use of Water Supply for Construction	Quantum of water used
Contamination from fuel and lubricants	Nature and quantum of contaminators

Impacts Due To Construction	Indicators
Contamination from improper sanitation and Waste Disposal in Construction Camps	Area of camp / disposal site and, proximity to water bodies / channels

In a water scarce state like Gujarat, the use of water for road construction may place a significant demand upon local water supplies. Water is used for compaction, suppression, concrete and foam work. However, these activities do not require high quality of water. So sources, which are not used by the community for lack of quality for intended use, may be utilised for road projects. The over all impact may be considered minor and short-term, as the strain on supply will cease after construction is complete. The purchase of water by the contractor may be considered a small positive impact for local water-owners.

2.2.6 Air Quality

Air Quality along corridors will be negatively impacted during construction phase and in operation phase when increasing volumes of vehicles use the highways. The negative impacts during construction will be from a number of sources. These include: large construction equipment, trucks and asphalt producing and paving equipment and which will increase emissions, but over a shorter duration. The negative impacts resulting from the operational phase will be result from the increasing volumes of vehicles using the road. The project activities during construction and operational phases include site levelling, clearing of trees, construction of the road, bypasses, bridges, quarry operations and hot-mix plant emissions.

2.2.6.1 Impacts due to construction of road

- Generation of Dust
- Generation of Exhaust Gases

2.2.6.2 Impacts due to Operation of Highway

During the operational phase there will be a slow but steady increase in the air pollution level due to high volumes of vehicular traffic. The significance of air pollution load depends largely on the nature and location of the various project corridors.

Traffic air pollution problems arise from two-sources: (i) inadequate vehicle maintenance; and (ii) use of adulterated fuel in vehicles. However, enforcement standards to meet better vehicle performance in emissions and the improvement of fuel constituents, which can assist in improving regional air quality, resides at the state level.

2.2.7 Ambient Noise

Noise is an irritant and has been aptly defined as unwanted sound. Noise is perceived as one of the most undesirable consequences of road development. Although the level of discomfort caused by noise is subjective, there is a definite increase in discomfort with an increase in noise levels. The discomfort has two components: auditory fatigue and temporary or, very infrequently, permanent lessening of hearing ability. The most commonly reported impacts of increased noise levels are interference in oral communication and disturbance in sleep. However, recent research in the U.K. suggests that the risk of sleep disturbance due to traffic

noise is very small. (EA, HMSO, 1993)

Crushing plants and asphalt production plants produce high noise levels, 90-100 dB(A). The movement of heavy vehicles, loading, transportation and unloading of construction materials also produces significant noise.

Assuming highway elements (geometry, pavement condition) and traffic mix remain constant, traffic volume increases of 25 percentage, 60 percentage and 100 percentage will produce average noise level increases of 1 dB, 2dB and 3 dB respectively. Average noise levels increase from 1 to 2 dB for each 10 km per hour increase in average traffic speed.

2.2.8 Impacts on Flora

The principal impact on flora involves the removal of trees and the grubbing of vegetative cover for construction and a clear zone within the RoW.

The need to remove the trees is as follows:

- To prevent vehicle collisions with the roadside trees, they cannot be closed to the pavement, particularly trees with strong and rigid stems.
- To provide construction of the embankment for the widened road cross-section and, to permit construction of adequate roadside drainage. Trees located within the area between the pavement and the “daylight line” need to be removed;
- Trees need to be cleared to facilitate construction and operation of traffic detours.

As a sum total, seventy number of trees in left hand side and fifty seven number of trees in right hand side of Right of Way need to be removed between Narol and Thakkarnagar Corridor.

2.3 SOCIAL ENVIRONMENT

Adverse socio-economic impacts include all disruptions on the social and economic interactions of communities due to the road project. This involves effect on both the adjacent communities (mostly direct) as well as the nearby communities (mostly indirect). The various impacts have been detailed for Pre-construction, Construction and Operation Period as shown in Table 2.3.

Table 2.3: Impact on Social and Cultural Environment

Project Activity	Planning and Design Phase	Pre Construction Phase			Construction Phase					Operation	
										Direct	Indirect Induced development
Env. Component Affected	Design decisions & Implementa-tion policies	Land acquisition	Removal of Structures	Removal of trees & vegetation	Earth works including quarrying	Laying of pavement	Vehicle & machine operation & maintenance	Asphalt and crusher plants	Labour Camps	Vehicle operation	-
Buildings and built structures	-	-	Loss of structures, Debri generation, Noise and Air pollution	-	Noise, vibration may cause damage to structures	-	Noise, vibration may cause damage to structures	Dust accumulation on building and structure	-	Vibration and noise	Change in building use and characteristics
People and Community	Anxiety and fear among community	-	Displacement of people Psychological impact on people loss of livelihood	Loss of shade & community trees, Loss of fuel wood and fodder, Loss of income	Noise and Air pollution	Odour and dust	Noise and Air pollution, Collision with pedestrians livestock and vehicles	Air and noise pollution and discomfort	Community clashes with migrant labour	Noise pollution, Risk of accident	Induced pollution
Cultural Assets	-	-	Displacement loss of structure from RoW	Loss of sacred trees.	Noise, vibration may cause damage to structure	-	Damage from vibration & air pollution	Dust accumulation	-	Damage from vibration & air pollution	-
Utilities and Amenities	-	-	Interruption in supply	-	-	-	Damage to utility and amenities	Dust accumulation on water bodies	Pressure on existing amenities		-
Labour's Health & Safety	-	-	-	-	Increase of stagnant water and disease	Asphalt odour and dust	Collisions with vehicles, pedestrians & livestock	Impact on health due to inhale of dust	Increase in communica ble diseases	Collisions pedestrians & livestock	-

2.3.1 General Impacts

2.3.1.1 Fear of uncertainties regarding future

Land and property owners are subjected to sufferings regarding uncertainties of the extent of loss and the nature of compensation. These involve:

- uncertainty of the amount of land/property to be acquired,
- time of acquisition and evacuation,
- extent and amount compensation,
- provision of alternative land or job, etc.

2.3.1.2 Inducement of Land Prices

Once the project becomes common knowledge, there may be a danger of unscrupulous speculators moving in to purchase land at what might seem to be advantageous prices, prior to the commencement of the official procedures. Such impact is more likely to occur in the case of urban fringe areas during the design and pre-construction phase.

2.3.1.3 Inducement of Squatter Influx

Squatters may attempt to occupy land along and adjacent to the proposed alignments, in the hope of receiving compensation or some other inducements to leave when construction commences. Such squatters could cause undue pressure on local resources such as water and firewood, which could result in conflicts with those who are harvesting the resources presently.

2.3.1.4 Loss of utilities and amenities

Site clearance involves removal of various assets, utilities and amenities that are:

- Natural (trees, bushes and grasslands), and
- Physical structures (public or private assets and utilities).

2.3.1.5 Public health and safety

a) Impacts on Public health and safety may arise during the phases of pre-construction, construction and operation phases. During the pre-construction and construction phases, dismantling of the structures for CoI clearance and road construction activities may result in the following health hazards:

   - Breaking and dismantling of properties during pre-construction has psychological impacts on their owners and others associated with them.
   - Dismantling of first row of structures (generally commercial) along the highway shall lead to exposure of second row of properties (generally residential) to higher dust, air and noise pollution levels .

b) Labour Camps during construction period can bring the following problems.

   - In the case of non-local labour (if so is arranged by the contractor), labour camps are set up at one or more sites adjacent to the alignment, and at some ancillary sites, like aggregate quarries.
   - In sanitary conditions in the labour camps might also result in impact on health of labourers as well as the local population. Transmission of diseases is also facilitated by the migration of people. During the construction phase work, crews and their dependants may bring with them a multitude of communicable diseases including sexually transmitted diseases (STDs) like AIDS. This is more so if the nature of the project requires more male-workers, who have migrated from other parts of the state or country.

c) Allied activities during construction period may cause local disruption.

   - During road construction allied activities like quarrying and crushing operations, traffic diversions, etc., may cause disruption of social and economic life of the local population of the nearby areas. Dust and noise generated in crushing and blasting operations may cause nuisance to the nearby communities.

- There will be some impact on land during construction, limited mainly to temporary acquisition to cater to road diversion or traffic detours and establishment of labour camps.

d) Accidents and Safety

- Although the design speeds have been kept lower in the major settlement areas, some amount of severance is expected in the rural areas. Especially where the residential area is on one side and their agricultural land and other facilities are on the other side of the highway. School children and ladies carrying pots full of water from the water sources (ponds/wells) also get exposed to this risk. In rural areas it was seen that cattle also cross the highways near the settlement.

2.3.1.6 Disturbance to the Road side Services

Along the highway, near settlements, small shops get attracted to serve the local people as well as the highway users. A composite socio-economically inter-dependent has been

developed as a consequence. The shops serve dual purpose by providing income and employment to locals as well as service to the road users. It is likely that due to implementation of the project some of the shops may get displaced. This would cause negative impact on the livelihood of people as well as loss of service to the local people and road users.

2.3.1.7 Removal of encroachments and squatters

In order to reduce the number of PAPs, land clearing shall be restricted to within the Corridor of Impact (CoI), which principally lies within the RoW. Width of the CoI varies according to the design and is narrower in the settlement areas, where the numbers of PAPs are likely to be more. However, some amount of land clearing will be essential in several of these stretches.

The potential impacts likely to arise from clearance of encroached residential areas (especially in settlements along the project corridor) may involve loss of valuable residential space to the residents. In the case of squatter settlements, displacement might lead to loss of shelter if adequate measures are not taken for their resettlement. Compensation may not be enough for the effected persons to gain access to shelter. Other impacts include disturbance to family and community life and increased distance from their workplace. In such cases the displaced persons may again resort to squatting.

Clearing of informal commercial establishments, such as an informal market within the RoW, may affect the local economy as well as result in loss of livelihood of these people.

2.3.2 Specific Impacts

Due consideration has been given while designing the different road stretches having varying RoW. Land Acquisition is not necessary as the design of the whole section is within the available RoW along the . All Temporary Structures coming within the RoW will be removed as per Supreme Court directive.

3. ENVIRONMENTAL MANAGEMENT ACTION PLAN

Environmental Management Action Plan (EMAP) deals with the implementation procedure of the guidelines and measures recommended to avoid, minimize and mitigate environmental impacts of the project. It also includes management of measures suggested for enhancement of the environmental quality along the highways.

The EMAP is a plan of action for mitigation / management / avoidance of the negative impacts of the project and enhancement of the project corridor. For each measure to be taken, its location, timeframe, implementation and overseeing / supervision responsibilities are listed. These components of the EMAP have been given in **Table 3.1**, that explains the environmental issues and the avoidance/ mitigation/ minimization or enhancement measures

adopted and/or to be adopted during different phases of the project namely:

- Pre Construction
- Construction and
- Operation.

It also provides with the references for the suggested measures, responsible agency for its implementation/ management as well as its timeframe.

3.1 THE ENVIRONMENTAL MANAGEMENT ACTION PLAN

Incorporation of the environmental elements in the design and bid documents is one of the highlights of the project. Intensive efforts have been made by the project team in avoiding and minimizing the negative impacts of the project during the design phase. Considerable effort has been made in the preparation of this EMAP to maintain the similar level of focus on environmental issues in the succeeding phases of the project and to ensure the successful implementation of the suggested measures.

Normally environmental recommendations are of normative and advisory nature with little or no sufficient lever to make the intended responsible agencies to comply with such recommended environmental requirements of the projects. Compliance is optional rather than mandatory. Wherever, the environmental issues are significant the mitigation/management is taken up separately (a situation where one agency damages and some other agency tries to mend the damage). Where environmental issues are not that significant, the responsibilities are distributed over a number of agencies. Multiplicity of such agencies seldom helps implementing the environmental measures in spirit when everybody's business becomes nobody's business.

Table 3.1: The Environmental Management Action Plan (EMAP)

Environmental Impact/Issue	Mitigation Measures[3]	Reference to the Contract Documents[4]	Location[5]	Time Frame[6]	Responsibility	
					Implementation	Supervision
3.1: PRE-CONSTRUCTION PHASE						
3.1.1 Removal of Trees	Trees will be removed from the Corridor of Impact (or, site, in other words) before commencement of Construction with prior approval of the DoF.	Legal requirement.	The Corridor of Impact.	Before Construction starts.	GIDB/AMC/AUDA	PIU/EMU
3.1.2 Land and Property Acquisition	Information dissemination and community consultation about the "GIDB Entitlements".	RAP and Project requirement.	The corridor of impact.	Before construction starts in any sub-section of roads.	GIDB/AMC/AUDA	PIU
3.1.3: Relocation of Cultural Properties	Community meetings will be held on relocation aspects of process, siting, etc. Relocation will be complete before construction starts.	RAP and Project requirement.		Before construction starts.	GIDB/AMC/AUDA	EMU
3.1.4 Clearance of Encroachment/ squatters	Advance notice, as per RAP to be given to the encroachers. For squatters needing relocation all	RAP requirement.	Within RoW.	Notice to be served at least four months before scheduled start at construction.	GIDB/AMC/AUDA	EMU/PIU
3.2: CONSTRUCTION PHASE						
3.2.1: SOIL						
3.2.1.1 Generation of Debris	(a) Cut and fill should be equalised, as per design.	Design requirement	Throughout Project Corridors.	During Construction.	Contractor.	Engineer, EMU.
3.2.1.2Compaction of Soil	(a) Construction vehicle, machinery and equipment shall move or be stationed in the designated area (RoW or CoI, as applicable) only.	MoST: 112.6	Throughout Project Corridors and all areas temporarily acquired.	During Construction.	Contractor.	Engineer, EMU.
3.2.1.3Contamination of Soil by Fuel and Lubricants	(a) Vehicle/machinery and equipment maintenance and refueling shall be carried out in such a fashion that spillage of fuels and lubricants do not contaminate the ground.	MoST: 113.13 (amended)	Throughout Project Corridors, all access roads, sites temporarily acquired and all borrow areas.	During Construction.	Contractor.	Engineer, EMU.
3.2.2 **WATER**						

[3] Some of the mitigation measures are preventive in nature while some others include additional measures in terms of environmental conservation and involve physical and construction work.

[4] The Contract Documents refer to the following:

(a) Federation Internationale Des Ingenieurs-Conseils (FIDIC). Conditions of Contract for Works of Civil Engineering Construction. Fourth Edition, 1987 (reprinted 1992 with amendments): Part I (General Conditions) and Part II (Conditions of Particular Application), suitably amended for the purpose of Gujarat State Highways Project.

(b) Ministry of Surface Transport, Roads Wing (MoST), Government of India. Specifications for Road and Bridge Works (Third Revision, 1995. Reprinted, 1998).

Both the FIDIC and MoST documents were amended to suit the needs of the GIDB, particularly the requirements of the Environmental Management Action Plan (EMAP) and the Resettlement and Rehabilitation Action Plan (RAP).

[5] Unless otherwise stated, the Project Site covers area beyond the Corridor of Impact and/or the RoW, such as borrow areas, access roads, service roads and equipment storage sites (MoST: 306.3).

[6] Time frame refers to the duration or instant of time when the mitigation measures will be taken.

Environmental Impact/Issue	Mitigation Measures[3]	Reference to the Contract Documents[4]	Location[5]	Time Frame[6]	Responsibility	
					Implementation	Supervision
3.2.2.1 Loss of Water Sources	(a) Any source of water (potable or otherwise) for the community such as wells, ponds or tube-well, etc., incidentally lost shall be replaced immediately.	RAP requirement. MoST: 110.3	Throughout Project Corridors, all access roads, sites temporarily acquired and all borrow areas.	Whenever Encountered During Construction.	Contractor.	Engineer, EMU.
3.2.2.2 Contamination from Fuel and Lubricants	(a) The work shall be carried out in such a manner that pollution of natural watercourses, ponds, tanks and reservoirs is avoided.	MoST: 111.4 FIDIC: 19.1 (c)	Throughout Project Corridors, all access roads, sites temporarily acquired and all borrow areas.	During Construction.	Contractor.	Engineer, EMU.
3.2.3 **AIR POLLUTION**						
3.2.3.1 Generation of Dust	(a) The Contractor shall take every precaution to reduce the level of dust emission from the hot mix plants and the batching plants up to the satisfaction of the Engineer. (b) The hot-mix plant be sited at least 500m from the nearest habitation.	MoST: 111.9 (amended)	Throughout Project Corridors, all access roads, sites temporarily acquired and all borrow areas.	During Construction.	Contractor.	Engineer, EMU.
3.2.3.2 Emission from Hot-Mix Plants and Batching Plants	(a) Hot mix plants and batching plants shall be located sufficiently away from habitation, agricultural operations or industrial establishments.	MoST: 111.5 (amended)	All Hot-mix and Batching Plants.	During Erection, Testing, Operation and Dismantling of Such Plants.	Contractor.	Engineer, EMU.
3.2.3.3 Emission from Construction Vehicles, Equipment and Machinery	(a) All vehicles, equipment and machinery used for construction shall be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of GPCB and the Engineer.	MoST: 111.13 (amended)	Throughout Project Corridors, all access roads, sites temporarily acquired and all borrow areas.	During Construction.	Contractor.	Engineer, EMU.
3.2.4 **NOISE POLLUTION**						
3.2.4.1 Noise from Vehicles, Plants and Equpment.	(a) The plants and equipments used in construction (including the aggregate crushing plant) shall strictly conform to the GoI noise standards. (c) Noise limits for construction equipments used in this project (measured at one metre from the edge of the equipment in free field)	FIDIC: 19.1 © MoS: 111.13 MoST: 111.13	Throughout Project Corridors, all access roads, sites temporarily acquired and all borrow areas.	During Construction.	Contractor.	Engineer, EMU.
3.2.5 **IMPACT ON FLORA**						
3.2.5.1 Loss or Damage of Vegetation	(a) Trees or shrubs will only be felled or removed that impinge directly on the permanent works or necessary temporary works with prior approval from the Engineer. (c) Trees felled shall be replaced as per the compensatory afforestation criteria in accordance with the Forests (Conservation) Act, 1980.	MoST: 111.15 (amended)	Entire Project Site. As decided by the DoF.	During Construction. As per DoF Existing Programmes.	Contractor. DoF.	Engineer, EMU. EMU.
3.2.6 **DISRUPTION TO USERS**						

Environmental Impact/Issue	Mitigation Measures[3]	Reference to the Contract Documents[4]	Location[5]	Time Frame[6]	Responsibility	
					Implementation	Supervision
3.2.6.1 Traffic Jams and Congestion	(a) Detailed Traffic Control Plans shall be prepared and submitted to the Engineer for approval 5 days prior to commencement of works on any section of road. (b) Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the Engineer.	MoST: 112.1 (amended)	All Project Corridors.	During Construction.	Contractor.	Engineer.
3.2.6.2 Traffic Control and Safety	(a) The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen (b) All signs, barricades, pavement markings shall be as per the MoST specification.	MoST: 112.4	All Project Corridors.	During Construction.	Contractor.	Engineer.
3.2.7 **WORKERS' ACCIDENT RISKS**						
3.2.7.1 Risk from Operations	The Contractor is required to comply with all the precautions as required for the safety of the workmen as per the International Labour Organisation (ILO) Convention	FIDIC: 19.2 FIDIC: 26.1 MoST: 602.9.3.2	Entire Project site.	During Construction.	Contractor.	Engineer.
3.2.7.2 Risk of Lead Pollution	No man below the age of 18 years and no woman shall be employed on the work of painting with products containing lead in any form.	FIDIC: 26.1 MoST: 111.1	Entire Project site.	During Construction.	Contractor.	Engineer, EMU.
3.2.7.3 Malarial risk	The Contractor shall, at his own expense, conform to all anti-malarial instructions given to him by the Engineer, including filling up any borrow pits which may have been dug by him.	FIDIC: 34.2	Entire Project site.	During Construction.	Contractor.	Engineer, EMU.
3.2.8 **WORKERS' HEALTH RISKS**						
3.2.8.1 First Aid	At every workplace, a readily available first aid unit including an adequate supply of sterilized dressing material and appliances will be provided as per the Factory Rules of Gujarat.	FIDIC: 26.1 MoST: 1207.6	Entire Project site.	During Construction.	Contractor.	Engineer, EMU.
3.2.8.2 Potable Water	In every workplace at suitable and easily accessible places a sufficient supply of cold potable water (as per IS) will be provided and maintained.	FIDIC: 34.2	Entire Project site.	During Construction.	Contractor.	Engineer, EMU.
3.2.8.3 Hygiene	(a) The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the resident engineer.	FIDIC: 32.1	All Construction Labourers' Camps.	During Construction.	Contractor.	Engineer, EMU.
3.2.9 **DAMAGE AND LOSS OF CULTURAL PROPERTIES**						
3.2.9.1 Conservation of Religious Structures and Shrines	(a) All necessary and adequate care shall be taken to minimize impact on cultural properties (b) All conservation and protection measures will be taken up as per design. Access to such properties from the road shall be maintained clear and clean.	FIDIC: 27.1 MoST: 301.5 Design requirement	Entire Project site.	During Construction.	Contractor.	Engineer, EMU.
3.2.10 **ENVIRONMENTAL ENHANCEMENT**						

Environmental Impact/Issue	Mitigation Measures[3]	Reference to the Contract Documents[4]	Location[5]	Time Frame[6]	Responsibility	
					Implementation	Supervision
3.2.10.1 Roadside Landscape	Road landscape plantation, re-vegetation of road embankments and other slopes, edge treatment of water bodies shall be taken up as per either detailed design or typical design guidelines given as part of the Bid Documents.	Design requirement	All project corridors.	During Construction.	Contractor.	Engineer, EMU.
3.2.10.2 Roadside Amenities	Provision, replacement, restoration of bus shelters inclusive of bus bays complete with seating arrangement, infrastructure, etc., if any, as per designs given as part of the Bid Documents.	Design requirement	All project Corridors.	During Construction.	Contractor.	Engineer, EMU.
3.2.10.3 Road Furniture	Road furniture including footpaths, railings, storm water drains, crash barrier, traffic signs, speed zone signs, pavement markers and any other such items will be provided as per design given in the Bid Documents.	Design requirement	All project Corridors.	During Construction.	Contractor.	Engineer, EMU.
3.2.10.4 Cultural Properties	Enhancement of all cultural properties inclusive of all such properties relocated prior to commencement of construction shall be completed as per design.	Design requirement	All project Corridors.	During Construction.	Contractor.	Engineer, EMU.
3.3: **OPERATION PHASE**						
3.3.1 Contamination of Soil and Water Resources from Spills due to Traffic and Accidents	a) Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals. (b) Spill of oil, fuel and automobile servicing units without adequate preventive systems in place to be discouraged.		All Project Corridors.	Framework at State and Sector Level is Expected to be developed.	Flying Squad of the Motor Vehicles Department.	Motor Vehicles Inspector.
3.3.2 Maintenance of Storm Water Drainage System	(a) The urban authorities and local government bodies will be reactivated for maintaining storm water drainage system in proper working condition.		All Project Corridors, especially the Urban Stretches.	Beginning and end of each monsoon.	GIDB, Municipal Authorities.	EMU.
3.3.3 Dust Generation	(a) Roadside tree plantations will be maintained. (b) New afforestation projects adjacent to the project road and in the surrounding will be encouraged.		All Project corridors and Surrounding.	Through operation period.	DoF, GIDB.	EMU.
3.3.4 Atmospheric Pollution	(a) Vehicular emissions of CO, HC, NO_X, SPM, RPM and Pb to be checked. (d) New afforestation projects adjacent to the project road and public awareness programme to be undertaken	Refer to the Air Pollution Monitoring Programme.	All Project Corridors and Surrounding.	Through Operation phase. Starting Immediately after Completion of Construction.	Motor Vehicles Department, STA, DoF, GPCB, GIDB	GPCB, EMU
3.3.5 Noise Pollution	(a) Noise pollution will be monitored. (b) Noise control programmes to be enforced properly.		Refer Noise Pollution Monitoring Programme.	Starting Immediately after Completion of Construction, Through Operation phase.	Motor Vehicles Department, STA, DoF, GPCB	GPCB, EMU

Environmental Impact/Issue	Mitigation Measures[3]	Reference to the Contract Documents[4]	Location[5]	Time Frame[6]	Responsibility	
					Implementation	Supervision
3.3.6 Traffic and Accident Safety	(a) Depending on the level of congestion and traffic hazards, traffic management plans will be prepared. (b) Traffic control measures including speed limits to be enforced strictly.		All Project Corridors and Surrounding.	Through Operation Phase.	GIDB/AMC/AUDA	GIDB, EMU.
3.3.7 Accidents involving Hazardous Materials	Compliance with the Hazardous Wastes (Management and Handling) Rules, 1989 including:		All Project Corridors and Surrounding.	Framework Expected to be During Early Operation Phase.	GIDB/AMC/AUDA, Motor Vehicles Department	Motor Vehicles Department.

3.2 CONDITIONS POSED BY DoEF, GoG

As per the EIA notification of April 1997 issued by the Government of India, Ministry of Environment and Forest, road widening and strengthening along the existing alignment, with marginal land acquisition and not passing through any national park or protected or sensitive area does not require an environmental clearance. However, the following environmental concerns **(refer ENV-10-2000-486-P1 Government of Gujarat, Forests & Environment Department, and dated October 20, 2000)** should be addressed before commencing the work and suitable measures taken there of:

- Creation of artificial wetland
- Degradation of near-by areas by construction labour, temporary dwellings, asphalt plant, crushing units, etc.
- Impact on natural drainage pattern due to construction and/or storage of construction materials
- Alteration of hydrological setting of project area and siltation/ addition of pollution level to the existing water bodies
- Contamination of natural water bodies-both during construction and operation phase
- Existing topography
- Pollution problems arising due to hot mix plant
- Problems due to loading/unloading of materials
- Pollution problems during operational phase
- Quarries having consent under Air Act – 1981 from the Gujarat Pollution Control Board should be preferred for procurement of materials
- Traffic management plan during the operational phase

3.3 THE ENVIRONMENTAL MONITORING PROGRAMME

For effective implementation of the EMAP, it is essential that an effective monitoring programme be designed and carried out. The objectives of the monitoring programme are:

1. To ensure that the measures suggested herein are being taken during construction;
2. To evaluate the efficiency of the proposed mitigation and enhancement measures;
3. To investigate the adequacy of the EMAP as well as suggest improvements to it;
4. To generate data that could be incorporated in future EMAPs; and
5. To evaluate what additional enforcement is required for the effective implementation of the EMAP.

3.3.1 Ambient Air Quality Monitoring

Ambient air quality parameters recommended for road transportation developments are RPM, SPM, CO, NO_x, HC, SO_2 and Pb. These are to be monitored at designated locations twice a year for at least five years from the commencement of construction. Twenty-four hours basis air quality data should be generated over three days at all identified locations in winter also.

3.3.2 Water Quality Monitoring

Water quality will be monitored for pH, total solids, total dissolved solids, total suspended solids, oil & grease, COD, chloride, lead, zinc and cadmium by Standard Methods. Monitoring should be carried out once in a year in January starting at the scheduled time of construction for five years.

3.3.3 Ambient Noise Monitoring

Noise level measurements will be carried out at all designated locations along the Phase-IIB project corridors. Twenty-four hours of sound pressure levels on an hourly basis will be monitored with intervals of two minutes during construction and operation phases. Noise should be recorded at a “A” weighted frequency using a “slow time response mode” of the measuring instrument.

AHMEDABAD MUNICIPAL CORPORATION

The Ahmedabad Municipal Corporation (AMC), constituted in 1950 under the Bombay Provincial Municipality Act, is a statutory body created to regulate development and prove utilities and facilities.

The Ahmedabad Municipal Transport Service, a body of AMC provides public transport services in Ahmedabad. Introduction of CNG buses through private sector participation is the recent initiative of AMC.

Shri. I. P. Gautam , IAS
Municipal Commissioner

GUJARAT INFRASTRUCTURE DEVELOPMENT BOARD

Gujarat Infrastructure Development Board (GIDB), established in 1995 , is chaired by the honorable Chief Minister of the State.
This is a unique organization of its type and is an over-arching body for infrastructure development in Gujarat, encompassing both the hard as well as the soft infrastructure sectors. GIDB itself does not develop infrastructure services but acts as a catalyst for their development.

Shri. Arvind Agarwal, IAS
Chief Executive Officer

AHMEDABAD URBAN DEVELOPMENT AUTHORITY

The Ahmedabad Urban Development Authority (AUDA), constituted under the Gujarat Urban & Town Planning Act 1976, is a nodal agency responsible for the preparation & implementation of Development plans and town planning Schemes in their jurisdictional areas.

AUDA planned and developed large network of roads in the expanding areas of the city.

Shri. K. Kailashnathan, IAS
Principal Secretary
Urban Development Department

Chairman, AUDA

CEPT UNIVERSITY

Centre for Environmental Planning & Technology University, established in 1962, is one of the premier institutes in India imparting education to students and professionals in the related fields of Architecture, Planning, Civil Engineering, and Interior Design.

Apart from academics, CEPT offers consultancy, research and short term professional training courses with various national and international organizations.

Dr. R.N.Vakil
Director

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