Consultation on ESMF

The Ministry of Urban Development (MoUD), GoI has applied to the Global Environmental Facility (GEF) to implement GEF's Sustainable Urban Transport Project (SUTP) in India under the National Urban Transport Policy. The GEF grant (of USD 25million) will be complemented with a grant of USD 150 million from GoI, State Governments and implementing agencies at the city level, along with USD 200 million co-financing from the World Bank. The project is to be implemented in 9 cities, namely Ajmer, Ahmedabad, Hyderabad, Indore, Jalandhar, Mysore, Naya Raipur, Pune and Trivandrum.

As part of this initiative, the development of Integrated Transit System will be implemented in Ahmedabad over a period of four years starting from April 2009. The project shall be implemented by AMC.

To integrate environmental and social concerns in project planning, design and implementation, an Environmental and Social Management Framework (ESMF) has been prepared, in line with the requirements of the applicable requirements/procedures of the GoI and the State, and in conformance with the Environmental and Social Policies of the World Bank. The ESMF lays down the principles and guidelines for addressal of environment and social safeguard impacts due to the implementation of Green Transport projects in India, This includes the development of Integrated Transit System, Ahmedabad to be taken up as part of the SUTP. A draft of the project is available for review on the website of AMC.

The project involves introduction of ITS (Automatic ticketing, passenger information, etc.,) A pilot project with similar scope has already been implemented and this project is to expand concept to entire system. The project also involves remodeling existing AMTS depot to accommodate control centre. The project does not envisage any adverse social or environmental effects.

A stakeholder consultation on the Draft project report to obtain the views, concerns, grievances of the various stakeholder groups is proposed. The consultation is being held on Friday, 12th December 2008 at 15:00 hrs at AMTS office. All interested stakeholders are invited to attend the same.

Sd/-

Ahmedabad Municipal Corporation

Accessible Ahmedabad

A Proposal under GEF

Complimentary Projects towards
Development of Integrated Transit System

A Proposal Submitted
To

MINISTRY OF URBAN DEVELOPMENT
GOVERNMENT OF INDIA

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1 Background

1.1 INTRODUCTION

The city of Ahmedabad, founded in 1411 AD as a walled city on the eastern bank of the river Sabarmati, is now the seventh largest metropolis in India and the largest in the state. The city at the present is spread over 466 Sq. km of area and accommodates 5.5 million people. The main agency governing the area is the Ahmedabad Municipal Corporation (AMC).

The population of the city is likely to rise to 7 million and to 11 Million by 2011 and 2035 respectively. This would incorporate surrounding settlements including the State Capital Gandhinagar to form Greater Ahmedabad. The area of the city is likely to increase from the present 460 Sq. Kms to 1200 sq. kms by 2035. Sustenance of this growth is possible only with the development of an efficient transport system. The city has drawn up a vision and a set of strategies to translate the plan proposals to reality.

A comprehensive plan was drawn up as part of report 'Integrated Public Transit System Alternatives', which envisaged a series of measures ranging from introduction of a rail based rapid transit system, a sub-urban rail transit system, bus rapid transit system, pedestrianisation of inner city areas, building bicycle ways, parking management etc., Subsequently detailed project reports have been prepared for developing metro system to connect Ahmedabad and Gandhinagar, regional rail to connect outlying towns and industrial areas and bus rapid transit system plan to serve the needs of the city. In addition, efforts to restructure the Ahmedabad Municipal Transport Service have also been undertaken. The effort has met with success as number of transit boardings have increased from 0.35 million in 2005 to 0.93 million passengers in 2008. The Ministry of Urban Development, Government of India has approved BRTS project which aims to develop about 88 kms of exclusive network for BRT under JnNURM. The project is in advanced stage of implementation. Complimentary measures such as developing a parking management plan, an advertisement plan etc., are underway.

The proposal under consideration for GEF support is part of this overall plan and seeks funding for certain critical incremental activities which have not been included for funding in other onoing projects. Inclusion of these will add significant value to the transit development initiative.

1.2 BASE PLAN AND PROGRAMMING

Following reports/plans have contributed largely to the structuring of the landuse-transport system in the city of Ahmedabad. These form the basis for this report.

1. Development Plan: A statutory plan (2002)
2. Ahmedabad City Development Plan: Prepared as part of JnNURM (2006)
3. Feasibility Study on IPTS for Ahmedabad – Interim Report (2001)
4. Integrated Public Transit Alternatives: Overall integrated landuse-transit development framework for the city (2002)
5. Ahmedabad Bus Rapid Transit System Plan: Detailed project report sanctioned under JnNURM (2006 and 2008)
6. Ahmedabad Metro and Regional Rail System study (2005)
7. Development of Logistic Hub in Ahmedabad (2007)
8. AMTS Plan (2006)

1.3 DATA BASE

Specific surveys have also been carried out for deciding on various aspects of integrated transit planning process.

Table 1-1: Database

Sr. No.	Details
1	Classified volume counts / Screen Line
2	Cordon Line Surveys
3	Origin-Destination Surveys LB-12000 Households (2000) (Greater Ahmedabad) RITES 5000 Households (2005) (Greater Ahmedabad) CEPT – 5000 Households (2006) (Ahmedabad City) CEPT – 1000 Users Response Survey/Willingness to shift & pay (2007)
4	Pedestrian Counts
5	Public Transit Surveys – 2007 Route Surveys – Volume Counts Bus & IPTS Occupancy Survey Bus Passenger O-D Survey User –non-user Preference surveys
6	Parking Survey
7	Speed and Delay /Travel Time Surveys
8	Topographic Surveys
9	Land value survey

1.4 STUDY AREA DELINEATION AND ZONING

Based on the study carried out by LB associates, the study area has been delineated. Total area of approximately 3000 sq. kms., was initially divided in to major sub-regions such as Walled City, AMC east, AMC west, New AMC, AUDA, GUDA and other villages. These sub-regions have been further divided into 427 traffic analysis zones (TAZ) based on the ward boundaries, census zones, village boundaries, district boundaries of the study area including major highways, railway lines, natural watercourses, land use and population density. For the purpose of better consistency and detailed analysis smaller zone sizes have been considered.

1.5 CONSULTATIONS

The Ahmedabad Municipal Corporation have organized a series of consultations. First set of workshops were held during January 20 - 25, 2000. The second series of consultations took place between May ‘02 to February ‘03. Consultations specifically to discuss BRTS Plan began with the stakeholder workshop on August 25, 2005. This was followed by a workshop to discuss bus technology on October 28, 2005. A series of meetings with the academic institutions, existing bus operators were also held in 2006. TAn international workshop was held in September 2007 by AMC with MOUD support to discuss the plans of all the 11 Indian cities whose BRT plans are underway. Detailed technical deliberations were held over 3 days and concluded with specific inputs for each city.

1.6 VISITS

Lessons from the visits to Bogota, Perriera, London, Beijing, Honghou and Jakarta by the officials and members of the study team provided important lessons for defining the Ahmedabad Transit Development Plan.

2 Baseline

Demand for transportation is a derived demand. The characteristics such as size of the city, city structure, household incomes, vehicle ownership and composition, location of employment, education and entertainment activities etc., determine the travel demand. These aspects have been described in this chapter.

2.1 SOCIO ECONOMIC PROFILE OF THE CITY

2.1.1 Geographical area

Historically, Ahmedabad has been one of the most important centres of trade and commerce in western India. The city was once famous as the 'Manchester of India' on account of its textile industry. It had as many as 66 mills employing a workforce of over one hundred thousand persons. It has three major industrial estates within its municipal limits. Thermal power plant in the city is operated by a private company. It is the home of several scientific and educational institutions of national importance. The city has a great architectural tradition reflected in many exquisite monuments, temples and modern buildings.

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 old Ahmedabad Municipal Corporation limit (AMC),
- an area of 270 Kms added in the year 2006 and 2007.
- Areas under the jurisdiction of Ahmedabad Urban Development Authority (AUDA),
- The State Capital, Gandhinagar and the surrounding villages,
- Chatral, Bopal and other surrounding villages adjoining AUDA limits
- Total area of AMC is 466 Sq.kms. It consists of:
    - the traditional city centre within the fort walls with relatively high-density development, large concentration of commercial activities and narrow streets,
    - the eastern sector accommodating large and small industries and low income residential areas, and
    - a well planned western sector with wide roads accommodating major institutions and high-income residential areas
    - The outgrowth areas added recently to AMC comprising mainly residential developments of middle and low income households

2.1.2 Location and Climate

Ahmedabad City lies between 22o 55' and 23o 08' North Latitude and 72o30' and 72o 42' East Longitude. The city is devoid of any major physical features except for the river Sabarmati, which cuts the city into two parts: eastern walled city and western Ahmedabad on either side of its banks.

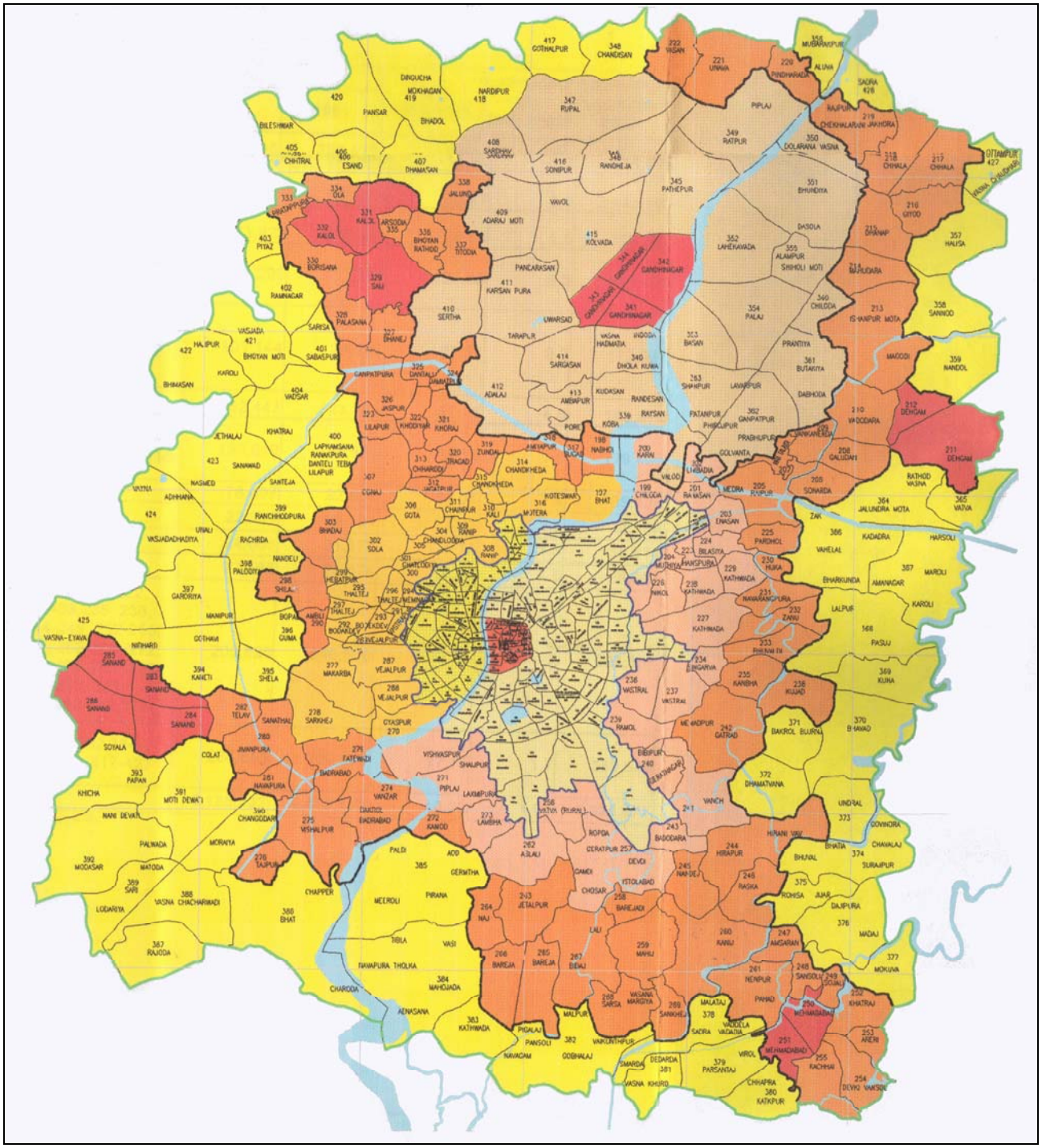
The Ahmedabad-Mumbai Golden Corridor has long been recognized to be an important development axis in western India. The city acts as a terminal, rather than as an intermediate node in this linear influence. It has seven major roadways, one expressway and five rail networks. A new corridor between Ahmedabad and Pune has recently emerged, connecting the

city to four other metropolitan cities of Vadodara, Surat, Mumbai and Pune. All these factors have resulted in the axial growth of the region.

Ahmedabad has a tropical monsoon climate which is hot and dry, except in the rainy season. Summer days are very hot with mean maximum temperature of 41.30C while, nights are pleasant with mean minimum temperature of 26.30C. The mean maximum and minimum temperature in winter are 300C and 15.40C respectively. 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. The average relative humidity is 60% which ranges from 80% to 90% during rainy season.

2.1.3 Demographic Trends

The population in the AMC limits increased to 45 lakh in 2001 from 33 lakh in 1991. 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.



Source: GIDB/LB (2000), Socio-Economic & Land use Studies

Map 2-1: Greater Ahmedabad

2.1.4 Spatial Patterns of Population Growth

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

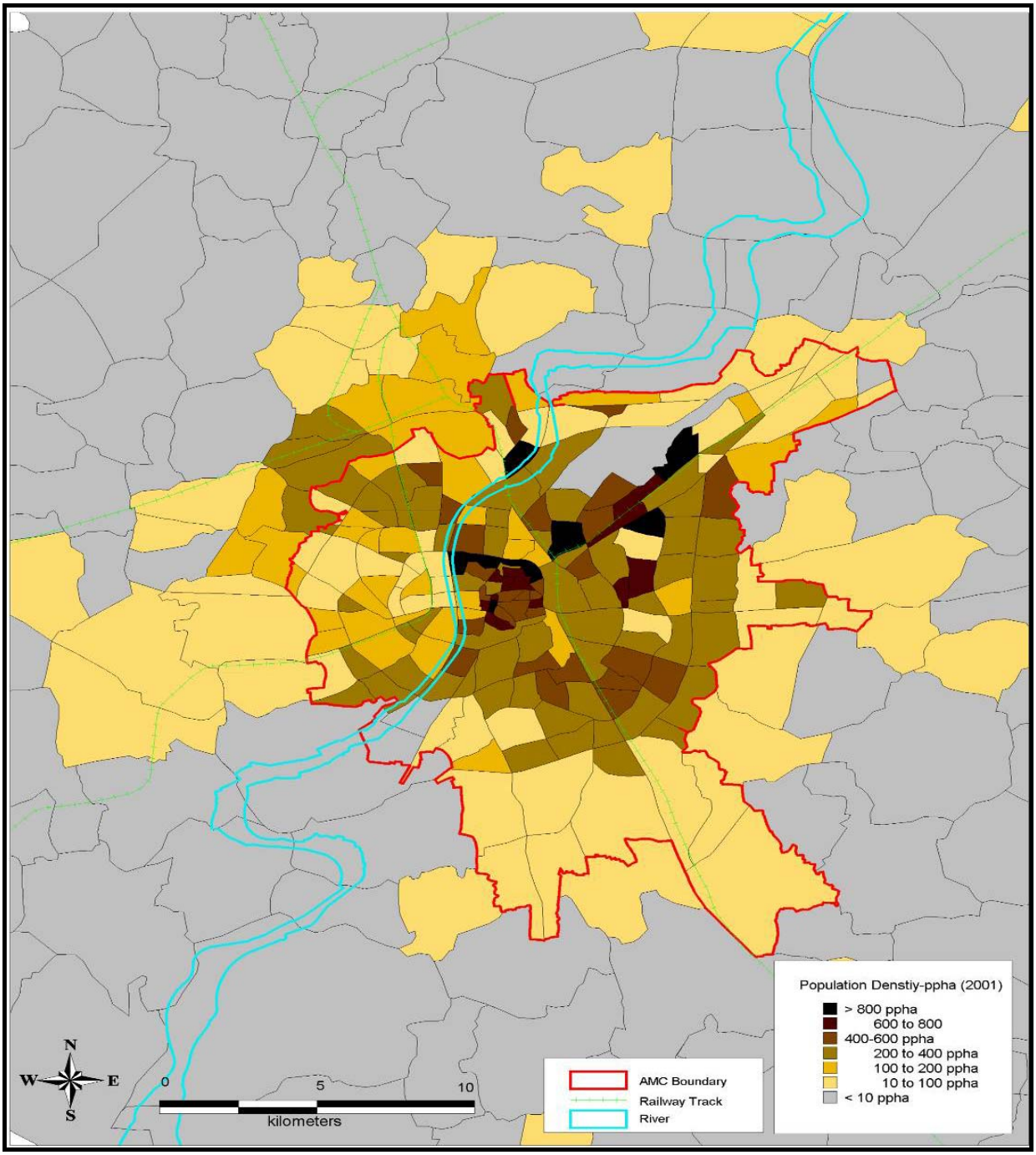
Table 2-1: Population Growth – Greater Ahmedabad

Location	Population in Mill			Density Persons/ Ha			Growth Rate %	
	1981	1991	2001	1991	2001	2001	1981-91	1991-01
1. Ahmedabad Municipal Corporation (AMC) - Old Limit	*2.2*	*2.9*	*3.5*	*113*	*151*	*184*	*-2.9*	*-2*
1.a Walled City	0.5	0.4	0.4	716	599	560	-1.8	-0.7
1.b. East AMC	1.1	1.9	2.5	79	134	178	5.4	2.9
1.c West AMC	0.5	0.6	0.7	109	135	159	2.2	1.6
2. Ahmedabad Urban Development Authority + Newly added areas of AMC	*2.7*	*3.8*	*4.7*	*11*	*61*	*77*	*3.3*	*2.3*
2.a East AUDA	0.1	0.1	0.2	6	7	11	2.5	4.6
2.b West AUDA	0.2	0.5	0.7	13	28	43	8.4	4.4
2.c AUDA (Rural)	0.2	0.2	0.3	12	14	16	1.6	1.1
3. Kalol	*0.1*	*0.1*	*0.1*	*27*	*31*	*38*	*1.7*	*1.9*
4. Mehemdabad	*0*	*0*	*0*	*19*	*22*	*26*	*1.6*	*1.7*
5. Dehgam	*0*	*0*	*0*	*11*	*13*	*16*	*2.4*	*2*
6. Sanand	*0*	*0*	*0*	*6*	*7*	*9*	*1.3*	*2.4*
7. Other areas outside AUDA	0.3	0.3	0.3	8	9	10	1.6	0.8
8. Gandhinagar	*0.2*	*0.3*	*0.4*	*5*	*7*	*9*	*3.5*	*2.9*
8.a. Gandhinagar (GNA)	0.1	0.1	0.2	24	47	75	7	4.7
8.b. Rest of Gandhinagar	0.1	0.2	0.2	4	4	5	1.4	1.3
Greater Ahmedabad	***3.2***	***4.3***	***5.4***	***12***	***16***	***20***	***3.2***	***2.2***

2.1.5 Population Density

The density pattern presented below indicates the spatial expansion largely limited to contiguous areas around AMC. The walled city is one of the most densely populated areas in the study area, and it has reached levels of saturation. The new outgrowths have been in the western parts of the city in the AUDA jurisdiction with people preferring to stay in the peripheral areas where they could avail of better infrastructure facilities.

From the map below it may be seen that most of the eastern part and few parts in the southwest and northwest have higher densities. Bus routes along these are likely to receive greater patronage.



Derived from GIDB/LB (2000), Socio-Economic & Land use Studies

Map 2-2: Population Density

2.1.6 Urban Economy

The city contributes to 17 percent of the State's income in 1995 and is expected to be around 20% in the current context. Traditionally, Ahmedabad has been an important centre of manufacturing. Almost 40% of the dyestuff factories in India are located in Ahmedabad. Pharma giants like Cadila Pharma, Zydus Cadila and Torrent Pharma and many small pharma companies have flourished in Ahmedabad and the growth trend is expected to continue given the positive outlook of pharma industry in India.

The slowdown in the textile sector since the 80s had its negative impact on Ahmedabad's growth. During the period 1981-85, the city lost about 100 thousand jobs in the manufacturing sector. The surplus labour, which was unable to enter the formal market/sector, was mainly

absorbed in the informal sector. Informal sector in the city today provides direct employment to 1 lakh people and indirect employment to 3 lakh people. Since then the sector has become significant creating business volume of approximately Rs 4 Crore everyday. Post liberalization the prospects of the city changed. The city currently is poised for multi-pronged growth and recent business survey placed Ahmedabad as one of the ten top destinations for investment in the country.

Large investments in private ports are likely and as a consequence the state is geared to become the trade gateway for the entire north and central India. This will be a major shift from ports of Maharashtra. Ahmedabad is centrally connected to all ports in Gujarat and is expected to be the main conduit for this trade. The extensive port network is also expected to facilitate the growth of new, high-end manufacturing industries, such as automobile accessories. Several key high-growth industries such as textiles, pharmaceuticals and natural gas are already anchored in Ahmedabad. Also the industrial centres around Ahmedabad, its traditional strength, are witnessing a turnaround, to Ahmedabad's advantage.

The traditional image of Ahmedabad with companies hesitant to launching new products has been changing over the years. Ahmedabad is now one of the most preferred destinations for opening retail outlets. An example being, the Tata Group's retail arm, Trent, which launched its Star Bazaar concept with a store in Ahmedabad. A wide range of multiplexes and associated businesses have grown all over the city.

Though not a tourist destination, in reality it is a gateway to large number of attraction in the districts. The city has the distinction of having probably the largest range of architectural monuments, from ancient examples of Hindu, Jain and Islamic architecture to some of the finest examples of the Modern Movement, designed by architects like Le Corbusier and Louis Kahn. The Sabarmati Ashram set up by Mahatma Gandhi is a major tourist attraction.

A major input to the city's growth and to the State as a whole has been the completion of the Narmada canal project. Further completion is expected to boost agricultural production in the areas surrounding Ahmedabad and improve rural incomes, leading to increased consumption. Ahmedabad is poised to emerge as a key consumption centre and may develop into the most favoured trading zone for farm products, given its capacity to build the right kind of storage and transportation facilities.

To add to these, the recent initiative to develop Delhi-Mumbai Industrial (DMIC), Freight corridor, which passes through the city add necessary boost to the city's growth prospectus. In all, 14 SEZ's have received approval for location in the greater Ahmedabad region. Another 4 have received in-principal approval.

2.1.7 Land Use

Spatial arrangements of activities determine the travel pattern in the city. The Ahmedabad Urban Development Authority is responsible for land use planning within its jurisdictional limits. As stated above, the area under AUDA may be seen as various subunits depending on the administrative jurisdictional limits and extent of development. This area is the focus in this study.

Of the total AUDA area of 1294.65 sq. km,

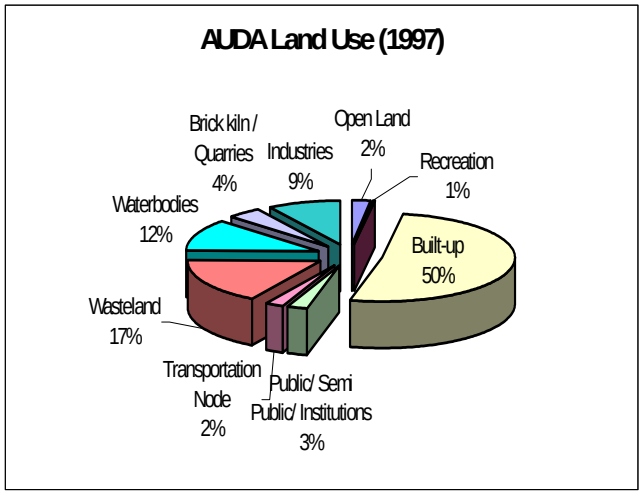


Figure 2-1: Land Use of AUDA area (1997)

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 for light 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.

In AMC area, as per existing land use (1997), more than one third (36%) of the 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.

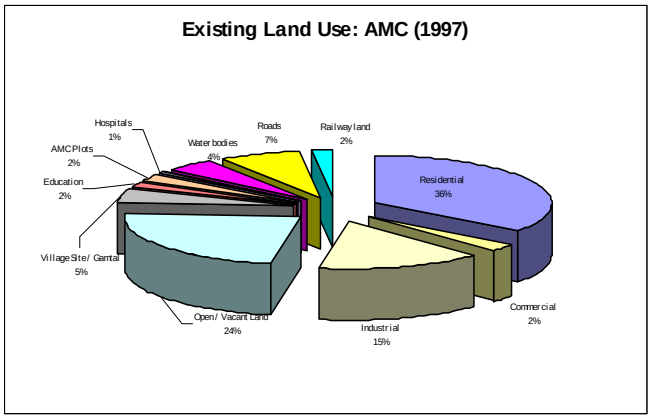


Figure 2-2: Existing land use of AMC area (1997)

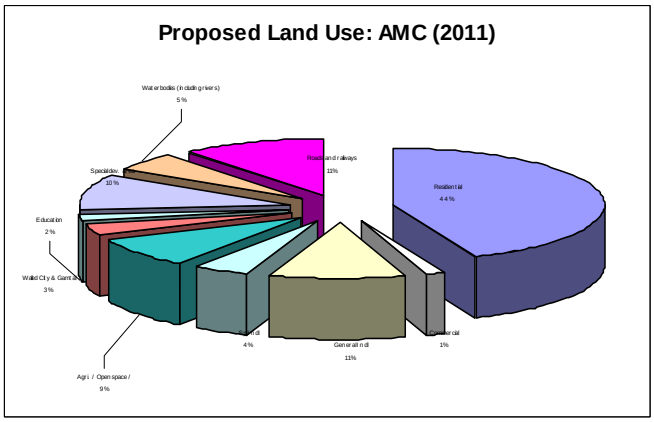


Figure 2-3: Proposed Land Use of AMC area(2011)

Table 2-2: Existing and Proposed Land use of AMC area

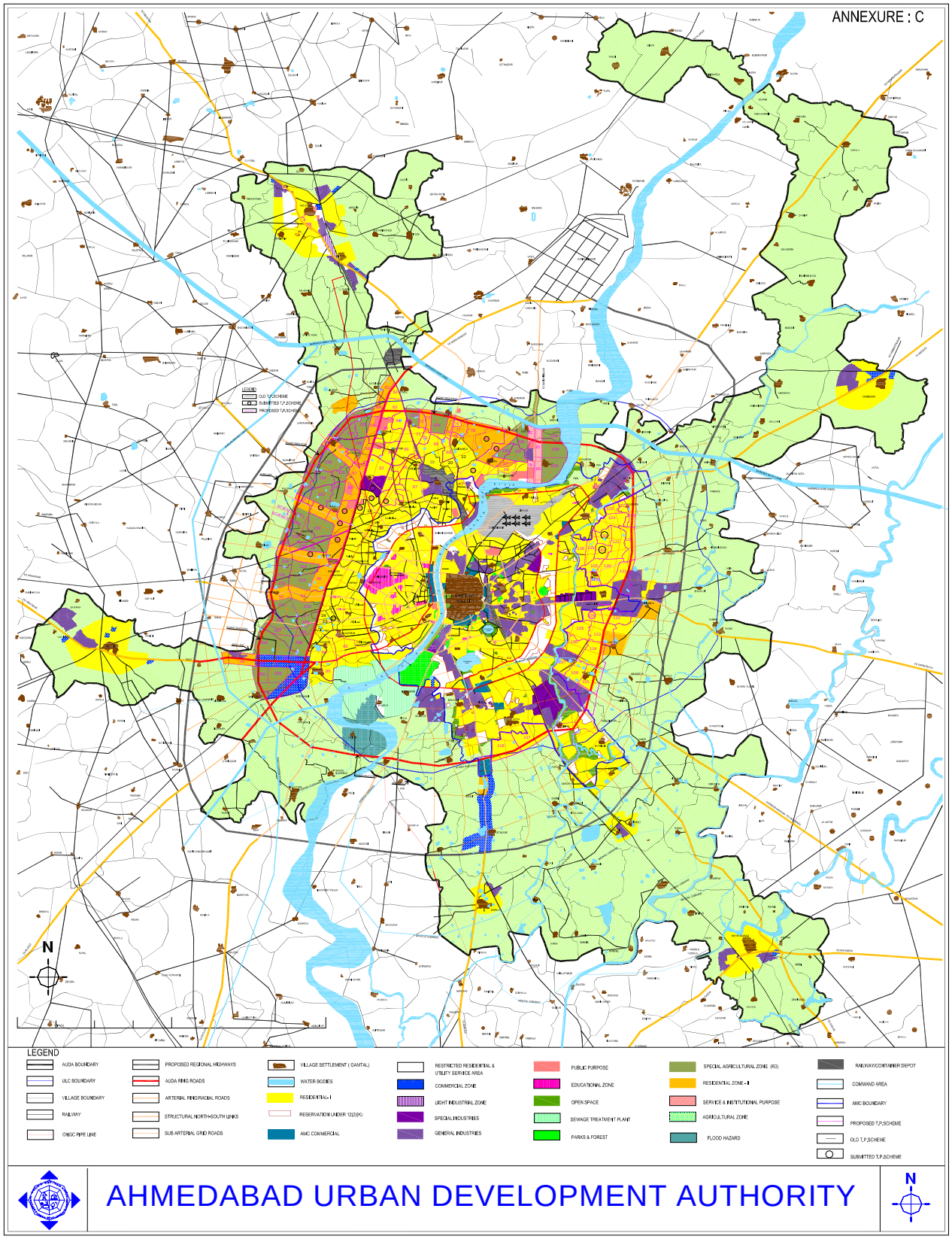
Existing land use for AMC area (1997)				Proposed land use for AMC (2011)		
Sr No	**Use/ Designation**	**Total Area (Ha.)**	**% Of Total Area**	**Use/ Designation**	**Total Area (Ha.)**	**% Of Total Area**
1	Residential	6664.44	34.92	Residential	8340.22	43.70
2	Commercial	472.64	2.47	Walled City and 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	**Total Area**	19084.00	100.00
12	Railway land	372.00	1.96			
	Total	19084.00	100.00			

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

Table 2-3: Existing and Proposed Land use of AUC area (Excluding AMC)

Existing Landuse of AUC Area (Excluding AMC Area) (1997)				Proposed Landuse of AUC Area (Excluding AMC Limit): (2011 A.D)			
Sr. No.	**Land Use**	**Total**	**% Of Developed Area**	**Sr. No.**	**Particulars**	**Area in Hect.**	**%age of Developed Land**
1	Residential include Gamtal	3559	38.99	1	Residential, Roads, Public and Semi-Public		
2	Public &semi public	572	6.27		Type 1 (old residential area)	9938	34.523
3	Commercial	276	3.02		Type 2 (new residential area)	4624.92	16.066
4	Industrial	647	7.09	2	Commercial	1071.92	3.724
5	Railway/ Roads/. Airport	406	4.45	3	Industrial	987.58	3.431
6	Water way and tank	3625	39.72	4	Public Activity Area	552	1.918
7	Garden open space and P.G	41	0.46	5	Public and Semi-Public	243	0.844
TOTAL		**9126**	**100**	6	Recreational	6300	21.885
				7	Treatment Plants (AUDA, AMC)	745.16	2.589
				8	High flood hazards	524	1.820
				9	Agriculture	3800.42	13.202
					Total area	**28787**	**100**

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



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

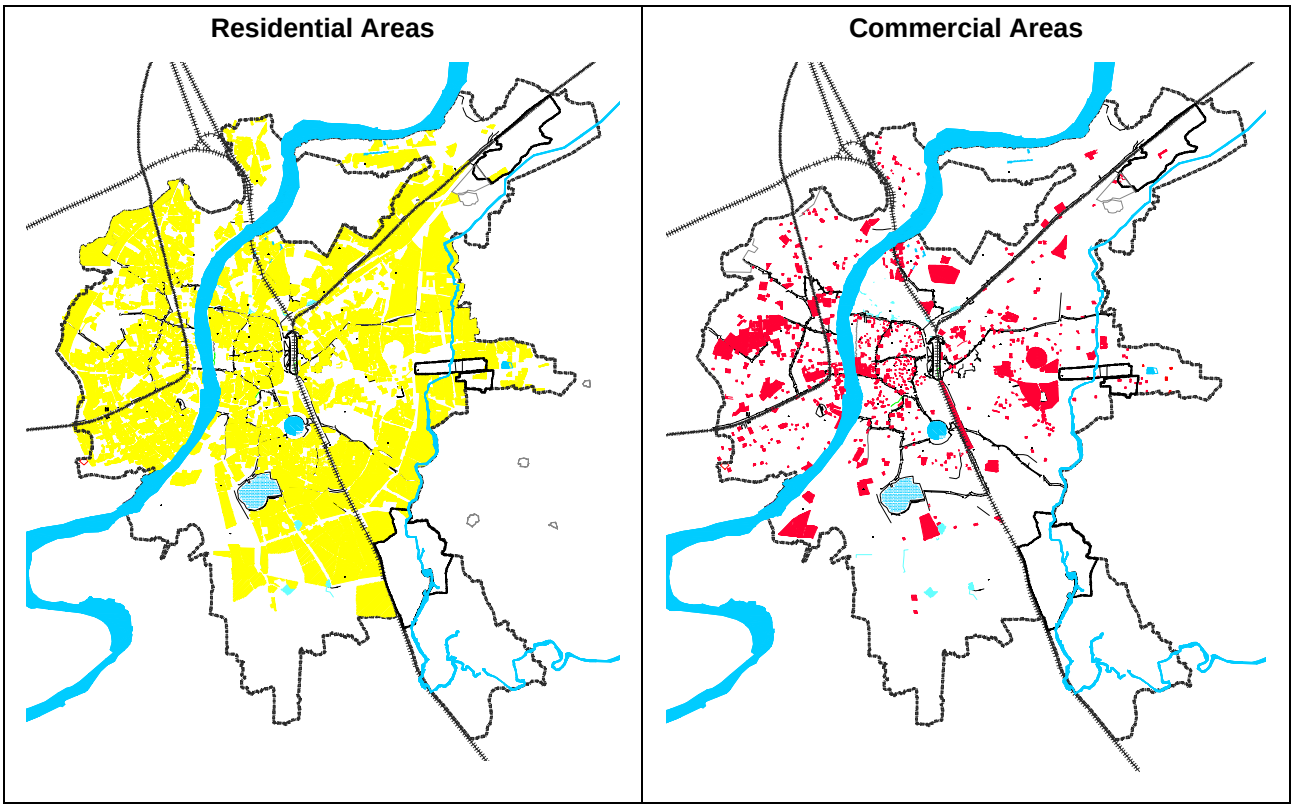
Map 2-3: AUDA Proposed Land Use 2011 Plan

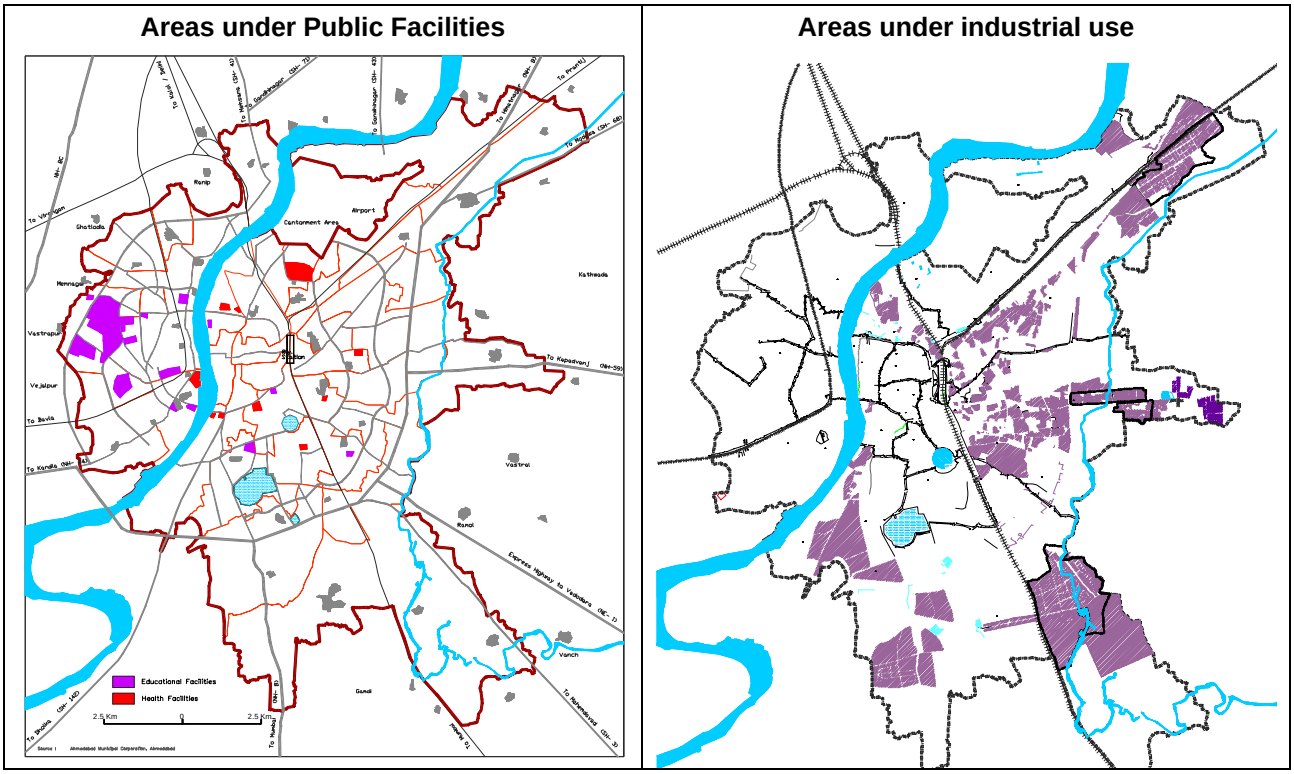
2.1.8 Traffic Generating Activities

The nature and location of economic activities in relation to houses determines the travel demand in a city. Nature and location of these within AMC have been presented below.

The city of Ahmedabad has had great importance in the economy of Gujarat owing to the large concentration of economic activities and their high growth rates and productivity. Ahmedabad accounts for 7% of the state's total population and around 20% of its urban population. In 1995, with 7 percent of the total population, Ahmedabad contributed to 17 percent of the state income ***(4)***.

Ahmedabad has a strong industrial base of traditional manufacturing, especially textiles, plastics, machinery and basic metals and alloys. Ahmedabad city accounts for 21.5% of factories in the state employing 18% of workers (2000). In 1981, before the textile crisis, Ahmedabad city used to account for 19.3% of factories and 27.7% of workers in the state. During the 18th and early 19th centuries, Ahmedabad was one of the most important centres of trade and commerce in western India. The economy of Ahmedabad has passed through various phases of transformation over the years. A gradual shift has been noticed from manufacturing oriented industries to services oriented economic scenario. The tertiary sector is gaining, in terms of share which includes business and commerce, transportation and communication, and other services.



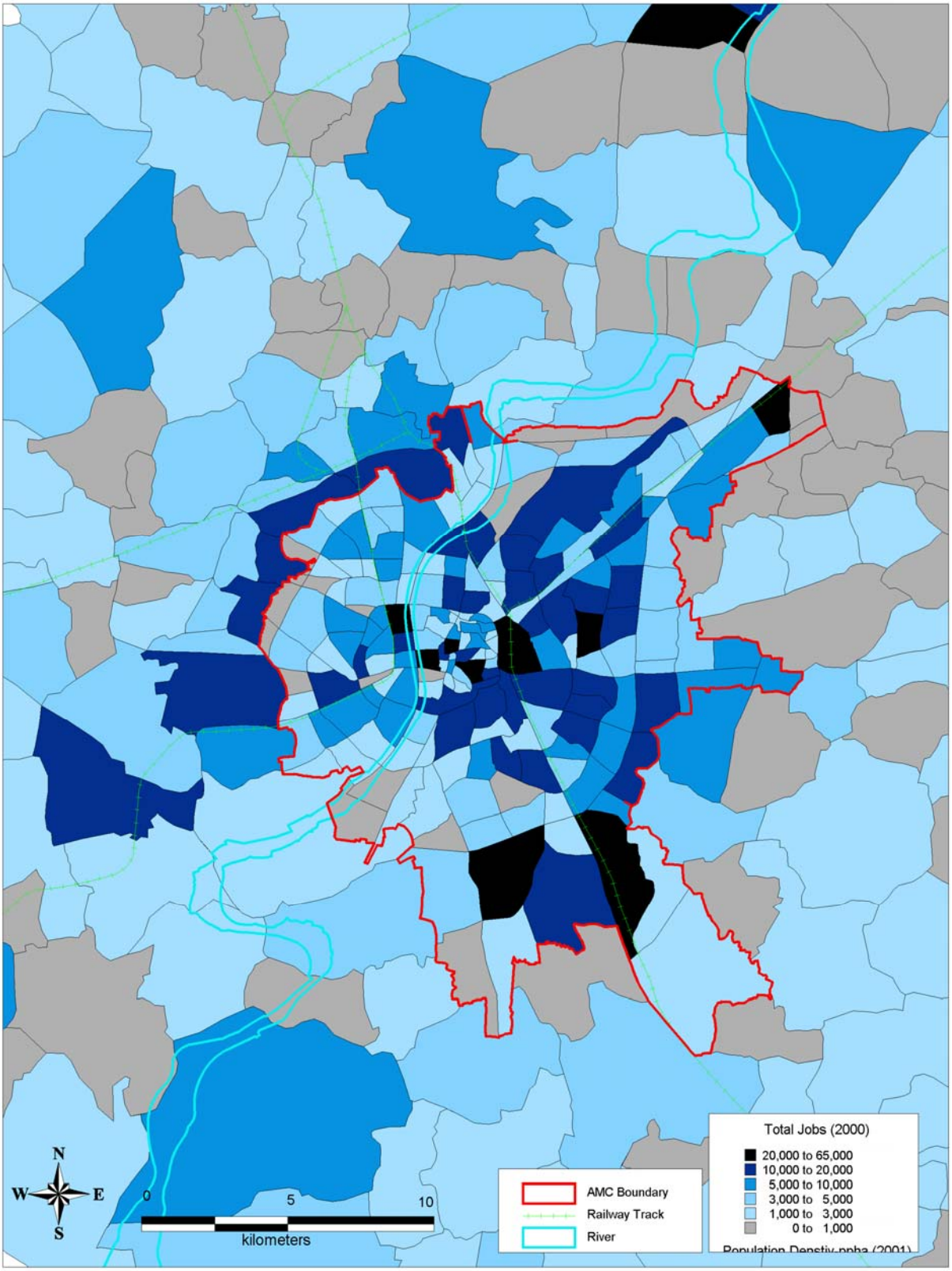


Derived from City Development Strategies, Ahmedabad (2003)

Map 2-4: Maps showing Various Activities

2.1.9 Employment Distribution

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 132 ft ring road have started showing similar development trends.



Map 2-5: Job Distribution in Study area

2.2 EXISTING TRANSPORTATION SYSTEM

Ahmedabad city is well connected by an expressway, several national and state highways, the broad-gauge and meter-gauge railways and an international airport. The city transportation system is predominantly dependent on roadway systems. Vehicular growth has been rapid. The network is experiencing heavy congestion. Consequently air pollution has become severe.

The information below provides an overview of the existing transportation system in terms of road network, vehicular growth and composition, performance of the system and its impact. A detailed analysis of public transportation system performance has been presented separately in the next section.

2.2.1 Vehicles

Ahmedabad RTO district has a total number of 12.9 lakh motor vehicles registered in the year 2002. This went upto 19.4 lakh by 2007 recording a compound growth rate of 8.5%. Of this 73% were two wheelers. The district, which accommodates 11% of the state population accounts for about 21% of the vehicles registered in the State. Accretions to car population are increasing annually. From 2002 to 2003, a total of 12738 cars were added in Ahmedabad. Last year, the increase is in the order of 19858. Increase in car use would have severe effect on traffic movement as it would reduce the road capacity in absolute terms.

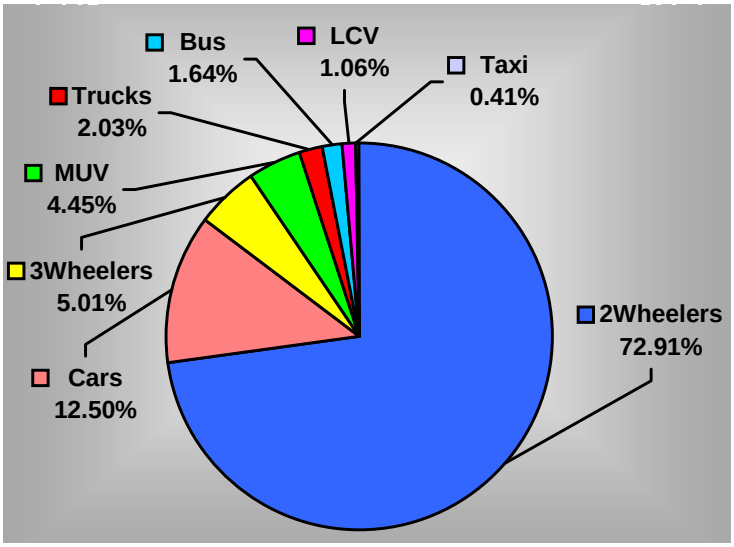


Figure 2-4: Showing the Composition of Vehicles in Ahmedabad-2007

Table 3-1 shows the growth pattern of various segments of vehicle in Ahmedabad in the last three decades. Two stroke engine vehicles (two wheelers & three wheelers) and public transport vehicles have a significant influence on urban air quality. Ahmedabad has one of the highest growth rates of two wheeleres and three wheelers.

Table 2-4: Total motor vehicle growth and growth of two/three wheelers and AMTS buses in Ahmedabad (1961-2007)

Year	All Vehicles		Two Wheelers		Three Wheelers		AMTS Buses	
	Total	Growth	Total	Growth	Total	Growth	Total	Growth
1971	62922	-	21702	-	4865	-	525	-
1981	165620	163%	86550	299%	16741	244%	610	16%
1991	538182	225%	361372	318%	38359	249%	756	24%
2001	1210278	125%	863003	139%	65868	72%*	886	17%
2007	1938518	60%	1422666	65%	90918	38%	1088	15%

Source: Transport Department, Gujarat, Ahmedabad, 2007

2.2.2 Transport Facilities

Roadnetwork

The study area roadway system is approximately 3650 Kms. Other than the National Highway Authority, which maintains National Highways and the State Roads and Buildings Department, the two urban local bodies; AMC and AUDA, are responsible for developing, operating and maintaining road infrastructure.

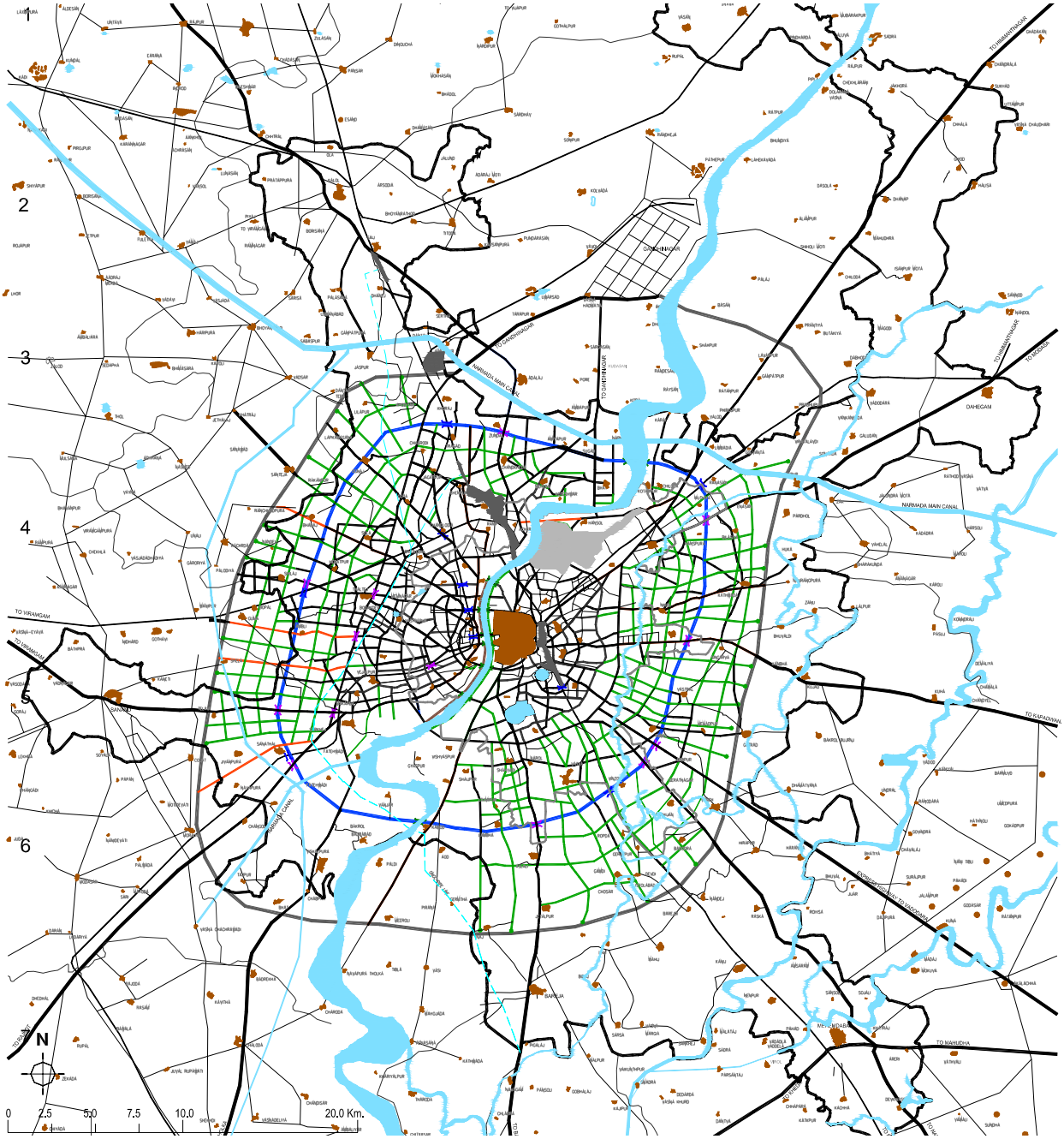
The street network in Ahmedabad evolved historically may be classified as ring-radial form. There are 20 well-defined radials; 12 in the west and 8 in the east, Ashram road, running along the river Sabarmati also functions as a north-south radial. As the need to connect these roads to facilitate cross mobility arose, a series of rings / orbital were added to form ring roads. As defined by AUDA, there are five complete rings within the AUDA area.

The Ahmedabad Municipal Corporation manages a large road network of 2398 km, of which 93% are surfaced roads. Recent efforts at better management of the road network in the city have resulted in effective widening of the main corridors of the city. It is to be noted that a bye-pass road has been built as an alternative to old NH 8 as the road has become a part of the city road network. The share of area under the roads constitutes only 7.5% of the entire city area as against the desired level of 15-18 per cent. This translates to an average road width of 12m. The road density was 6.6 kms per sq.km of area which has come down to 5.5 kms per sq.kms due to merger of areas which are in the process of development. The road network in the central area (walled city of the AMC) is narrow and encroached upon by adjacent activities for parking as well as informal activities. The city has recently removed the encroachments in some areas of the walled city.

Table 2-5: Types of Roads in AMC

Parameters	2000-2001	2006-7
Surfaced roads (km)	1187.1	1823.2
% black topped	93.34	76.0
Un-surfaced roads (km)	84.64	575
Total length of roads (km)	1271.74	2398.2
Length of roads per sq.km	6.66	5.2

Source: AMC Statistical Outline, 2000-2001

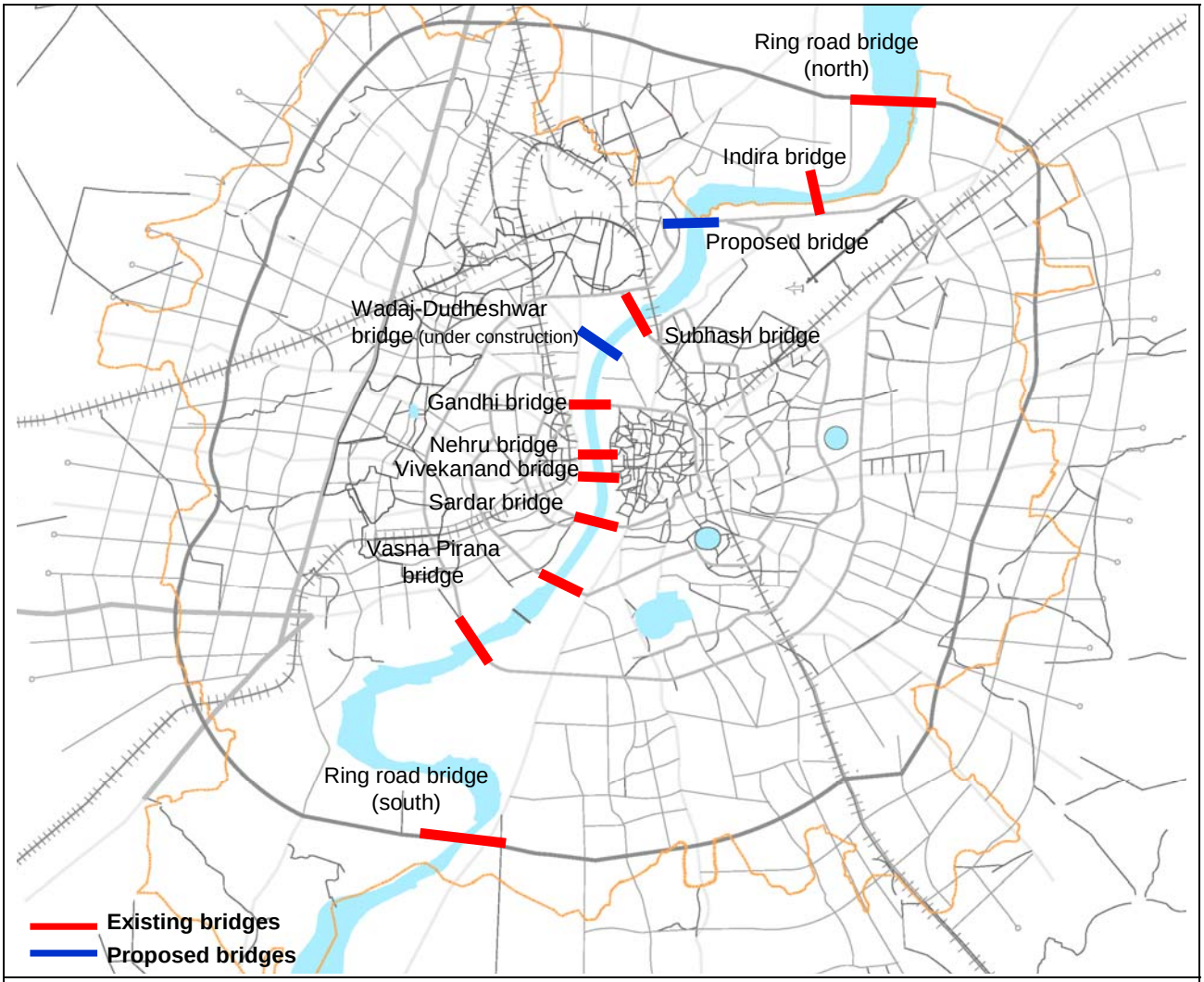


Source: AUDA Development Plan

Map 2-6: AUDA DP Proposed Road Network

Bridges and Flyovers

There are ten bridges across the river Sabarmati and eleventh is under construction, and one is under proposal. Within the study area, 106 Km long B.G. line and 126 Km long M.G line pass through the network. There are 9 rail over-bridges existing in Ahmedabad and 5 under-passes built across railway line.

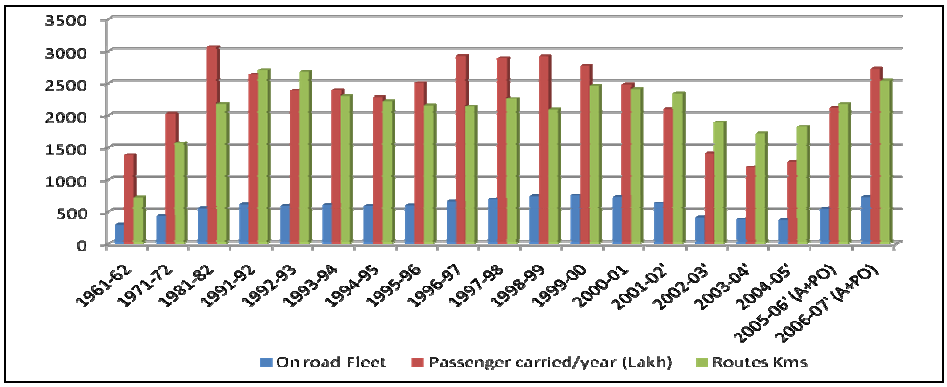


Map 2-7: Existing and Proposed River bridges

2.2.3 Public Transport

In the city of Ahmedabad, AMTS has been providing public transport facilities since 1947. The peak performance of AMTS was observed in 1997 when it recorded about 8 lakh boarding with a fleet size of 820 operating over 164 routes. Due to inherent constraints of public sector body, the agency started suffering a great deal. Excessive manpower, stagnant and aged fleet, poor maintenance, large overheads, non-responsive operations plan became the sources of inefficiency. The organization started loosing heavily. Fleet availability become uncertain forcing reduction in operations. Average daily ridership came down to 325,378 in the year 2004.

As a restructuring policy, to improve transit service, AMC invited private operators to participate in provision of public transport on a gross contract model (kilometre scheme). Since the AMTS was not able to meet the increasing demand of the fleet as well as increasing deficit, the private operators were asked to run the buses in 2005. As on Feb 2008, there are 538 buses operated by private operators and 484 by AMTS taking the total fleet to 1022. Daily passengers (boardings) have gone upto 936,886. This is a clear indication of latent demand waiting to be serviced.



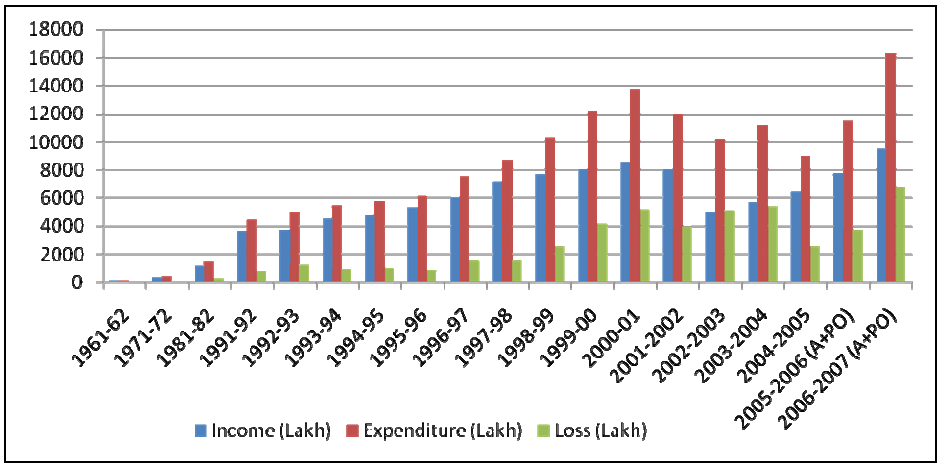


Table 2-6: Level of Operations of AMTS (1948-2007)

Year-ending 31st March	Fleet-size (Buses)	No. of Routes	Service kms per day	Buses per lakh of population	No. of passengers per day
1948	205	38	15000	26	109024
1951	188	57	19755	21	153004
1961	337	100	44038	27	333865
1971	525	164	75757	33	541096
1981	610	205	96685	30	786301
1991	756	248	111452	24	619726
1995	705	180	115123	19	625479
1996	724	170	119563	19	683607
1997	820	164	134192	21	800822
1998	882	166	141726	22	791370
1999	882	132	150134	22	799321
2000	942	144	155675	22	757852
2001	886	140	151245	21	678861
2002	801	136	124375	18	574257
2003	687	115	81802	15	385682
2004	601	110	76028	13	325378
2005	540	117	77411	11	349653
2006	848	131	117536	14	579254
2007	920	141	170255	15	744550

Source: AMTS

2.2.4 Intermediate Public Transport Modes

The intermediate modes for public transport such as the shared auto rickshaws known as "Chakdas" have proved to be stiff competition for the AMTS buses. They ply on the same routes as AMTS at comparative fares. Their operations are mainly concentrated in the eastern part of the city.

2.3 TRAVEL CHARACTERISTICS

Travel patterns, defined in terms of trip rate, mode choice, geographical distribution etc., are the guiding principles in determining the system needs. These are determined by household/ person characteristics such as income, age, sex, occupation, vehicle ownership etc., This section, after a brief description of critical household characteristics, attempts to describe the travel characteristics in Ahmedabad.

2.3.1 Household Characteristics

As per the survey, 80% of the total population is in the active age groups. About 58% of the population are in the working age group years and another 29% in the age-group of students. About 8% of the population belongs to retired and old age category.

About one third of the persons are workers, about one fifth are learners who mainly contribute to two major purposes of travel; work and education. Of the 30% workers dependency on private service or own business is in almost equal proportion (together 25-28%) with only about 4 percent engaged in government service.

Table 2-7: Distribution of Persons by Activity Status

Area	Occupation														total	% age
	govt. service	%age	private service	%age	business	%age	Un-employed	%age	student	%age	house-wife	%age	Others	%age		
Walled city	8208	2	47199	13	55575	16	13307	4	70309	20	113327	32	46817	13	354743	100
AMC west	37594	5	79850	11	99842	13	22519	3	168114	22	233662	31	114200	15	755780	100
AMC east	84978	3	366688	15	267391	11	122712	5	512170	20	771237	31	374947	15	2500123	100
Remainder	121411	5	203333	9	350853	15	103109	4	474312	20	704589	30	363545	16	2321151	100
Total	**252191**	**4**	**697070**	**12**	**773660**	**13**	**261648**	**4**	**1224905**	**21**	**182281**	**31**	**899509**	**15**	**5931798**	**100**

Source: GIDB IPTS Study (2000) by LBA

Vehicle ownership, mode choice and expenditure on transport are dependent on the income levels of the household. The average income in the city per month per household is Rs. 9945.

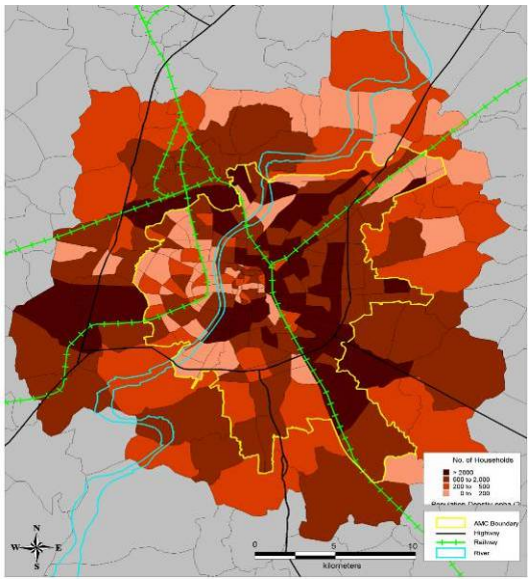
Table 2-8: Distribution of Households by Income Group

Income Range	%ge
< 5000	38.5
5-10000	29.1
10-20000	18.3
20-30000	8.8
>30000	5.3
Total	100

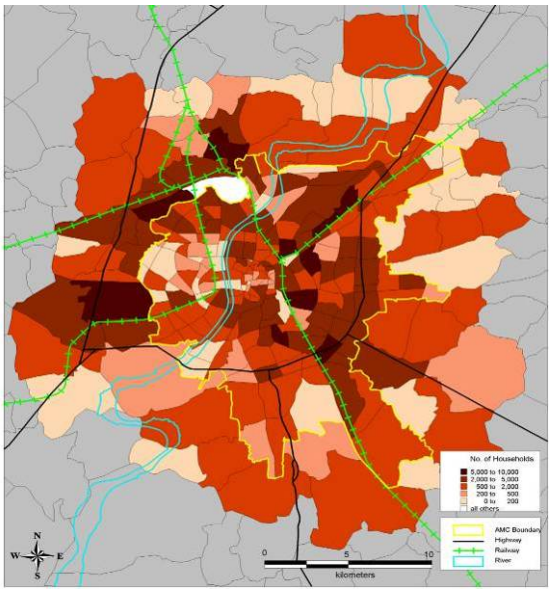
There are still a large number of households (39%) having income less than 5000 per month. Even after accounting for some understatement of income, the level is still high. The dependence on walk and bicycle continue to be significant. Bus as mode of transport also has a potential. Similar trends have been observed in the recent survey of GIDB Metro Study (2004) by DMRC. The income distribution is more balanced when compared to Surat and Bangalore.

It is also important to note that urban poor is faced with limited choices in terms of residential location. In a segmented market, they would locate themselves based more on social factors. This factor should be integrated while choosing network for transit development.

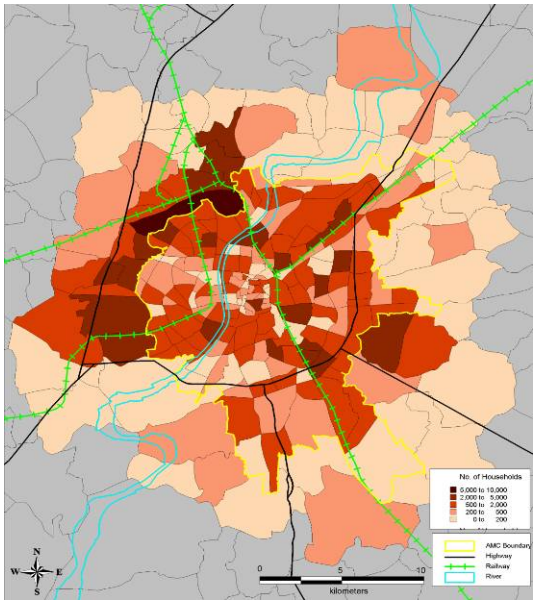
EWS Households



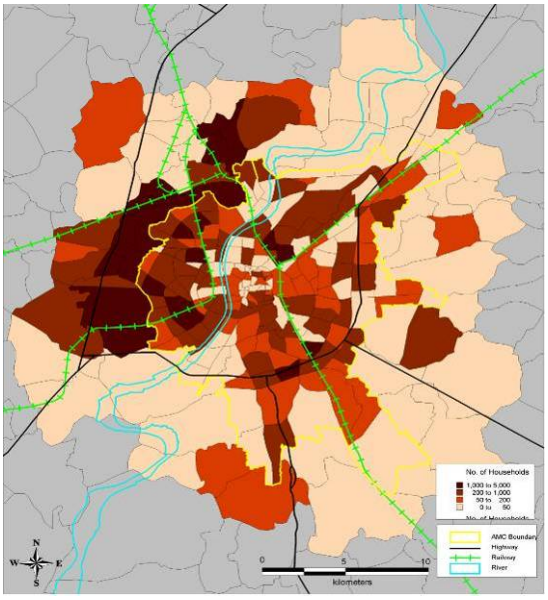
LIG Households



MIG Households



HIG Households



Derived from GIDB IPTS Study (2000) by LBA

Map 2-8: Income group wise Distribution of Population

Vehicle Ownership: Despite the progress in the economy, large number of households (31%) still does not own motorized vehicles. Of these 8% do not own any vehicle while another 23% own only bicycles. This clearly emphasizes the need for building facilities for bicyclists and pedestrians. This is also a group who are captive to public transit. About 60% own two wheelers and another 10% own cars.

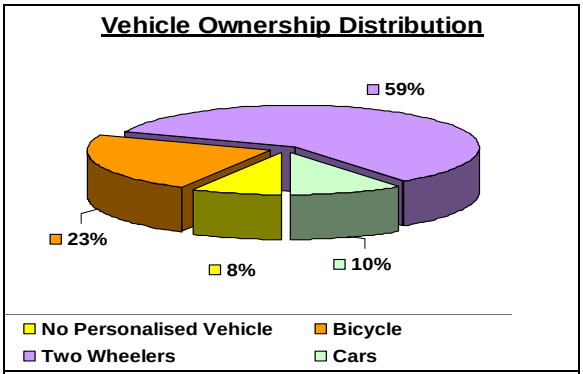
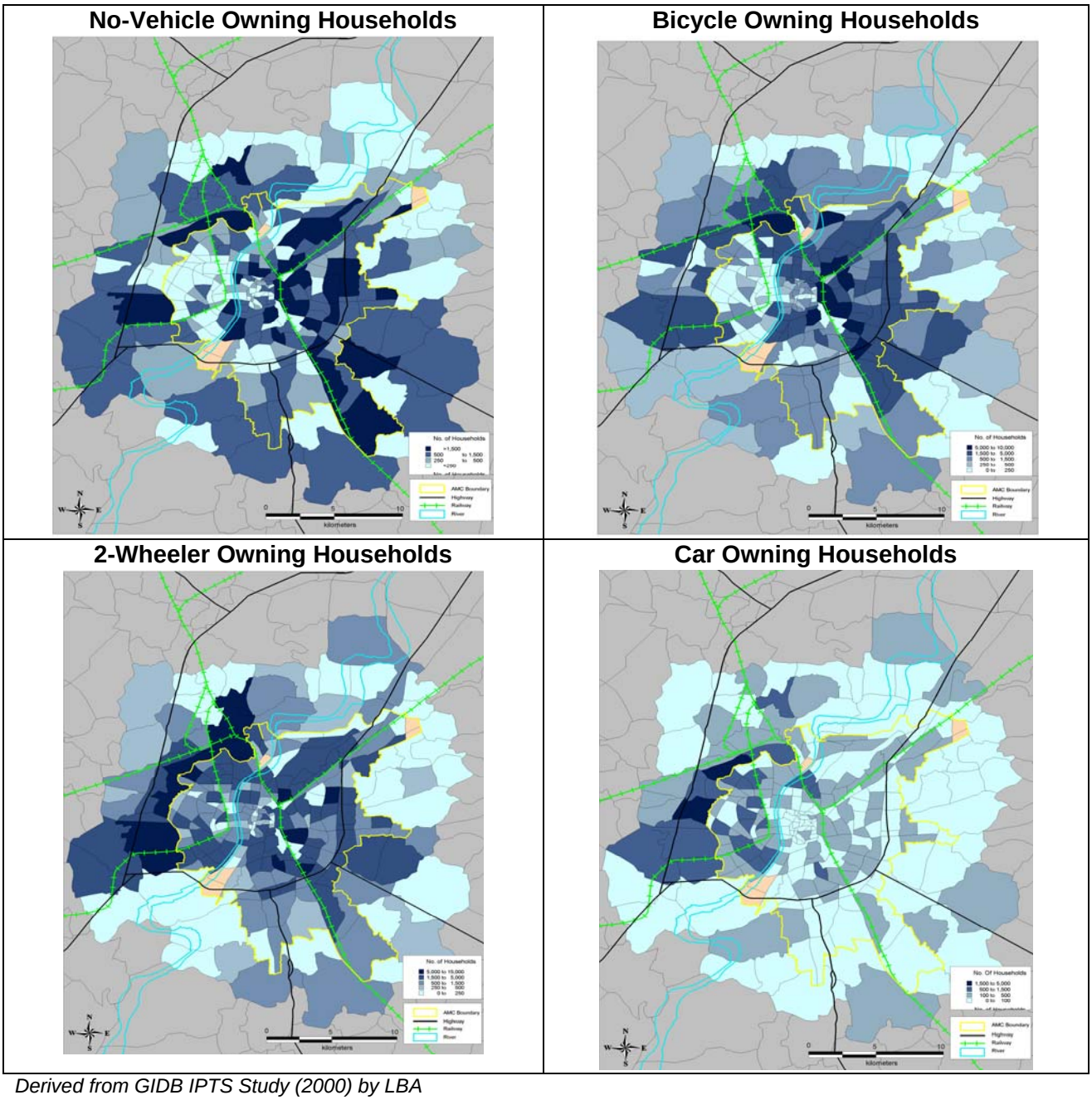


Figure 2-5: Vehicle Ownership Distribution



Derived from GIDB IPTS Study (2000) by LBA

Map 2-9: Spatial Distribution of Households by type of vehicle ownership

2.3.2 Travel Characteristics

The per capita trip rate including walk, as per AMTS/CEPT (1992) was 1.2, GIDB IPTS 2000) was 1.1 trips per day, GIDB Metro study by DMRC (2003) was 1.16. The same excluding walk was 0.72. Per capita motorized trip rate was 0.52.

However, recent study by CEPT show trip rate to be high at 1.92 (all trips). The trip was defined as more than 500 meters. About 80% of the walk trips were less than a km distance. If we exclude all trips having length less than 1 km trip rate works out to 1.14 excluding walk trips is 0.99 and motorized trip rate at 0.77.

Table 2-9: Travel Characteristics

Travel Characteristics	**2006**		**Mode Choice & Trip Length**		
Family Size	4.9		**Mode**	**%age**	**Length (Km)**
Workers/HH	1.6		Walk	13.2	2.2
Avg. Income	8728		Bicycle	18.8	3.3
% HHS without personalized Vehicles	8		2 Wheeler	35	5.4
% with only bicycles	10		Auto Rikshaw	8.8	4
Trip Rate - all (> 1km)	1.14		4 Wheeler	3.1	6
Trip Rate - Excl Walk (>1km)	0.99		Bus	15	6.2
Trip Rate- Motorized Vehicles > 1km	0.77		Others	5.8	4.6
			Total	**100**	**5.4**

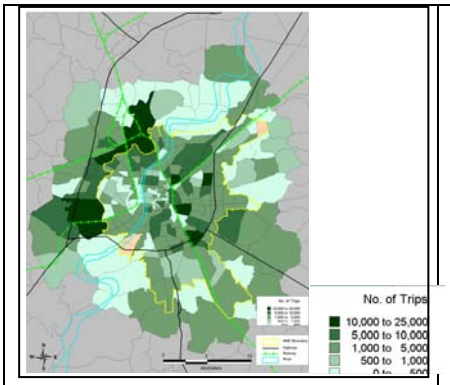
Trip Purpose: Work trips form 23% of the total trips followed by education trips at 19%. An important element is that about 8% are transfer trips. An assessment of transfer trips was also made. Of the total trips, about 8% constituted transfer trips. These trips involve movements using one or both the public or intermediary public transit mode.

Table 2-10: Trips by Purpose

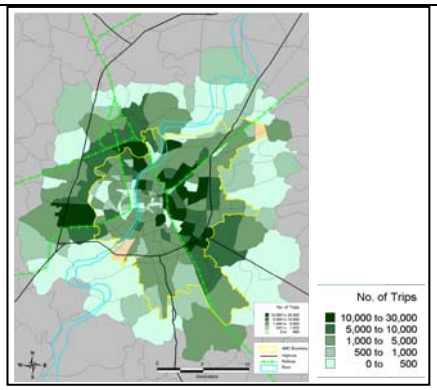
Sr. No.	**Trips by Purpose**	**%Trips**
1	Work	18.41
2	Business	9.27
3	Education	18.79
4	Others	4.56
5	Return	48.97

Mode Choice: About one third of the trips (trip length exceeding 1 km) are bicycle or walk trips. Walk trips are short with a length of 2 kms. Bicycle trips are about 3 kms. Two wheeler trips alone constitute a third of trips. Average trip length is 5.5 kms. About 9% are auto rikshaw trips. Bus trips accounted for 15%. Car trips constituted a small proportion of total trips.

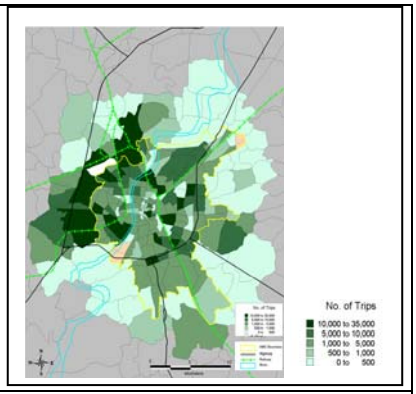
Zone-wise Demand for Different Modes



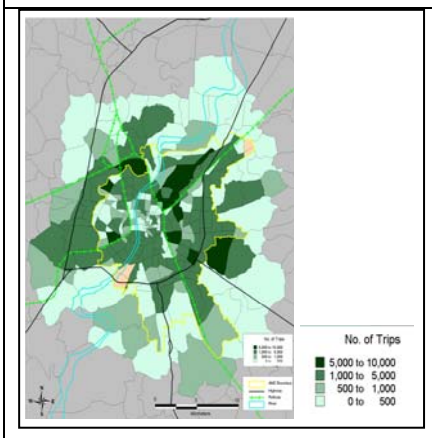
Zonewise demand for bus



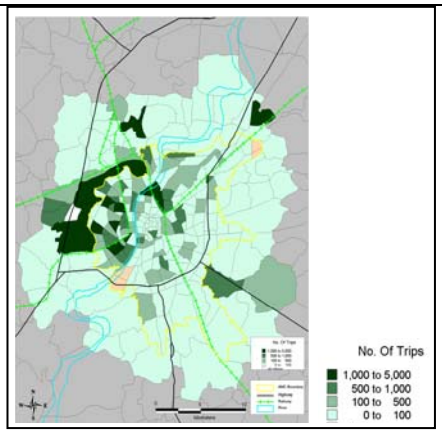
Zonewise demand for bicycles



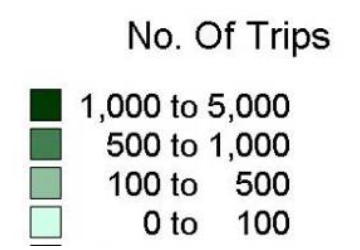
Zonewise demand for two-wheelers



Zonewise demand for shared auto



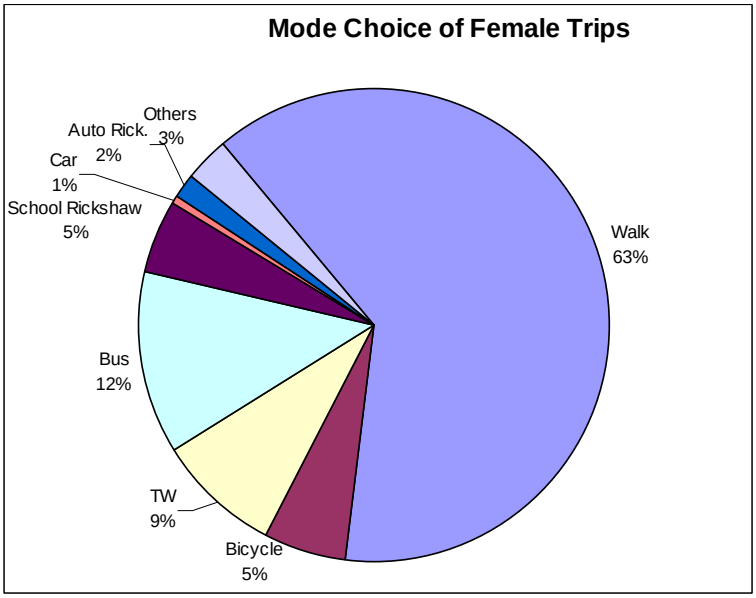
Zonewise demand for cars



Legend

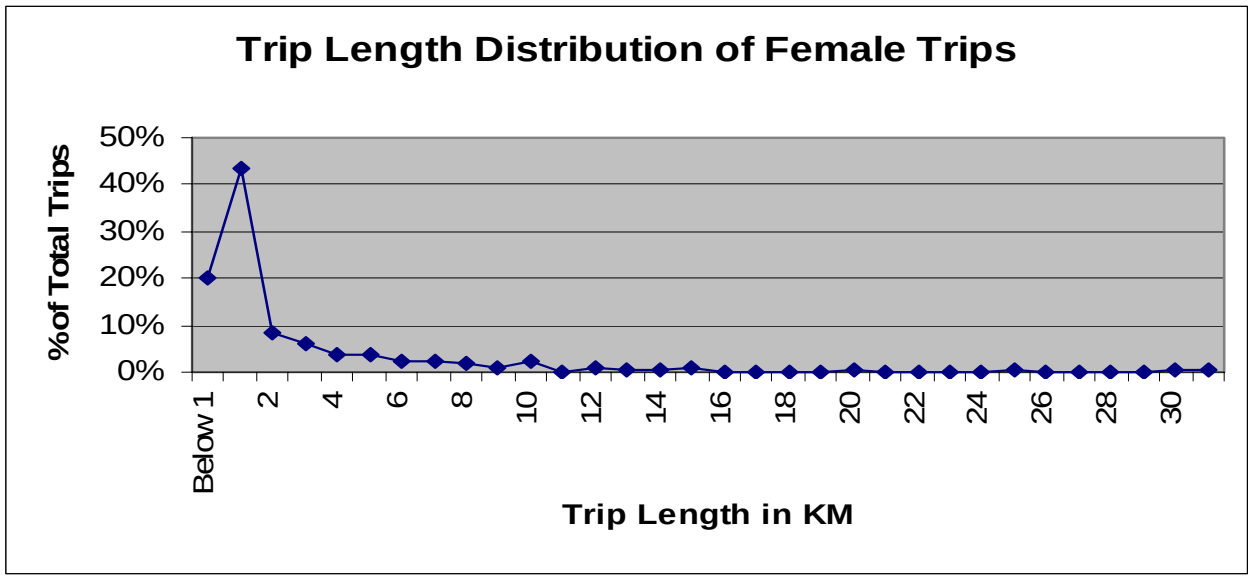
Travel Pattern by Women:

Average daily number of trips made by women are 1,555,000 trips (2000) constituting about of the total trips. Most of them walk (63%). About 12% depend on buses. Trip lengths made by women are also shorter.



Derived from GIDB IPTS Study (2000) by LBA

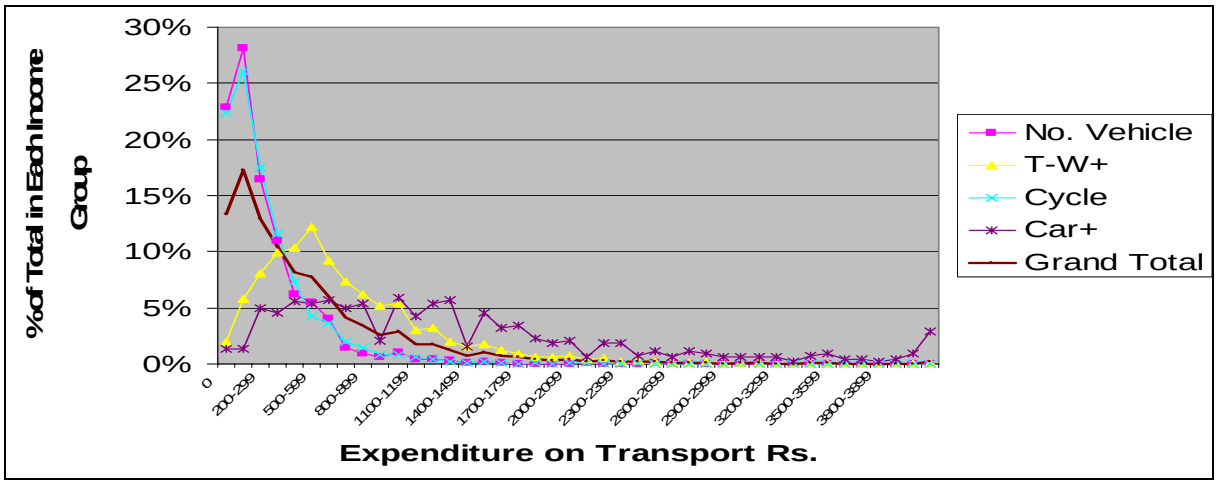
Figure 2-6: Mode Choice of Female Trips



Derived from GIDB IPTS Study (2000) by LBA

Figure 2-7: Trip Length Distribution of Female Trips

Monthly Expenditure on Travel: In Ahmedabad on an average households spend about Rs. 200 to 500 per month on transport.



Derived from GIDB IPTS Study (2000) by LBA

Figure 2-8: Vehicle Ownership and Monthly Expenditure on Travel

2.3.3 Movement Pattern

The outcome of interaction between socio-economic characteristics, land use and transport system results in a movement pattern. Distributed pattern of movement is evident in the desire line presented below, A large number trips cross the river. As expected, the walled city (Kalupur, Gita Mandir), Naroda, Odhav, Vatva industrial estates, Ashram Road, CG Road, 132 feet ring road and Highway are major trip attraction places.

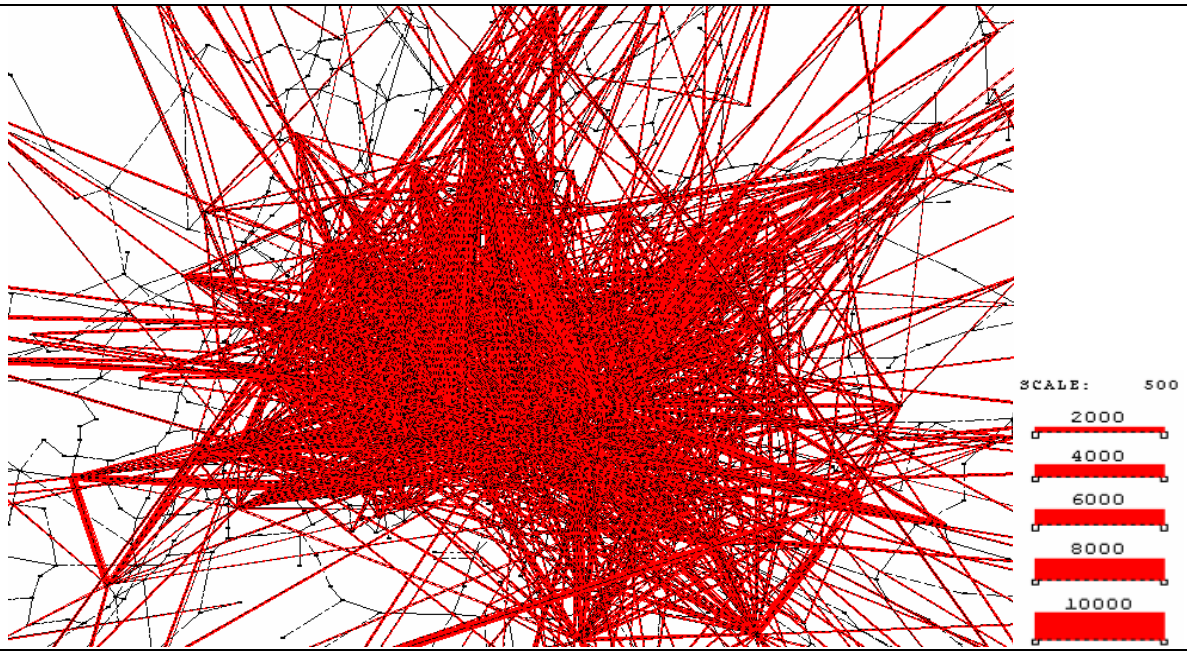


Figure 2-9: Desire line Diagram - 2000 (Total Zone-Zone Movement in excess of 300 Trips)

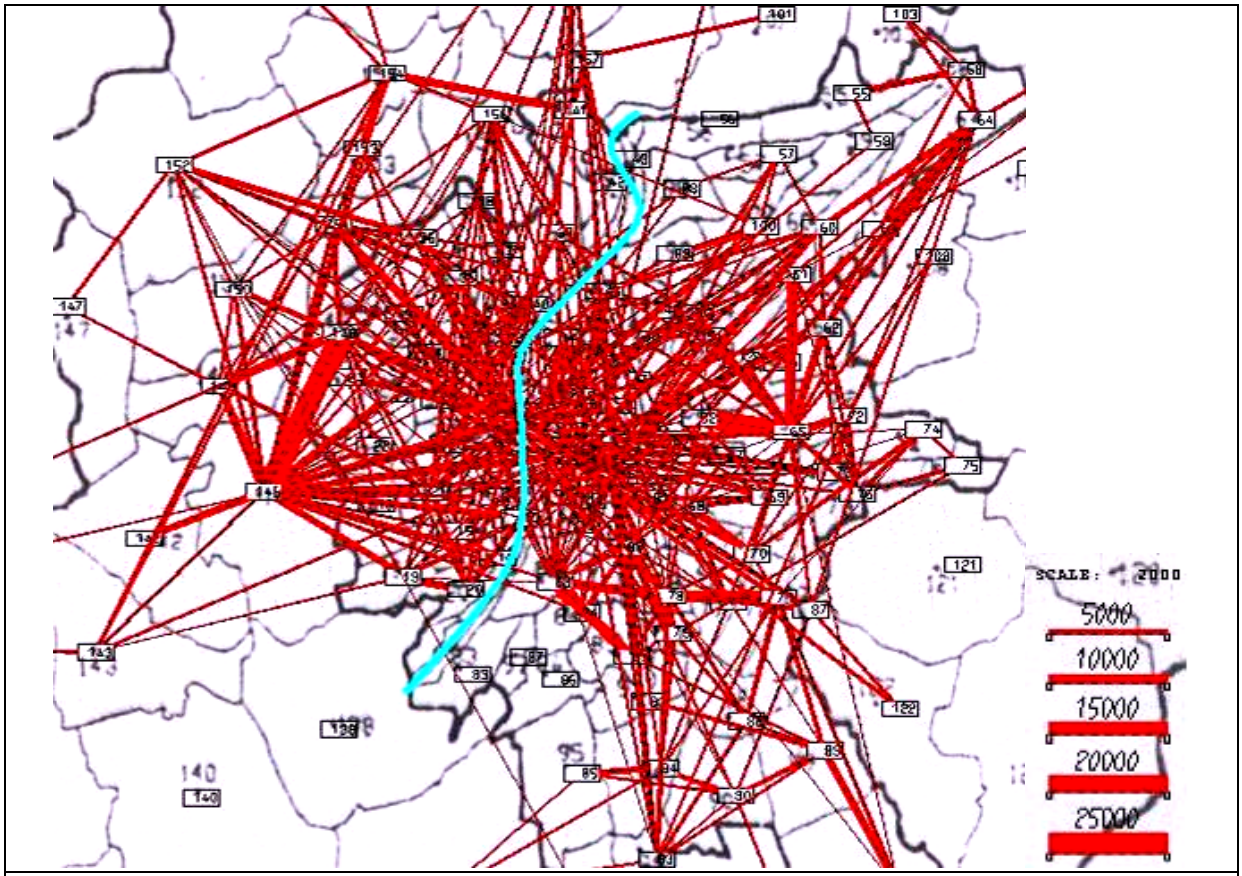


Figure 2-10: Desire line Diagram – 2003

2.4 TRANSPORT SYSTEM PERFORMANCE

2.4.1 Traffic Volume

Traffic congestion on the city roads of Ahmedabad is still moderate when compared to many other cities of similar size. However, with rapid rate of motorisation, the congestion levels are begining to show up on certain stretches. The western part of the city has developed as a mainly residential area and the eastern part has the industrial estates. Because of this, the traffic flow is heavy from west to east in the mornings and vice-versa in the evening, which causes traffic congestion and frequent traffic jams on the city roads during morning and evening peak periods. Traffic volumes on major roads has been presented in the map below. As may be observed, volumes exceed capacities at some places.

The results of traffic volume count survey conducted at eleven locations on the potential corridor as part of this study is presented in Table below.

Table 2-11: Traffic Volume at different locations

Location	Traffic Volume (in No.), 16 hrs	Traffic Volume (in PCU), 16 hrs	Peak Hour Traffic (in No.)	Peak Hour Traffic (in PCU)	Peak Hour
MB-01: Andhjan Mandal - Nava Vadaj	59732	42845	5877	3856	19:45-20:45
MB-02: Sahajanand Complex	67057	43340	6806	4204	20:00-21:00
MB-03: Akhbarnagar U/Bridge	66826	47763	8097	5456	18:15-19:15
MB-04:Prabodh Raval Bridge	71705	47911	8276	5265	18:15-19:15
MB-05: Airport 'T'/Hotel Taj Residency-Umed	38905	31303	3700	3064	19:15-20:15
MB-06: Kotarpur W/Works. Nr N H 8	12485	10057	1379	1097	18:15-19:15
MB-07: Naroda ST Workshop on Kalupur-Naroda Rd	58837	47764	4581	3545	9:30-10:30
MB-08: Krishna Nagar	57696	48261	4736	3746	19:30-20:30
MB-09: Chamunda Nagar	67278	51949	6785	5126	20:00-21:00
MB-10:Jivan Park	57040	50107	5381	4759	18:30-19:30
MB-11: Nr Someshwar Bunglows	66380	43765	6771	4207	20:00-21:00
MB-12: Ashram Road*	53343	39688	7812	5485	09:45 -10:45
MB-13: Anjuma high school*	42415	29097	9577	6798	18.15 - 19.15
MB-14: ONGC*	18169	13890	4932	3705	09:00-10:00
MB-15: Sabarmati Snanagar*	22770	17269	6146	4405	09:00-10:00

Source: CEPT Survey
**Traffic data for 5 hrs only*

The survey was conducted for 16 continuous hours (06:00 to 22:00 hrs) on pre-designed proforma manually. The mode wise traffic volume has been converted to equivalent passenger car unit using PCU factors. The analysis of traffic composition reveals more than 70% two-wheeler and around 10% cycles which is a reflection of the almost non-existence for public transport on corridor.

2.4.2 Travel Speeds

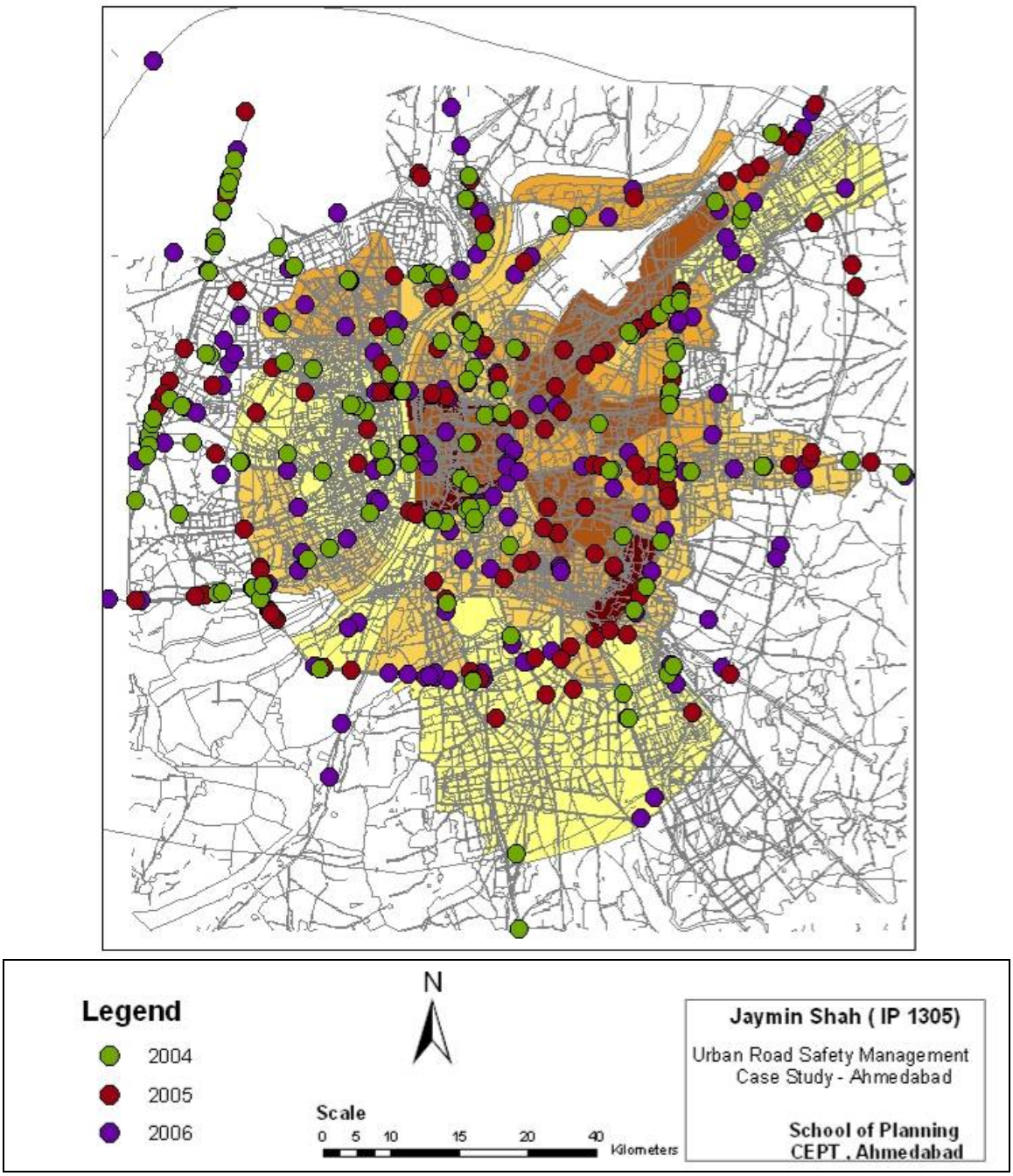
Detailed study of bus speeds has also been caried out. The speeds works out to 18.7 kms/ per hour for AMTS buses. Inner city network offer lower speeds.

2.4.3 Accidents

Total number of accidents have been declining. They have come down from 2931 in 1991 to 2718 in 2001 and to 2601 and 2605 in 2006 and 2007 respectively. Last year 220 persons got killed in the road accidents. The number is one of the lowest in the country. Some reduction in number of accidents has been observed in the recent past.

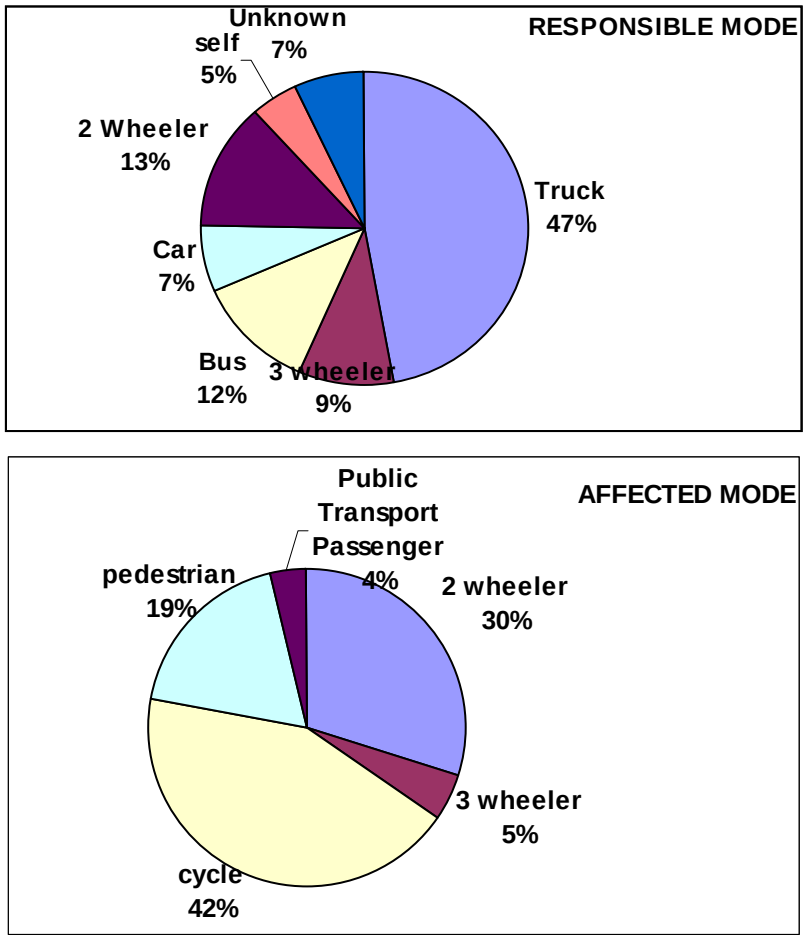
Table 2-12: Population, Vehicles and Accidents in Ahmedabad City

Year	Accidents	Fatal accidents
1961	643	38
1971	866	73
1981	1676	144
1991	2931	192
2001	2718	162
2002	2652	178
2003	2589	155
2004	2425	176
2005	2460	181
2006	2601	238
2007	2605	248



Map 2-10: Fatal Accident Spots in Ahmedabad

The stretches along Vasna-Sarkhej and Narol-Naroda highway accounted for almost 50% of the total fatal road accidents that occurred in Ahmedabad. These roads have higher travel speeds and a higher composition of regional traffic, which consists of trucks and light commercial vehicles. An analysis of causes of fatal accidents (Refer Map above) indicates that trucks accounted for causing about 47 per cent of total fatal deaths in the city. The pedestrian traffic accounts for causing about 19% of total fatal deaths in the city, and there is a high level of pedestrian traffic along the Narol-Naroda Highway at certain locations, but lack of proper pedestrian facilities such as footpaths and zebra crossings. Over 40% of fatalities belong to those on bicycles.



Source: Safe Traffic Advocacy Cell, School of Planning, CEPT University

Figure 2-11: Responsible and Affected modes for Fatalities

2.4.4 Effects on Air Quality

The city of Ahmedabad has seen a rapid growth in two wheeler population in the last two decades, which has also resulted in rising pollution levels in the city. As a result the city has been included under the air quality monitoring. In 2001, the city was ranked number 4 among the polluted city. Things have improved since then due to various efforts by the local government. In 2007, the city was ranked 43.

3 Mobility Plan Proposals

3.1 TRAVEL NEEDS ASSESSMENT

With economic development potential continuing to getting brighter, the pace of growth in the city is likely to receive further momentum. The population and employment in the city is expected to grow at a rapid pace during the next 3 decades. Estimated population by 2035 is around 10.9 million with an employment level at 1/3rd of the population. The forecasts are presented below (Table 5-1). Based on an assessment of economic development prospects and the demographic trends, population and employment in Ahmedabad region is forecasted as below.

Table 3-1: Population and Employment Forecast

Sr. No.	Year	Population	Employment	Approx. Area (Ha)
		In Million		
1	1981	2.5	0.8	19000
2	1991	3.4	1.1	23000
3	2001	5.4	1.8	30000
4	2011	7.4	2.4	50000
5	2035	10.9	3.7	120000

Source: GIDB/LB (2000) 'Socio-Economic & Land use Studies

With a balanced distribution of activity systems in the city, the impact of proposed development on the transport network will be one of the areas for immediate focus.

Table 3-2: Summary of Travel Demand Forecast

Sl. No.	Item	2008	2011	2025	2035
1	Population	6.7	7.4	8.4	10.9
2	Employment	2.2	2.4	2.8	3.7
3	Trip Rate	0.88	0.9	0.95	1
4	Trips	5.9	6.7	8.0	10.9
5	% Transit Trips	18	25	40	40
6	Transit Trips	1.1	1.7	3.2	4.4

About 80% of estimated transit trips i.e. 8.5 lakh trips are performed within the city. Medium term plan for the same has been outlined in chapter 7 on operations plan.

Given the strategic nature of the initiatives, the objective is to enhance accessibility and mobility options of the people of the city as a whole in an integrated framework rather than a limited part intervention focused only on bus or rail. One of the priority remains in the form of facilitating cycling and walking. Promotion of these modes would compliment public transport development as well as from a larger environmental concern of this project. BRT is one of the tools being used to attract users of other modes and will also fill the gap in public transport. Affordability will also be an issue, as the proposed system will also need to compete with the intermediate public transport systems. It is expected that by 2025 roughly 40% of the trips would performed using public transport.

3.2 VISION AND STRATEGIES

The trans-vision of Ahmedabad captioned as 'Accessible Ahmedabad' is to redesign the city structure and transport systems towards greater accessibility, efficient mobility and lower carbon future. The vision focuses on:

- Reducing need for travel
- Reducing the length of travel
- Reducing automobile dependence

These are the concepts embedded in the National Urban Transport Policy (NUTP) of Government of India. To provide affordable solutions, cross subsidy mechanisms would be evolved. Transit investments often contribute to increase in land value and hence mechanisms to capture the value for sustenance of the system operations are required. Private participation is conceived as an integral part of system operations. In line with this, AMC has decided to develop and implement an integrated public transit system which includes:

- A Suburban Rail Transit System to connect the city with its industrial suburbs such as Kalol, Naroda, Mehmedabad etc.,
- A Metro Rail System to cater to major high intensity movement between the City and Gandhinagar,
- A Bus Rapid Transit System to cater to major mobility needs of the city,
- A regular Bus System to support BRTS,
- Decentralised Regional Bus & Rail Terminal
- Clean Air Action Plan (CNG Introduction)

Recognizing that no single mode would cater to the mobility needs of the city and that the 'Bus' forms the most critical segment of the public transport system in the city, the city government have accorded priority to improve the existing bus system run by AMTS and introduction of BRTS. AMTS fleet has been increased through private participation. The Ministry of Urban Development, Government of India, has sanctioned development of BRTS in Ahmedabad, which includes, among other things, development of exclusive roadway over 58 kms. The buses are procured through private participation on gross contract. Ticketing system is hived out to private party to manage. Pedestrian access facilities are being developed on PPP basis. The project is under advanced stage of implementation. A company, Janmarg Ltd., has been established as a special purpose vehicle to manage BRTS in Ahmedabad.

To maximize on the gains from the investments made as part of phase-1 project, the city government had identified certain critical activities to be taken up. They included:

- Adding another 30.5 Kms of roadway to BRT network, which is seen as part of Phase-2 proposal submitted to government of India.
- Adoption of fully external ticketing system and introduction of ITS for phase-1 and phase-2 project
- Introduction of ITS and automatic ticketing of AMTS

These have been sanctioned as part of Phase-2 proposal by the Ministry of Urban Development, Government of India under JnNURM. To optimise the outcomes, certain critical activities are still to be covered, which have been proposed under the GEF project. These are:

- Integration of BRTS and AMTS ticketing system
- Development of a Bicycle Plan including introduction of bicycle rental scheme
- Preparation of Transit Oriented Plan
- Capacity Building of Janmarg

3.3 TRANSIT PLAN PROPOSALS

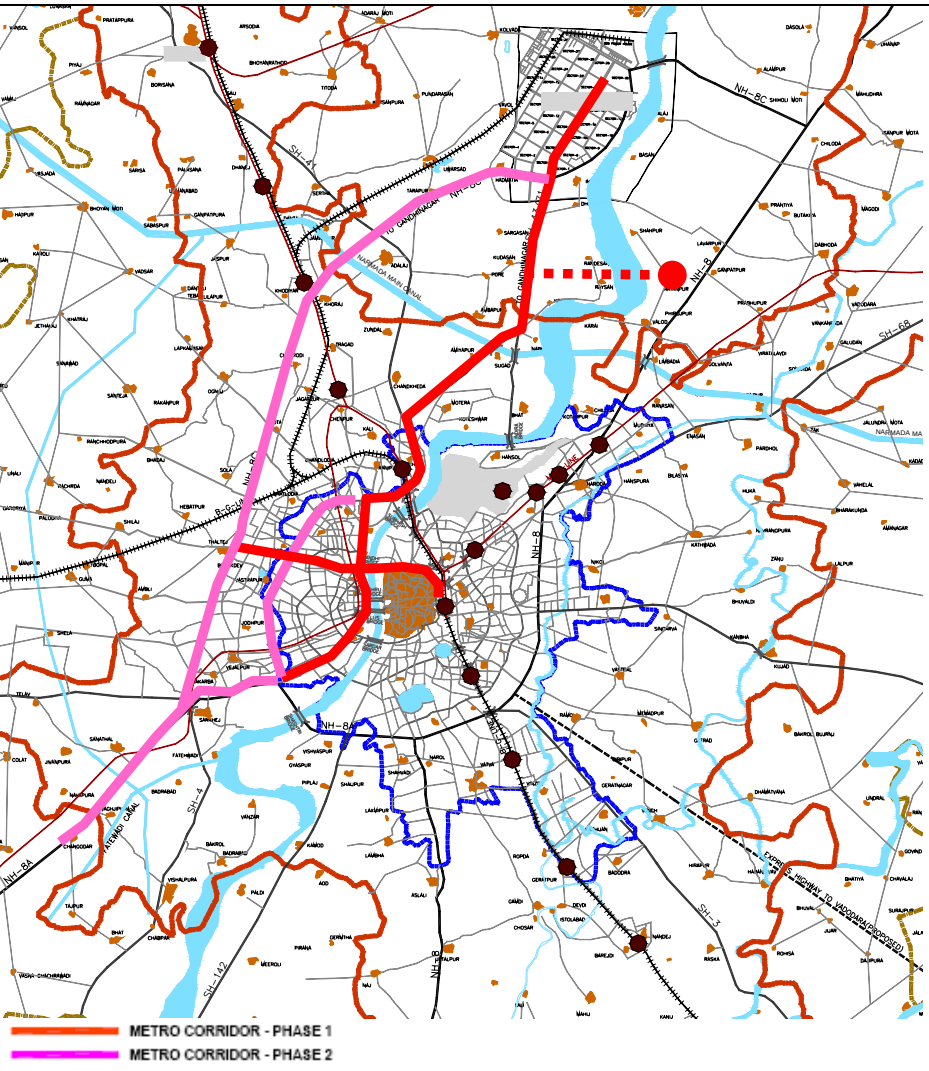
The components of the public transit plan have been presented below.

3.3.1 Metro Rail System

A proposal for metro rail has been under consideration since 2003. The DPR proposes a total of 99.65 kms of metro rail system connecting Ahmedabad with the state capital Gandhinagar in two phases. The proposal for phase-1 covering a length of 54.75 (line -1 &2) is under active consideration.

Table 3-3: Proposed Metro Corridors

Section	Length (in km)	Number of Passengers (in Lakhs)	Passenger km (in Lakhs)	Passenger km/km (in Lakhs)	Cost (in Lakhs)
Line1: Changodar-Vishala-ITO-Sabarmati – Akshardham	**45.1**	**13.27**	**126.85**	**2.81**	**3382.5**
Line2: Kalupur- ITO- thaltej	**9.65**	**6.28**	**52.81**	**5.47**	**723.75**
Line3: Vishala-RTO	12.5	2.25	20.56	1.65	937.5
Line4: Sarkhej- Indroda Circle	32.4	8.18	87.61	2.7	2430
Total	**99.65**	**29.98**	**287.83**	**12.63**	**7473.75**



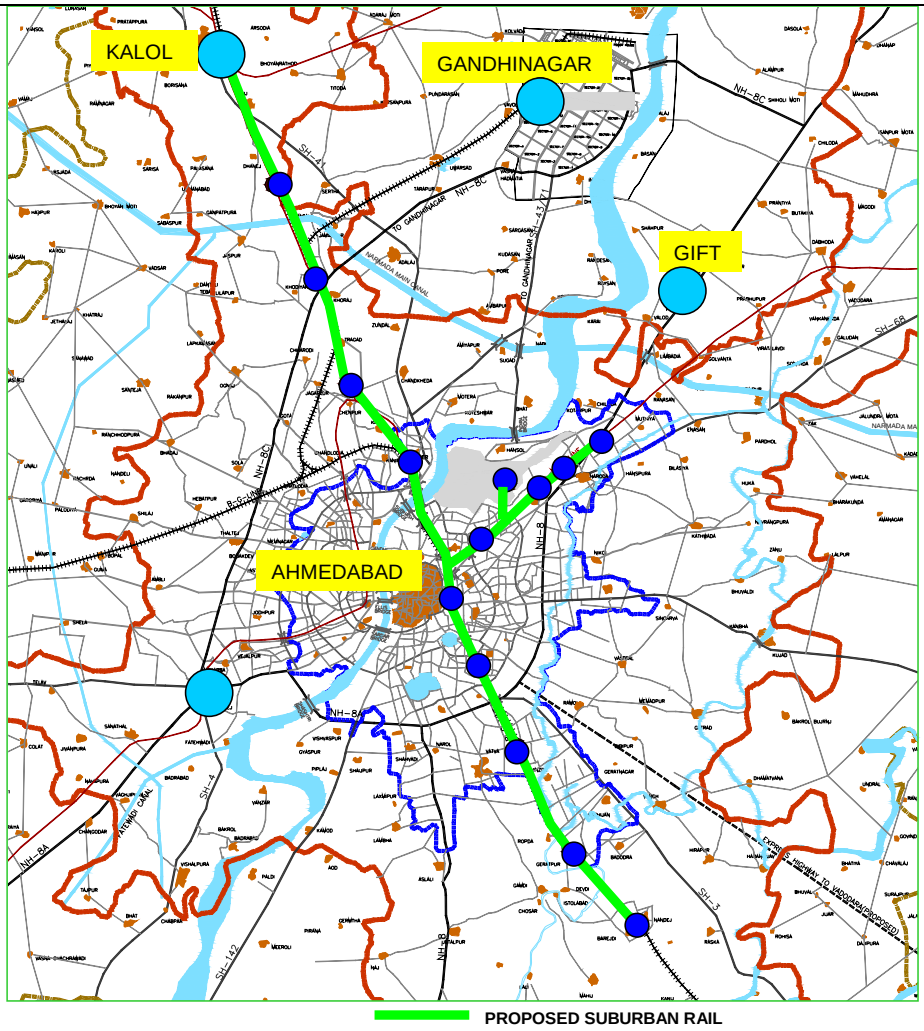
Map 3-1: Proposed Metro Corridor

3.3.2 Regional Rail System

A regional rail corridor has been proposed using additional space available along the existing rail line. The proposal has been forwarded to the Ministry of Railways. The proposal consists of 153 kms connecting core city with Naroda, Kalol, and Barejadi with 25 rail stations. The proposal is under active consideration of the Railway Ministry.

Table 3-4: Proposed Sub-urban rail network

Section	Length (km)	Number of Passengers	Passenger km	Passenger km/km	Cost
	Km	*Lakhs*	*Lakhs*	*Lakh*	*Lakh*
Line1: Barejadi-Kalupur-Kalol	43.5	2.47	34.3	0.79	957
Line2:Kalupur-Naroda	9.4	1.65	13.73	1.46	206.8
Total	**52.9**	**4.12**	**48.03**	**2.25**	**1163.8**



Map 3-2: Proposed Regional Rail Corridor

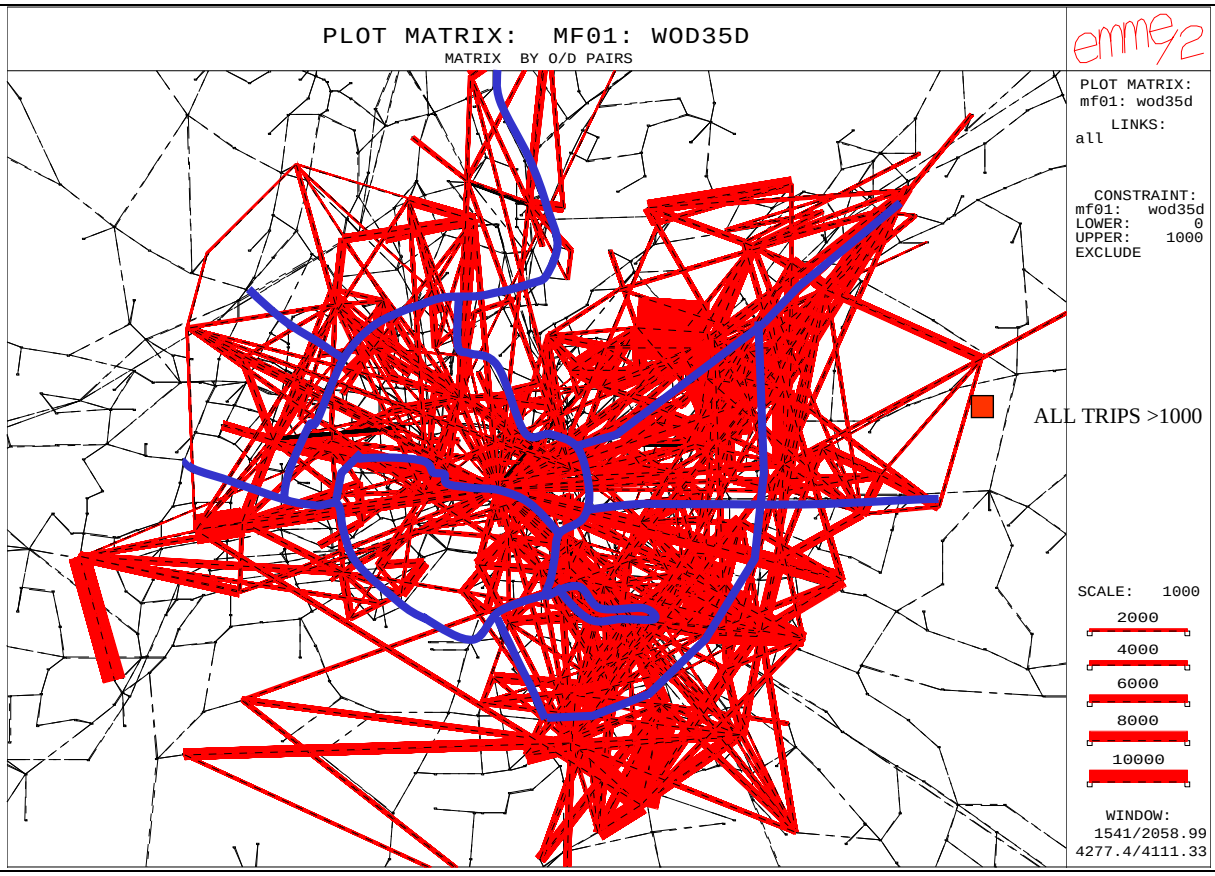
3.3.3 The BRT

Bus Rapid Transit system was proposed by AMC as a viable transit option for Ahmedabad In the year 2005. The first phase of the project covering 58 kms is under advanced stage of implementation. The primary objective of identifying and developing phase 2 corridors is to complement the 58 km of phase 1 being built now and to make more areas of Ahmedabad

accessible through BRT. Phase 2 corridors attempt to link more destinations and also access the central areas of the city. The outlying suburbs which are developing rapidly are also linked with the BRT network.

The guiding principles for identifying phase 2 corridors are:

- They should feed demand into phase 1 corridors and vice versa
- They should link more destinations (residential hubs, commercial hubs, educational institutes and transport hubs)
- They should access EWS areas and provide more options for the lower income group
- They should have potential for new development and redevelopment (transit oriented development)
- They should be feasible to implement
- They should provide system wide impact and
- They should access critical destinations, yet not pass through congested streets.



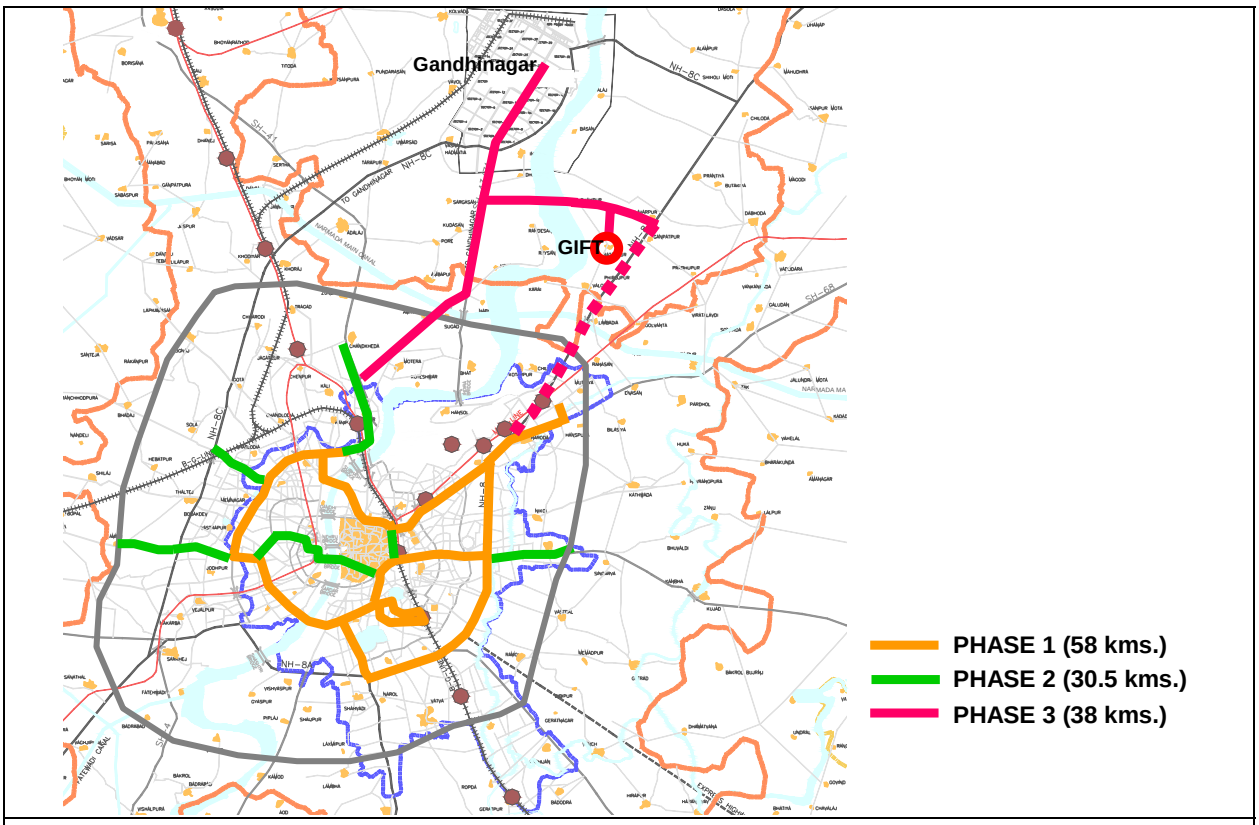
Map 3-3: Travel demand pattern - 2006

System wide impacts include relief from congestion, improved safety, maximization of the rider ship serving the needs of the poor, provision of opportunities for transit-oriented development and integration with other modes. The expected impacts have to be citywide and not limited to small areas.

Keeping the above principles in mind, a further 30 km of trunk corridors has been identified, which will make the BRT network complete and generate higher demand on the entire corridor. The proposal was sanctioned by the Government of India on August 19, 2008. With this the total length of exclusive BRT network is 88.8 kms. This would enable BRT system to pass through central area, busy commercial areas in the intermediary circle of the city and to the educational

hub, where over 15000 students come to study every day. Third phase proposal connects the city with the state capital and the emerging business district of Greater Ahmedabad, GIFT city.

The selected corridors in three phases, have been depicted in the map below.



Map 3-4: Proposed BRTS Corridor

As shown in the above map, a total of 88.5 km of BRT trunk corridors would be implemented. After implementation of phase 1 and 2, it is important to note that:

- All major railway stations will be linked by BRT
- All major GSRTC terminals will be linked by BRT
- The major educational hub in Navrangpura will be on the BRT network
- Industrial suburbs of Odhav, Naroda, Narol and Vatva will be on the BRT network

Upcoming residential suburbs of Chandkheda, Satellite, Bopal will be linked by BRT

Most of these routes were identified as phase 2 even during preparation of phase 1 DPR. An important departure from phase 1 planning has been the introduction of the route from Gujarat University to Geeta Mandir via CG road, Law garden, Ellis bridge and Astodia. This route has been considered now because of implementation of the Development Plan RoW by AMC on the Ellis bridge to Astodia link in 2007.

Table 3-5: Passenger demand

Sl. No	Population Forecast (million)	Trip Rate	Total Trips (lakh)	Target Public Transport Share %	No. of Passengers (Public Transport) mill	Passenger Lead (kms)
2008	5.50	0.88	4.84	20.0	1.0	6.5
2009	5.66	0.88	4.98	22.0	1.1	7.0
2010	5.83	0.88	5.13	23.0	1.2	7.0
2011	6.00	0.90	5.40	25.0	1.4	7.0
2012	6.18	0.90	5.56	27.5	1.5	7.0
2013	6.36	0.90	5.72	28.0	1.6	7.5
2014	6.54	0.90	5.89	29.0	1.7	7.5
2015	6.73	0.90	6.06	30.0	1.8	7.5

Table 3-6: Bus Operating Characteristics and Fleet Requirements

Year	Occupancy Ratio	Avg. carrying Capacity/Bus	Vehicle Utilization (kms)/ Day	Fleet. Utilization	Total Fleet Required
2008	55	60	210	85	1069
2015	70	75	220	95	1242

Three types of bus transit services are envisaged. They are:

- BRT Services (Trunk)
- Complimentary services
- Feeder Services

The complimentary services are on second order trunk routes and in future these may be clubbed as BRT or BRT feeder depending on the importance and network connectivity.

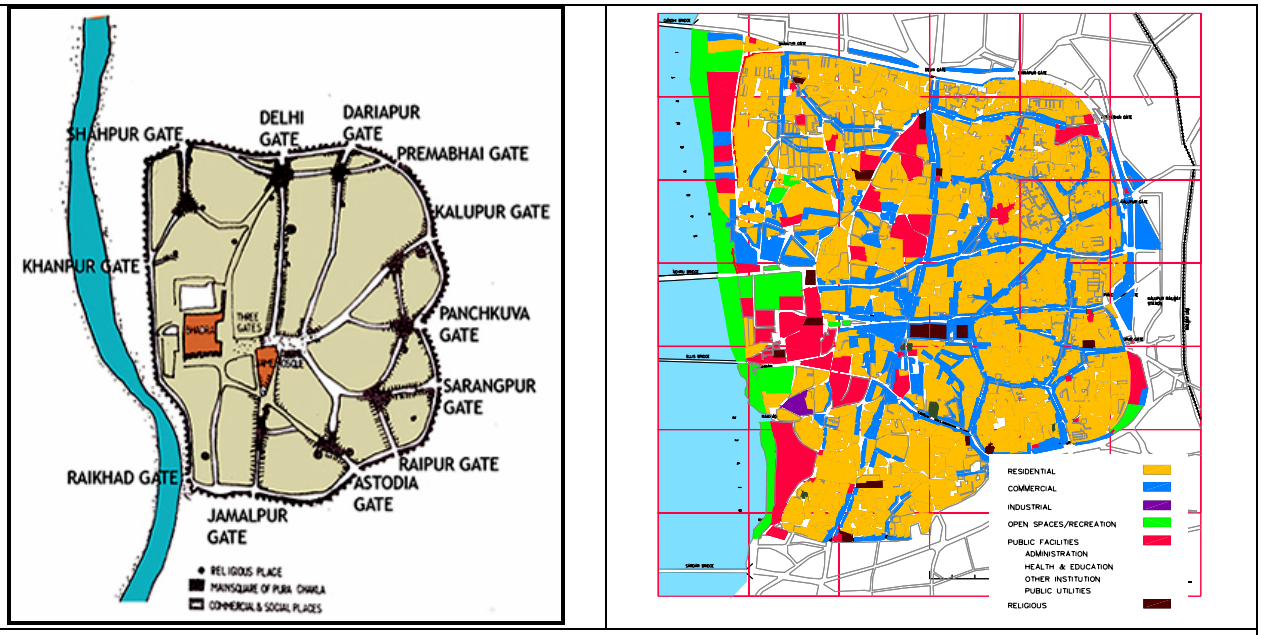
3.3.4 Other Complimentary Actions

Ring Road: Intrusion of regional commercial traffic, in addition to congesting the urban road network, is a major cause for accidents. Detailed proposals to minimize intrusion of regional traffic through building of outer ring road, development of interception terminals by State Road Transport Corporation and developing logistic hubs are under way. Ring road has already been built. Widening is underway.

Goods Terminal: Due to absence of organized goods terminal in the city, heavy trucks ply on congested city roads causing fatal accidents. Based on the origin-destination of goods movement, four potential locations (one in each direction of major goods entry) have been identified.

Regional Passenger Transport Terminals: The GSRTC regional terminal and the private bus parking places are located in close proximity to several activity nodes within the city. Due to these activities, congestion created is high. Though in terms of physical location they are in the centre, in terms of time distance it is not the same. Decentralized terminals are being developed at four locations. These are integrated with BRTS.

Inner city Transit Development Plan: The Inner city, the historic core of Ahmedabad, is the cultural, economic and administrative heart of the city. With a spread over 5.8 Sq. Km and population of about 3.7 lakhs, it is characterized by intense commercial activities, dense population and rich architectural heritage. It generates greater mobility and accessibility needs. The continuing spread of retail and wholesale markets, infrastructure inadequacies, excessive ingress of personalized vehicles and traffic congestion are resulting in the deterioration in physical and living environment. There is a continuous decline in the residential population of the Inner city. To maintain its quality and character, measures to improve its accessibility and mobility along with physical improvement in streets is necessary. In view of this, a plan to enhance inner-city access has been conceived.



Map 3-5: The Inner city of Ahmedabad and its Landuse

The specific challenges related to transportation and traffic management within the inner city are:

- Dense urban fabric with restricted road widths and these road widths are further reduced due to haphazard parking and unorganized informal activities
- Peak hour speeds range from 5 to 15 km/h
- Mixed traffic comprising of slow and fast moving modes
- Deteriorating ambient air quality.
- Significant Non-motorized Vehicle movement without any specific facilities
- Limited classification of roads, certain roads used as thoroughfares
- No physical demarcations for pedestrians
- Public transport inefficiencies in terms of under utilized bus terminals and inefficient locations
- Traffic congestion and associated spill over effects

Air Quality Action Plan: With a Respiratory Particulate Matter (RSPM) level of 198 microgram /m3, in the year 2001, Ahmedabad was the 4th most polluted city amongst the 85 cities monitored under National Air Quality Monitoring Programme. The actions undertaken by AMC and the state to improve air quality from the transport sector perspective are:

- Enhance public transport
- Switch to cleaner fuel (CNG)
  - o Auto CNG Plan
  - o Bus CNG Plan

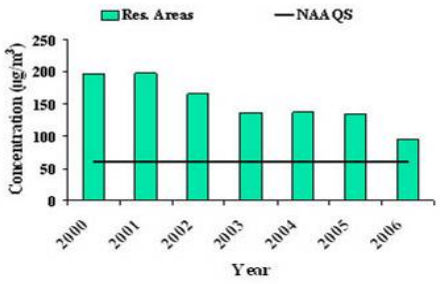
- o Phase out old auto rickshaws
- Demand Management
  - o Limit issue of licenses to Autorickshaws
  - o Introduce Parking Policy

In 2005, about 15000 of the 50000 auto rickshaws registered before 1991 were phased out as most of them were operating on adulterated fuel (diesel and kerosene). At the same time, owners of these auto rickshaws were encouraged to buy modern CNG auto rickshaws. To augment supply, 45 CNG stations were set up in Ahmedabad though private sector. Currently, *over 35,000 autorikshaws run on CNG.*

The newly inducted buses to augment public transport run on CNG. Out of the total fleet of 1010, 650 are privately operated CNG buses. The results are evident in the graph and table.

Table 3-7: Air Quality in Ahmedabad

Year	RSPM levels in microgram /m3	Ranking among 85 cities covered under NAMP
2001	198	4
2002	166	N.A.
2003	136	N.A.
2004	138	12
2005	134	13
2006	96	43
2007	82	~50 (projected)



Trends in Annual Average Concentration of RSPM in residential areas of Ahmedabad

Figure 3-1: RSPM levels

Figure 3-2: Interventions in para-transit

Parking Policy: arrangements- at grade and multi level parking options. Specifically, integrated terminal-cum-parking facility development will need to be carried out for the two public transit terminals, central railway station, regional bus station and major whole sale markets located in

the close proximity in this area, and Traffic management arrangements including one way systems and signalization, public information systems, signages etc., for effective traffic management are required.

The proposed strengthening and widening will require relocation of the informal sector, as part of the design demarcates zones for informal activities and vendors so that traffic is not hindered. Further, conservation of heritage[1] and Improvement in quality of place is also a major consideration as part of network expansion.

3.3.5 Pedestrian and NMV Facilities:

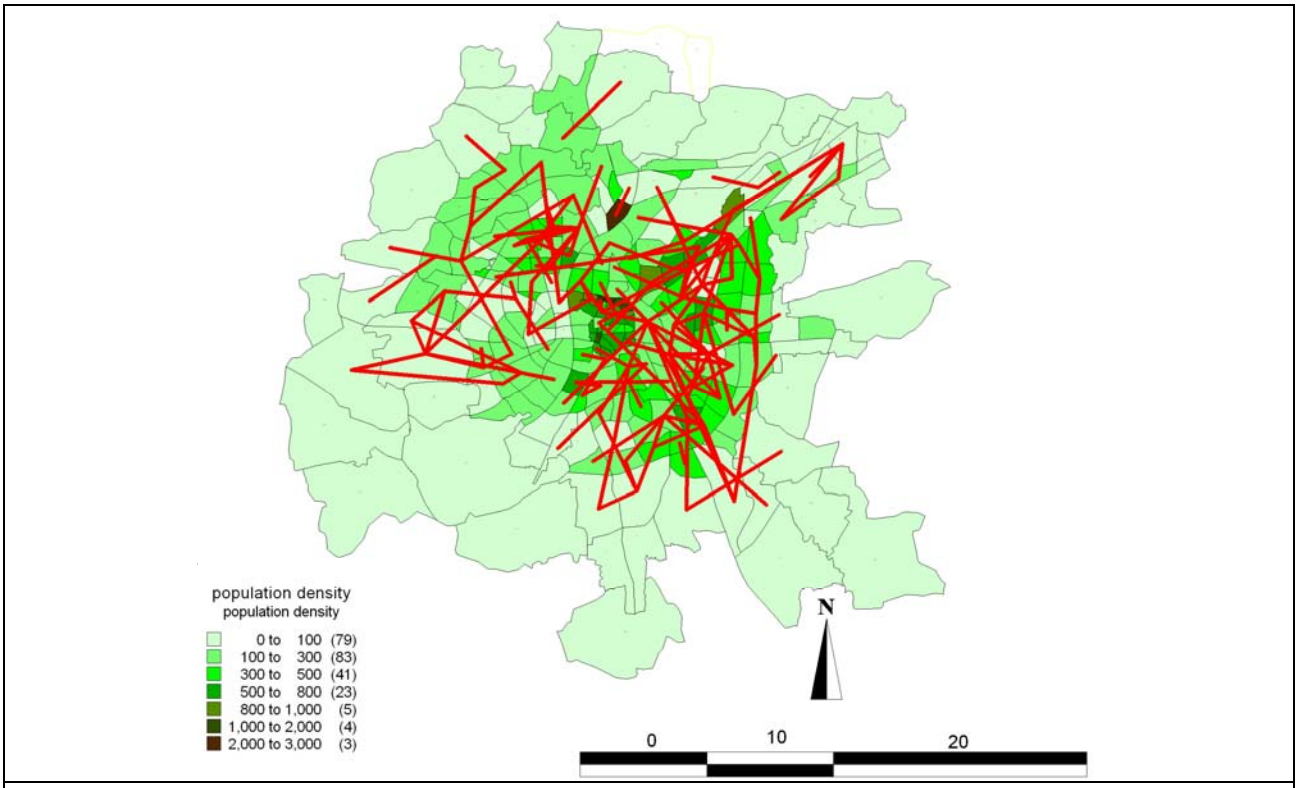
Providing walkable streets and bicycle facilities is a priority action on the agenda of AMC. The actions taken so far include:

- Integration of BRT and other major roads:
- Pedestrian facilities on all the BRT corridors and other major roads (88 kms).
- On all roads with width over 36 mts, a separate bicycle lane has been proposed.
- Bicycle parking has been integrated with BRT plan.
- A comprehensive bicycle master plan is being prepared.
- The inner city and Kankaria area have been designated as vehicle free zones as they attract a large volume of traffic.

3.3.5.1 Bicycle Plan for Ahmedabad

Under the economically weaker sections and low income groups the most common mode of vehicle owned is the bicycle. 49.5 % of the total vehicle ownership is the cycle which is highest among all the modes owned by the household of Ahmedabad.

[1] The heart of the Inner city resides in two of its most famous Chowks viz. Manek Chowk and Bhadra Chowk and these two areas are to be delineated as pedestrian friendly precincts and will be paved with the traffic being rerouted. Informal activities like that of hawkers etc will be accommodated within this precinct so as to retain its vibrancy. Also lighting and seating spaces etc to be designed



Map 3-6: Population density and Origin & Destination of Bicyclists

3.3.5.2 Bicycle Lanes on Arterial Network:

The proposal incorporates provision of segregated bicycle facilities on all arterial roads (36m and wider). This would also include development of segregated bicycle lanes and access improvement plans at the bus stations, markets etc.

A bicycle master plan for the city of Ahmedabad is under preparation. This includes development of 70 kms. of bicycle network, inclusive of provision of bicycle and pedestrian facilities on all BRT corridors.

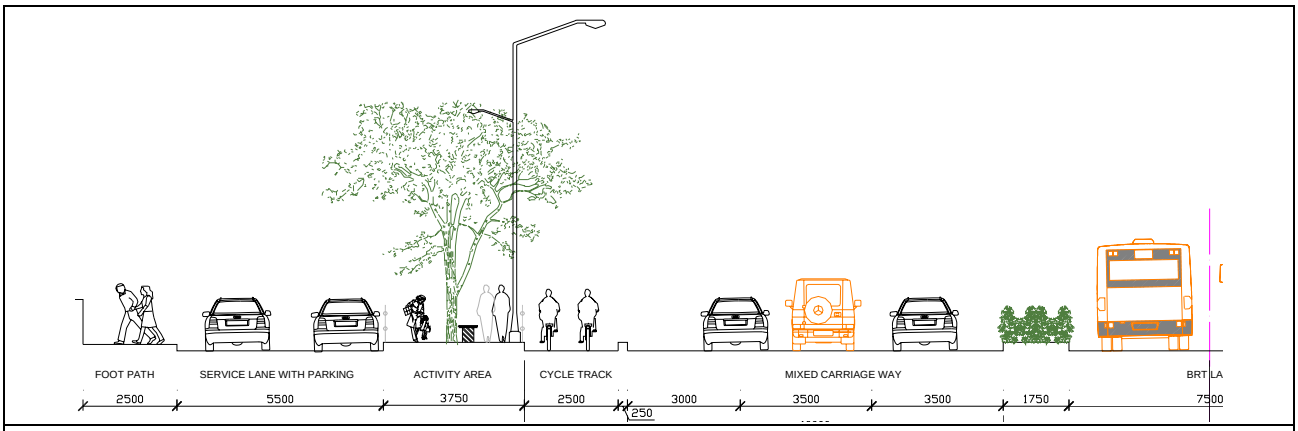
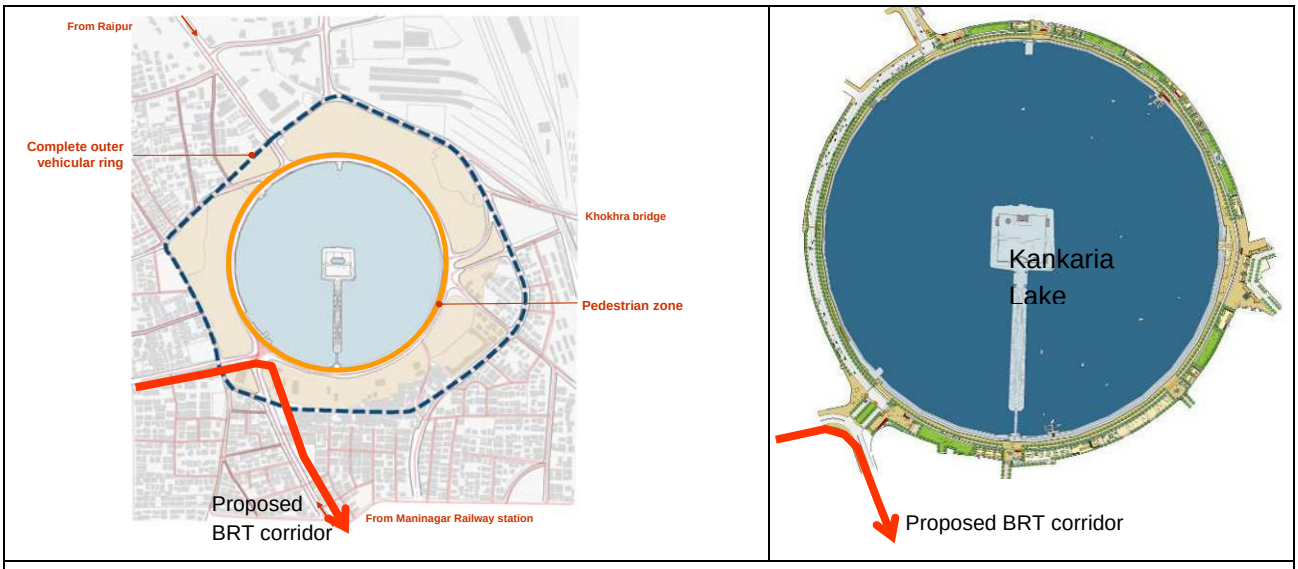


Figure 3-3: Proposed Pedestrian pathways and Cycle tracks on all BRTS corridors

3.3.5.3 Kankaria Lake Area Development

Kankaria lake is an important destination for public recreation. Initially the lake was open to vehicles. As part of the proposal which is now under implementation stage, an alternate ring road has been constructed to divert the mixed traffic to make the lakefront a vehicle-free and pedestrian zone. Cycle tracks, pedestrian walkways, seatings, landscaping, food courts, hawkers

area, etc. have been proposed to enhance the precinct. The BRTS corridor links the lake precinct with rest of the city network.



Map 3-7: Proposed Kankaria Redevelopment Plan

3.3.6 Road safety and Traffic Management Initiatives

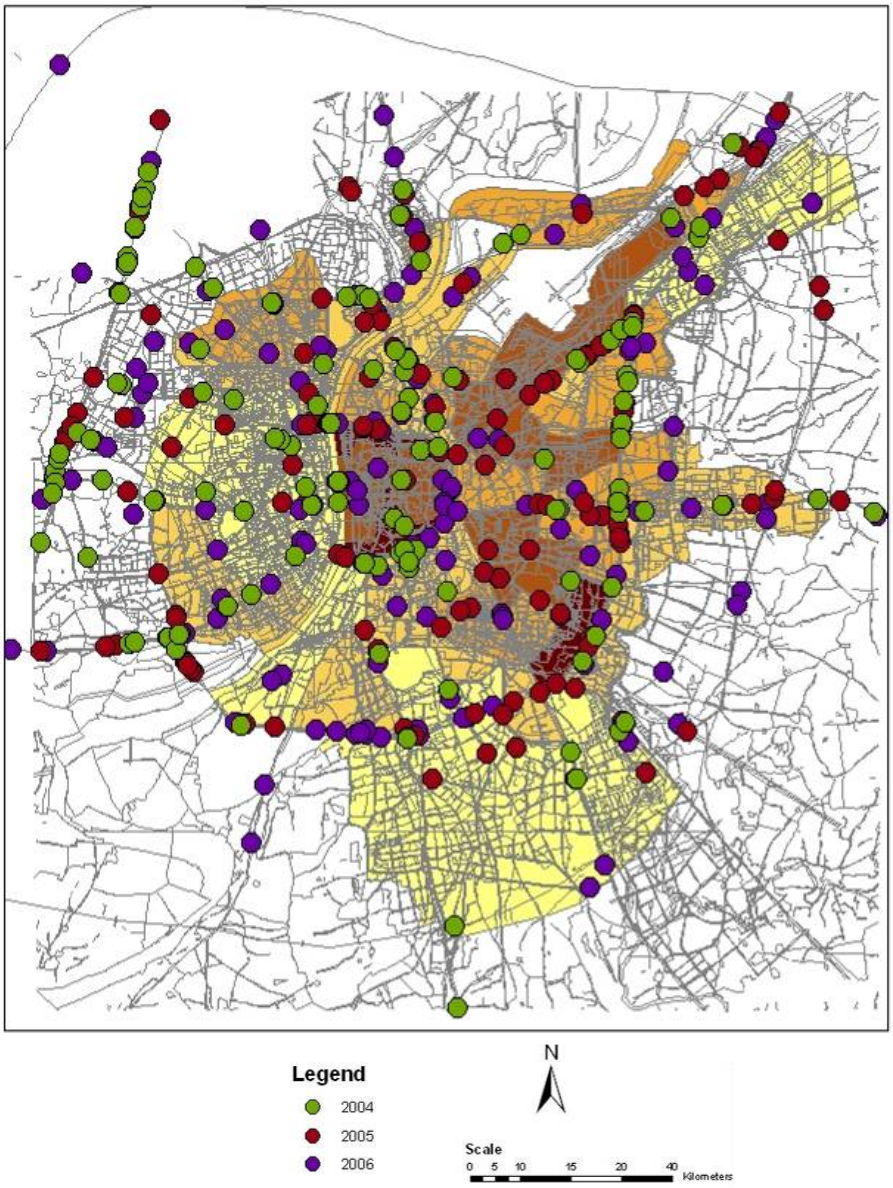
Road safety

The table and map below shows the location of fatal accidents in Ahmedabad. It is observed, that there has been a rise in the number of accidents in the past three years. Considering the rising speeds on roads and traffic indiscipline, the following initiatives have been taken to increase the road safety for all the modes.

- Accident Information Management System
- Area Traffic Control System
- Education and Training activities

Table 3-8: Accidents and Fatalities (2005-2007)

Year	Fatal	Serious Injury	Minor Injury	No Injury	Total
2005	168	156	1987	149	2460
2006	238	225	2136	2	2601
2007	248	265	2092	0	2605



Map 3-8: Fatal Accidents (2004 – 2006)

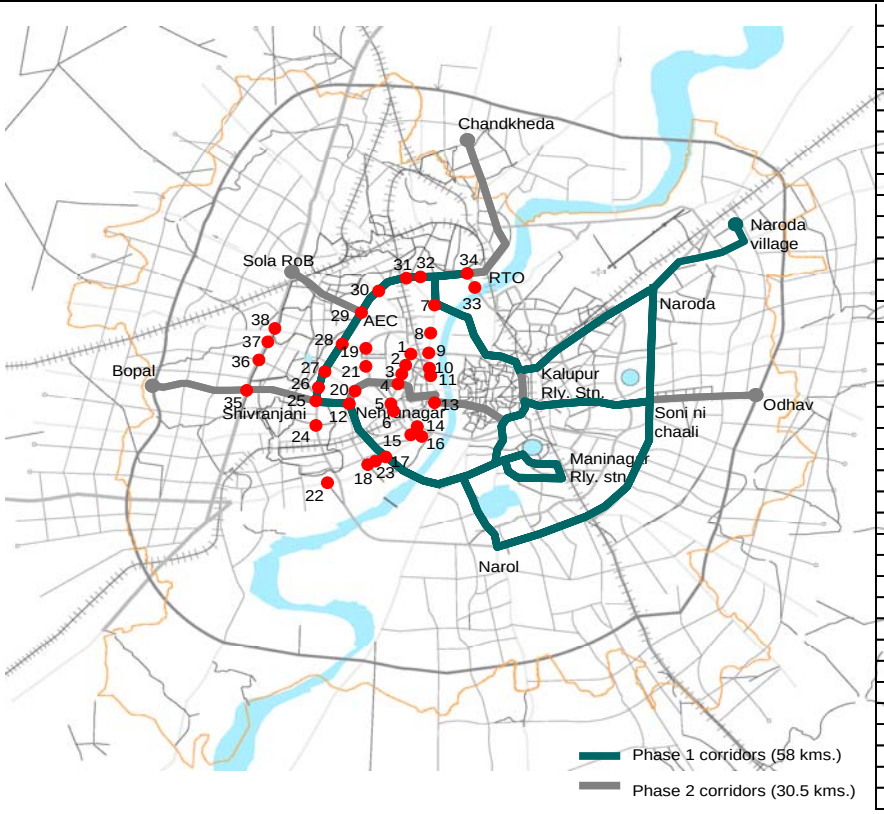
Accident Information Management System: AMC along with Traffic Police and CEPT has initiated development of AIMS for the city of Ahmedabad. The objective of this exercise is to develop an information system on GIS frame to identify accident prone stretches/locations and analyse possible causes. Based on the analysis submit recommendations necessary to ameliorate the situation. The report is expected to be submitted twice a year and will include analysis of time series data. Initially, only fatal accidents are included in the analysis.

Area Traffic control System: AMC has initiated installation of Area Traffic Control System for 38 intersections on junctions falling on BRT or feeding into BRT corridors.

The system includes:

- Traffic Signal Controller
- Vehicle Detectors(Through Embedded sensor)
- Communication Network
- ATCS Application Software

Central Control System



1	Stadium Junction
2	Swastik cross road
3	Girish Junction
4	Bodyline Junction
5	Panchvati Junction
6	Parimal Junction
7	Wadaj Junction
8	Usmanpura Junction
9	Income Tax Junction
10	Mount Carmel Junction
11	Delite Junction
12	Neherunagar Junction
13	Townhall Jucntion
14	Paldi Junction
15	Mahalaxmi Junction
16	Panchtirth Junction
17	Anjali
18	Vasna Junction
19	Vijay cross road Junction
20	Panjrapole Junction
21	L D Engineering Junction
22	Vishala Junction
23	Jivraj Junction
24	Shyamal Junction
25	Shivranjani
26	Keshvabag
27	Andhjan
28	Memnagar
29	AEC Naranpura
30	Pragati Nagar
31	Akhbarnagar
32	Vyasvadi
33	Chimanbhai Bridge Junction
34	RTO Junction
35	Iscon Junction
36	Pakwan Junction
37	Gurudwara Junction
38	Thaltej Junction

Map 3-9: BRT corridors and Proposed Area Traffic Control system along with junction improvements at 38 Locations

Education and Training activities: AMC along with traffic police has initiated education and training activities at a major scale. The plans have been discussed with senior officials of traffic police. A training session with junior officials has been conducted. More sessions are being planned. Presentation to school children on traffic management has been done. More programmes are planned. Information dissemination to public is being done through movie clips on cable channel, newsletters, radio announcements.

3.3.7 Parking Policy

The thrust of the parking policy is in terms of removal of on street parking and promotion of off street pay-and-park facilities. The larger objective of the proposed CMP is to improve access and at the same time promote use of public transport.

The current proposals under implementation / consideration are:

Developing Multi-storied Parking Complexes on a BOT basis: Detailed assessment of land availability and suitability studies for developing off-street parking facilities is underway. Two locations with heavy parking demand have been identified on priority for development. EOI has been invited for developing multistoried parking complexes in Ahmedabad

A detailed inventory of on-street parking within the inner-city has been made, a survey of parking demand is underway. As part of the 60 km long first phase BRT road, utility areas on either side have been developed and parking will be integrated along with BRT operations.

The Government of Gujarat has prepared a Draft Parking Policy and is under consideration of the State Government. The framework[2] for the proposed parking policy is to discourage travel by individual modes to congested areas through restrictive practices such as ;

- Control the amount of on-street parking to improve traffic flow and safety, and minimise interference with access and servicing
- prevent overnight parking of heavy vehicles on the major roads
- Support economic activity by providing sufficient on-street and off-street car parking for business purposes and essential trips.

The management measures to enforce the policy are:

- Suitable systems for effective management of parking facilities, supported by sustainable parking standards.
- Integrate parking management system with overall planning and development of traffic and transport facilities.

3.3.8 Supplementary Measures

The additional measures contemplated to implement the CMP include:

- Creation of Urban Transport Fund (UTF)
- Creation of SPV 'Ahmedabad Janmarg Limited' company to manage BRT System
- Urban Mass Transit Authority

The fund would be based on some of the following:

- Plough back of primarily additional FSI proceeds
- A share of surcharge on stamp duty levied on all property transaction;
- A share of VAT on petrol, oil and lubricants;
- A share of development charge levied on all planning permissions issued;
- MV Tax collected in the Metro Area; and
- Other programmatic grants

[2] Annexure for details

4 INTEGRATED SERVICES PLAN

4.1 APPROACH

Services plan is the backbone of any public transit service. Principal components of services plan are:

- Services type
- Route definition
- Fleet optimization and utilization
- Frequency of routes in peak hour and off peak hour
- Station wise timing of each route
- Identification of transfer points to provide appropriate infrastructure
- Assessing Boarding/Alighting demand at each bus station for its sizing
- Location and sizing of terminals and transfer points

In 2005, AMTS was being revived from a near collapse. Bus demand was still nascent and growing with the addition of capacity (new fleet addition through PPP model as well as direct purchase of buses by AMTS). In the ensuing period, bus fleet has been nearly doubled. Passenger demand has stabilized to some extent now. Current situation of AMTS is as below:

Table 4-1: AMTS – 2008

a)	Routes	154 full routes and with addition of shuttles, routes are 187
b)	Road length under Transit Routes	573 kms
c)	No. of bus stops	1398
d)	No. of Terminals	6
e)	No. of Depot/ Workshop	1 (Private operators have own facility)
f)	Fleet Size	1022
g)	Fleet Utilisation	85 %
h)	Vehicle Utilisation Per day	210 Kms
i)	Average Speeds	18.6
j)	Occupancy Ratio	65%
k)	Passenger Per day: 2006-7	746294 (Feb 2008: 936886)
l)	Daily Revenue (2006-7)	Rs. 2587416
m)	Daily Expenditure	Rs. 44792521

There is a need to rationalize since only 25% of existing routes have a frequency of more than one bus in 20 min. No single route has headway of less than 8min. The services are very dispersed, often with low frequencies on multiple branches in the same area with each branch within walking distance to each other. Rationalizing and optimising such routes can provide all passengers in the area a high and dependable frequency.

4.1.1 Surveys

To have an accurate understanding of present transit demand and to create an operations plan which is relevant to present usage, it is necessary to reassess the demand based on fresh surveys. Four principal surveys were conducted for this purpose.

- **AMTS bus frequency occupancy survey**
- **IPTS frequency occupancy survey**
- **AMTS bus onboard origin-destination survey**
- **Passenger transfer survey**

These four surveys gave the planning team high quality data to work with which was previously not available. Transit modelling based on this data is the genesis of the operations plan given in this report. This model takes into account all public transit services and also looks at rationalizing bus services of AMTS such that BRT and AMTS form a seamless integrated public transit service for the convenience of citizens of Ahmedabad.

AMTS bus frequency and occupancy survey: As the name suggests, this survey found the on street frequency of buses in all parts of the city. Survey was done at 52 locations (108 directional counts) spread around city. Total sample size was 20000 sightings with occupancy. This gave precise data of route wise link loads on all sections of the route network.

IPTS frequency occupancy survey: Additional frequency occupancy data was collected for IPTS, bicycles users and motorcycle riders. The probability of IPTS and, to a certain extent motorcycle users, shifting to a modern public transit system is very high compared to other modes. Bicycle user data also gives important benchmarks to assess the usage of new bicycle lanes being built on the entire BRT network. This survey was conducted 24 locations.

AMTS bus onboard origin-destination survey: Traditional onboard origin destination surveys employ interview as the means of collecting data. Much like household survey, this gives zone to zone information, with transfers if applicable. But the time taken to collect each sample of data is high. In its place an innovative method was devised to quickly get large sample size without degrading quality of data. This method involves giving out numbered ticket to each boarding passenger and then retrieving the coupon from the passenger at the point of exit. A total of 150,000 samples of data were collected in the morning peak. This data gives exact stop to stop trip information for the 1400 locations where bus stops exist as of now.

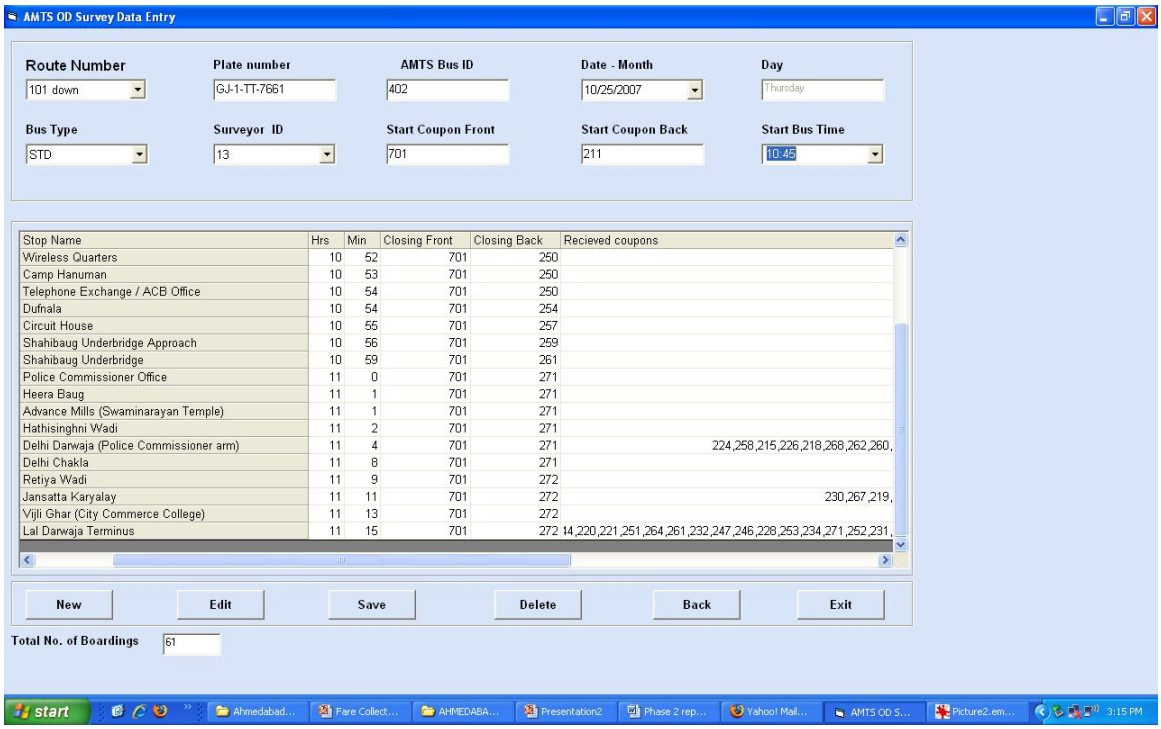


Figure 4-1: Sample AMTS Survey Data Entry

Passenger transfer survey: Passenger transfer survey was conducted at 17 important locations where a large number of boarding and alighting of passenger was noticed and where passengers were noticed transferring from one service to another to reach their chosen destination. This survey was extended to find transfers of passengers from other nearby cities who come daily to Ahmedabad on work. These additional surveys were conducted at the two main railway stations at Kalupur and Maninagar as well as the central intercity bus terminal at Geeta Mandir. A total of 28000 samples were collected through interview format. This data has been used to refine the origin-destination matrix to give an accurate picture of real origin and destination as against the stop to stop origin-destination matrix extracted from the earlier survey.

4.2 SERVICES AND ROUTES

A new GIS road network was created since the city boundaries have expanded since it was coded the last time. All modelling work carried out to estimate demand on BRT network of Phase 1 and 2 was done on this new GIS road network using data collected through surveys as mentioned in the earlier section. Thematically, the BRT network chosen for Phase 1 is fairly accurate. But a good operations plan needs to assess the demand location by location on this network to structure a good routing plan with bus frequencies. EMME3, industry leading software for transit modelling has been employed.

The operations plan developed not only provides route structure for BRT operations but also the rationalised routing plan for AMTS operations. This is necessary so that the two systems compliment each other rather than compete with each other.

Transit demand estimation would involve estimation of change in demand from the current users under various operating conditions, estimating shifts from transit-like (shared auto) services,

estimating shifts from intermediary transit and personalised modes, generated traffic due to quality improvements in transit. In terms of routes following three types of routes are structured to operate transit services.

1. BRT Trunk Routes
2. Complementary Routes (AMTS)
3. BRT Feeder Routes

Scenarios have been developed with and without fare integration.

Based on an assessment of the existing routes and travel desires, alternate set of BRT trunk routes, BRT feeder routes and Complimentary routes have been analysed. Of this following set has been adopted. In this set there are 10 BRT trunk routes, 21 BRT Feeder and 60 complimentary services have been identified for operation. Alternative services plans have been analysed.

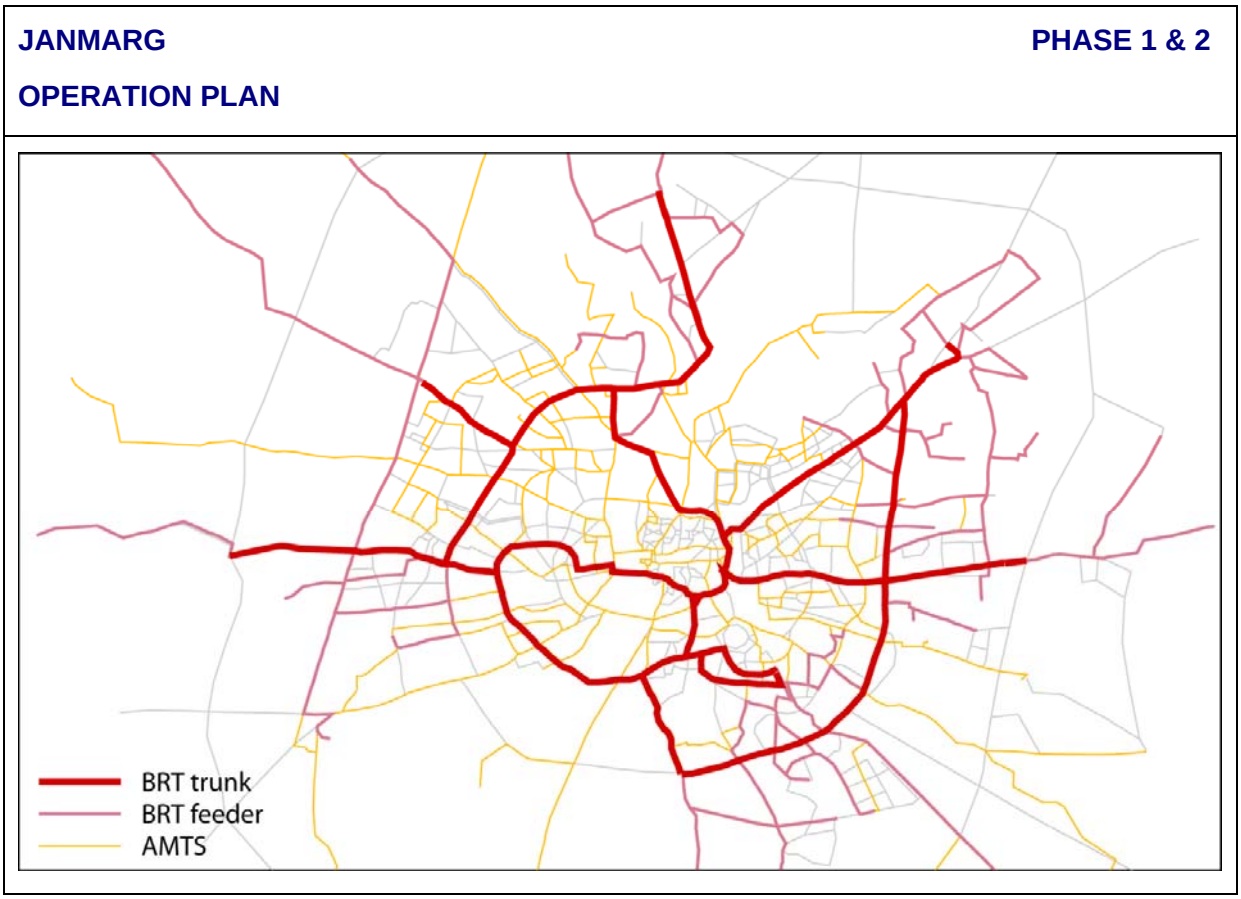


Figure 4-2: Operations Plan Phase 1 and 2

BRT Routes: Following are the 10 routes are proposed for BRT trunk routes in the base year (2008). These would be put into operations in phases as each section of the network is constructed and ready for operations. The table below gives us the route descriptions with length, in one direction travel time, headway for each route and average speeds on each route.

Table 4-2: Route Descriptions with Length

Route	From	To	Via	Length	Line Time one Direction	Headway (minutes)	Avg speed
n01	Chandkheda	Narol	Ranip, Wadaj, Dudheshwar, Kalupur, Geeta Mandir, Shah Alam, Dani Limda	20.9	57.2	4.2	21.9
n02	Bopal	Odhav	Iskcon, Shivranjini, University, Law Garden, Ellis Bridge, Danapith, Astodia, Geeta Mandir, Sarangpur, Rakhial, Soni ni chali	23.5	62.2	3.7	22.7
n03	University	Naroda	Law Garden, Ellis Bridge, Danapith, Astodia, Geeta Mandir, Kalupur, Amdupura, Memco, ST workshop	15.5	42.3	4.2	22.0
n04	Naroda	Maninagar	ST workshop, Memco, Amdupura, Kalupur, Geeta Mandir, Shah Alam, Kankaria	14.9	40.5	3.8	22.1
n05	Sola	Maninagar	AEC, IIM, Shivranjini, University, Law Garden, Ellis Bridge, Astodia, Geeta Mandir, Shah Alam, Kankaria	19.6	52.7	2.9	22.3
n06	Sola	Soni ni chali	AEC, Bhavsar Hostel, Wadaj, Dudheshwar, Kalupur, Sarangpur, Rakhial	16.9	46.4	6.3	21.9
n07	University	Maninagar	Manek Bagh, Anjali, Pirana, Dani Limda, Shah Alam, Kankaria	12.6	28.6	9.9	26.4
n08	Naroda	Narol	ST workshop, Thakkarbapanagar, Soni ni chali, CTM, Ghodasar	15.2	41.4	8.6	22.0
n09	Iskcon	Kalupur	Shivranjini, University, Law Garden, Ellis Bridge, Danapith, Astodia, Geeta Mandir	14.5	41.1	6.9	21.2
n10	Chandkheda	Iskcon	Ranip, AEC, IIM, Shivranjini	16.6	45.2	12.1	22.0
Total				**170.2**			

The overall system has been optimized such that at the end of Phase 1 and 2, BRT system shall function as a trunk and feeder system with trunk lines operating only within segregated corridor network. Janmarg BRT was originally envisaged as a hybrid BRT system where BRT route network is not limited to the segregated corridor network.

But in the interest of system sanctity, not to dilute the concept of BRT, a decision has been taken to keep the BRT system as a closed system with Trunk and Feeder services. This implies that standard BRT buses will ply only within segregated corridors. They shall be supported by feeder services at terminal locations and a few important dedicated transfer stations.

A closed system with only Phase 1 segregated network will attract not much of a ridership on the BRT system since many of the passengers, whose travel route brings them on the Phase 1 network have origins or destinations outside the network. It is necessary therefore to add Phase-2 corridors to expand the network such that it allows the creation of meaningful routes for passengers on a closed BRT system. It should be noted that routes and corridors are not the same. To enhance user convenience and to reduce the number of transfers, multiple routes operate on any given corridor section.

This closed BRT system rider-ship is further enhanced by adding feeder services at terminal locations and a few intermediate transfer stations. The map below shows transfer terminal stations and interchange stations. Such transfer facilities may be extended to other locations based on passenger demand changes in the future but such changes are not foreseen in the near future.

Further, 21 feeder routes are envisaged that shall be integrated with trunk routes at the Terminals / Intermediate Transfer Stations. AMTS route network has been rationalised and optimised to have a total of 60 routes which provide services in those areas which are not served by BRT corridor.

4.3 DEMAND ESTIMATION AND OPERATION PLAN

The following is the general approach in estimating these based on the data bases listed above.

- **Existing Transit Users:** First step is to assess the demand pattern of existing transit users in an integrated optimised routing, services and fare plan. It is anticipated that all current users will remain transit users. The services will be complimentary in terms of routing. Scenarios are developed with and with out fare integration.

Table 4-3: Transit Choice – Existing Users

	Distance-based fare		Flat fare	
	Integrated	Non-integrated	Integrated	Non-integrated
BRT trunk				
Boardings	302742	239256	295389	273663
Trips	252940	223669	193104	171923
Distance per boarding	5.21	5.67	6.42	6.30
Fleet requirement	190	166	220	203
Bus-km/day	49567	43576	57329	53382
Passenger-km/day	1577045	1357582	1895998	1723826
BRT feeder				
Boardings	18610	13935	17973	12648
Distance per boarding	2.61	2.94	2.94	3.37
Fleet, feeder	116	108	67	153
Bus-km/day	15519	12533	15871	13042
Passenger-km/day	437369	369337	474762	383470
BRT transfer rate	1.20	1.07	1.53	1.59
AMTS				
Boardings	500895	549981	543672	582489
Trip length	4.22	4.34	3.64	3.77
Fleet	478	505	436	473
Bus-km/day	84364	90388	75584	83773
Passenger-km/day	2115482	2388682	1977431	2197706
Total				
Boardings	822247	803172	857034	868800
Total operational fleet (excl Standby)	784	779	723	829
Total Bus-km/day	149449	146497	148784	150197
Total Pax-Km/day	4129896	4115600	4348191	4305002

- **Estimating Modal Shifts (from two wheeler, three wheeler, car users) and Generated Traffic:** Personalised vehicle users are likely to shift to transit modes, once better services are made available. The extent of these shifts is generally estimated based on willingness to shift studies. The studies indicate potential shifts from personalised and intermediary transit modes to be in the higher order (34% aggregate; See box 1). In this case a flat 10% increase on the existing transit ridership is assumed as shifts from personalised vehicles.

- **Estimating shifts from Shared Auto:** On certain corridors of the BRT network, existing transit services are limited. On these corridors, shared auto-rikshaws are used extensively. Since the services are illegal, once modernised transit comes into operation, 60% of shared auto users will shift on to transit.

With these, the number of BRT boarding would go up from 302742 to an estimated 378525. The total fleet requirement is estimated at 252 buses.

Table 4-4 a: BRTS Routes, Boarding, Frequency and Fleet

BRT Route Code No.	Route Length		Daily Boarding		Total	Max. Link Volume 2-direct.	Frequency per hour	Head way	Fleet
	In Kms	in min. Round trip	AMTS Users	Shifts Pvt+ IPTS					
n01	21.00	114.23	38781	2916	41697	1452	16	3.72	31
n02	18.25	100.61	44658	13410	58068	2195	25	2.46	41
n03	15.51	84.62	28836	23911	52747	2612	29	2.07	41
no4	14.78	81.95	37944	2590	40534	1583	18	3.41	24
n05	19.18	106.88	43380	3319	46699	2028	23	2.66	40
n06	17.01	92.81	23526	1548	25074	946	11	5.71	16
n07*	10.47	58.76	12312	985	13297	602	15	8.97	7
n08	15.16	82.72	27828	24889	52717	2010	23	2.69	31
n09	15.08	83.03	33138	1415	34553	865	10	6.25	13
n10	16.58	90.45	12339	801	13140	490	6	11.03	8
Total			302742	75784	378526				252

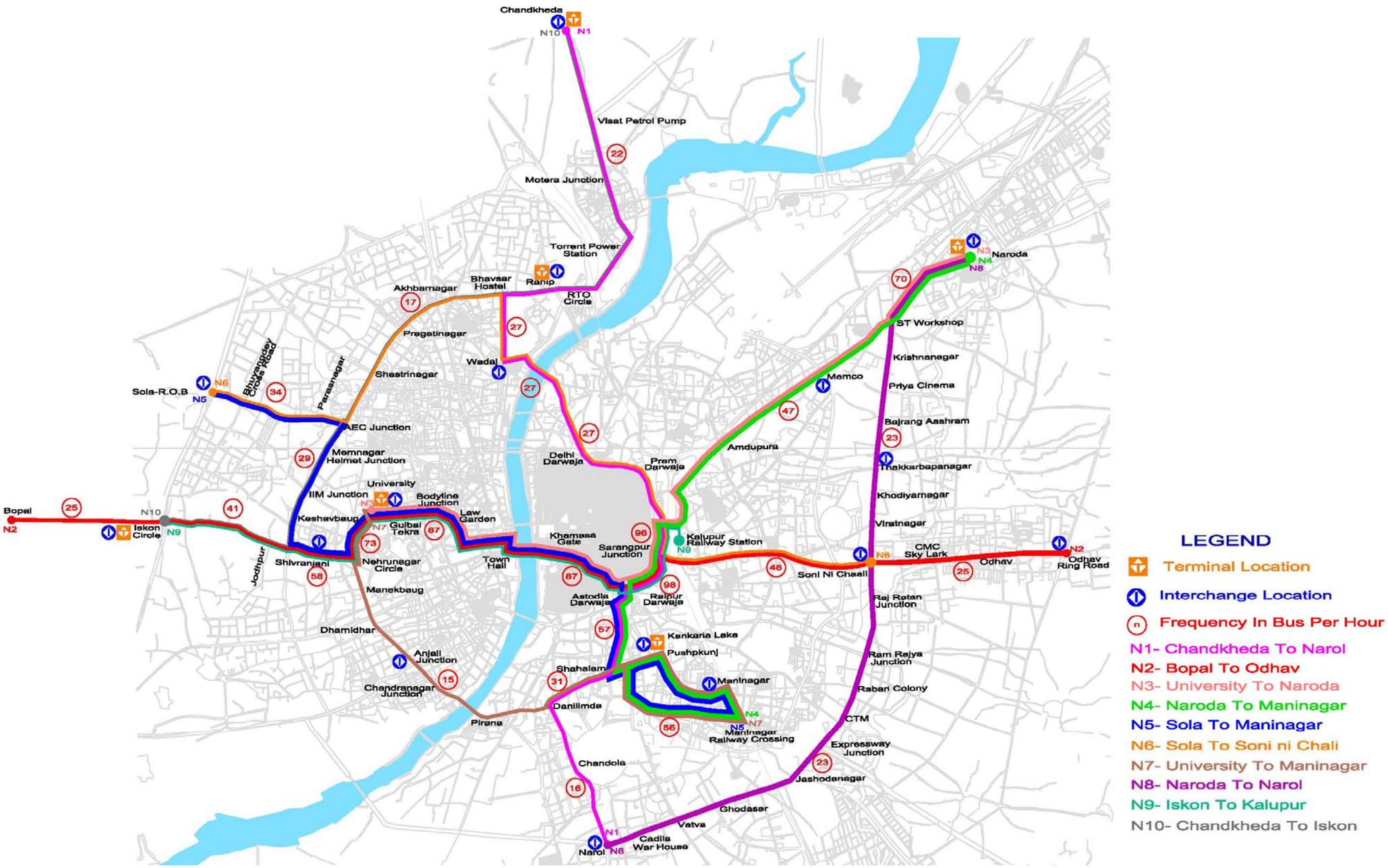
***Note:** Due to establishment of GSRTC terminal at Narol and RTO, the trips estimated are 15 buses with headway of 4 min.*

Frequency= Max. Volume/capacity (90)
Headway=60/Frequency
Fleet= Round Trip Length (Min) x Frequency/60

Table 4-5 b: BRTS Routes, Boarding, Frequency and Fleet

Corridor	Exising Pax/dir/hr on Bus	IPTS Pax/hr/dir	Route length(km)	% of IPTS shift to BRT	Shift from IPTS to BRT/hr/dir	Additional buses/hr/dir
Naroda – Narol	600	2200	15.1	60%	1320	15
Odhav - Soni ni Chaal	600	600	3.2	60%	360	4
Soni ni Chaal – Sarangpur	1600	1100	4.2	60%	660	7
Iscon Mandir – Bopal	600	600	5.1	60%	360	4
Naroda – Kalupur	2600	2000	7.5	60%	1200	13

BRT ROUTES AND FREQUENCY



Map 4-1: BRT Routes and Frequency

- **Estimating Transit Ridership Growth:** Despite transit development, given aspirations of the people, ownership of personalised vehicles will continue. However, the use of the vehicles is subject to traffic conditions and parking restrictions determining travel time and costs. Both the travel time and costs are likely to increase. At an aggregate level, to increase the transit ridership from the present 18-20% to 30% by 2015, an annual compound growth rate of 7% would have to be achieved.

BOX-1: Willingness to Shift

The statistics, as presented below, show an overall shift of about 34 % to the BRTS. The study is further analyzed at different aggregation levels, as per the household income, sex, occupation and the current mode. This helps to understand the shift as per the respective category. In terms of income group, middle and lower income group show greater shift as compared to high income class. When analyzing in terms of gender, it shows that women are more likely to shift to BRT than males. This could be due to the fact that males more often use the vehicles own at household than females and thus they have a less tendency to shift to the BRTS. Also, students have slightly higher percentage shift as compared to workers.

Percent of cases willing to shift to BRT at different aggregation level

Aggregation Level	No. of samples (with choice set data)	Cases willing to shift to BRT	
		No. of cases	%
Monthly Household Income (Rs)			
2: <=5500	195	77	39.4 %
3: 5501 – 10000	474	196	41.4 %
4: 10001 – 15000	256	65	25.4 %
5: >15000	172	37	21.5 %
Missing value	3		
Sex			
Female	205	90	43.9 %
Male	894	285	31.9 %
Missing value	1		
Occupation			
Student	237	90	38.0 %
Worker	858	285	33.2 %
Missing value	5		
Current mode			
Auto Rickshaw	14	2	14.3 %
Bicycle	120	34	28.3 %
Bus	149	110	73.8 %
Car	98	12	12.2 %
Motorscooter	569	176	30.9 %
Shared Auto	82	36	43.9 %
Walk	68	5	7.4 %
	1,100	375	34.1 %

4.4 TRANSFER STATIONS /INTERCHANGE FACILITIES

Ahmedabad will have five basic types of public transit systems in the future. The BRT, its feeder services, AMTS, Regional rail and Metro. The success of public transit system in Ahmedabad will depend largely on how efficiently commuters can transfer between different modes. The BRT plan will ensure that transfers are easy and convenient and encourage people to use public transit.

All interchange stations will be pedestrian friendly. The design will enable old people, children and handicapped people to move without any fear of injury and at a convenient pace. Ramps to access bus stops, subways, foot over bridges, footpaths and other public utilities will be designed keeping in mind wheel chair users. All precautions will be taken to ensure that motorized vehicles do not enter pedestrian zones.

BRT is being planned as a trunk and feeder system. Buses in the BRT corridor will terminate at stations on the corridor itself. Commuters are expected to transfer to special feeder buses which will run in mixed traffic on other roads to reach their destinations. In addition, some transfers will also happen where AMTS bus routes overlap BRT routes for short distances and at Kalupur and Maninagar railway stations.

BRT will have the following types of interchanges (as part of phase 1 and 2):

- BRT – Rail – AMTS
- BRT – AMTS
- BRT – BRT feeder
- BRT – GSRTC

BRT – Rail – AMTS

There will be two such kinds of interchanges.

Kalupur railway station

This is major interchange point in Ahmadabad's public transit with almost 80,000 people accessing this area daily. As of today, AMTS has a linear bus stand on the road towards the west of the station and another one at Sarangpur about 500m to the south of the station. Passengers arriving and departing from trains are expected to walk on narrow congested footpaths to reach these bus stops. AMTS buses parked on the streets outside cause congestion.

BRT buses will reach Kalupur through an elevated bus way. This bus way starts from Dariapur darwaza in the north and continues in front of the station at an elevated level before landing at the new cloth market. Two rotaries are proposed at the elevated level to enable the bus way to cross the railway lines. BRT bus stops will be at the elevated level and will be directly linked to the existing pedestrian FOBs. This will enable passengers to cross directly into the railway station and vice versa without accessing the road below. For passengers with business in the old city, ramps and elevators will enable them to reach ground level and move out. In the longer run, it is proposed that AMTS services to Kalupur may be withdrawn gradually to lessen congestion at grade.

Maninagar railway station

Maninagar railway station is a satellite station south of the main Kalupur railway station. It provides a convenient connection for passengers coming from nearby towns and outlying areas of Ahmedabad like Mehamdabad, Anand, Nadiad and Vadodara. An AMTS terminal exists here which functions as an interchange point. Auto rickshaws too function as a para-transit mode here.

The proposed new interchange point here will include BRT. The connection between the three modes will be at grade through zebra crossings. The entire junction in front of the railway station will be revamped and traffic management measures taken to curtail some of the motorized traffic. This junction will have a separate phase for pedestrians. A separate parking area will be provided for BRT buses, AMTS buses and auto rickshaws.

BRT – AMTS

Akhbarnagar

Akhbarnagar falls on the RTO Pirana corridor of phase 1. AMTS has an existing terminal and turn around facility at Akhbarnagar. This plot of land adjoins the BRT corridor. The interchange between BRT and AMTS will be through a subway which will start from the BRT bus stop and emerge onto the AMTS terminal. This subway will be accessed through ramps and will be accessible to the handicapped.

University

The AMTS has a big bus stop at University. This is a on road facility. As part of phase 2, the BRT will pass close to the University. There will be an at grade transfer facility with AMTS here as also a BRT to BRT feeder.

Nehrunagar

The AMTS bus stop at Nehrunagar will be connected to BRT by means of a foot over bridge which will be accessed through ramps.

Vaadaj

Vaadaj has an exiting AMTS terminal as well as transit bus stop. The BRTS route cuts across this terminal coming from Ranip (phase 1) and continuing towards Dudheshwar and Kalupur. As such, it is an important interchange location for passengers from north Ahmedabad who wish to access Ashram road.

In addition, there will be other smaller locations (in terms of demand), where AMTS routes over lap with BRT for short distances. In all such cases, at grade facilities for crossing will be provided.

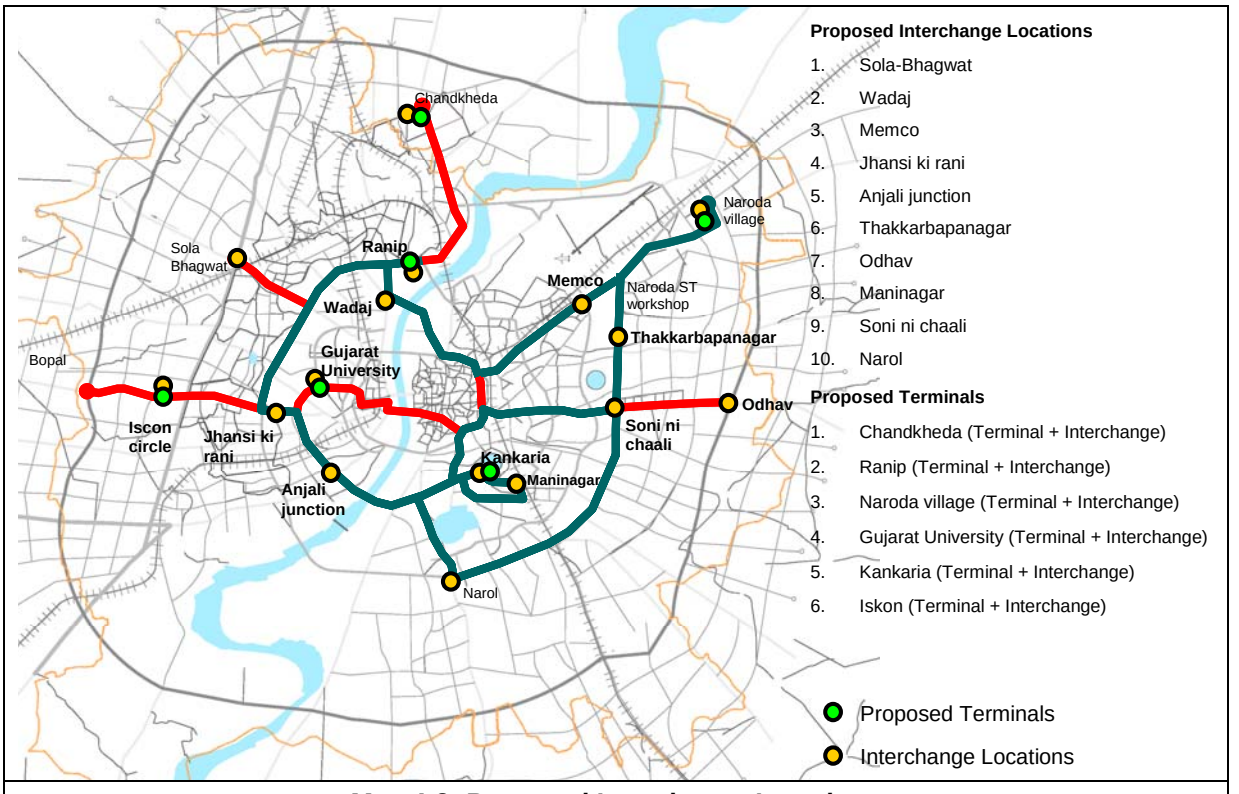
BRT – BRT feeder

These locations are Chandkheda (for access to Motera, new CG road), Ranip (for access to Sabarmati, Shahibagh and Ranip), Bopal T-junction (for access to Bopal and Ghuma), Shivranjini (for access to Shyamal and Jivaj Mehta), Iskcon (for access to Bodakdev and Ramdevngar), Kankaria (for access to Khokra, Hatkeshwar), Naroda village (for access to GIDC), University (to access University and surrounding colleges) and Memco (for access to Bapunagar, Sahijpur Bogha and Meghaninagar). These terminals will be located on or off road, depending on the site situation and transfers from trunk buses to feeder will be possible.

BRT – GSRTC

This interchange will happen at four locations, all of them part of phase 1. The first location is at Geeta mandir, the second at Naroda, thethird at Ranip and the fourth at Narol. At

Geeta mandir, transfer will be at grade, at ST workshop, through a FoB, at Narol at grade and at Ranip through a subway. Another small transfer will happen at Nehrunagar when a FOB enable transfers from GSRTC & BRT & visa versa.



Map 4-2: Proposed Interchange Locations

4.4.1.1 Terminals/Depot/Workshops

Terminals are locations where the service of any particular route terminates and a return service begins. Buses may have no waiting period and turn around immediately for the return trip. Alternatively, they may wait for a few minutes before turning back. Logically, it makes sense to have terminal facilities at the end of the corridor/ route.

In non-peak hours, buses may be parked for a longer duration of time at the terminal. At terminal locations, transfers to BRT feeder services will also happen. Thus, the terminal design should have facility to enable easy and fast transfers from trunk line to feeder service. Some passenger facilities like rest rooms, snack counters can be provided. A small administrative office for BRT will also be accommodated here.

As part of phase 1 and 2, six main terminal facilities are proposed. The map below shows the terminal facilities. The facility at Ranip is being developed under phase 1.

Factors considered in terminal design by appreciating activity and facility inter-relationship is:

- Segregation of terminal and non-terminal traffic
- Segregation of vehicular and pedestrians traffic and movement
- Segregation of traffic by type, function and direction
- Co-ordination of different activities in terms of functional and spatial inter-relationships
- Provision of good user and vehicular information

- Provision of necessary and identified facilities to meet requirement of all user groups
- Achieving minimum passenger and vehicular processing time
- Achieving overall functional and space efficiency
- Achieving smooth flow for all types of traffic to and from the terminal

The figure below shows activities planned in a terminal location.

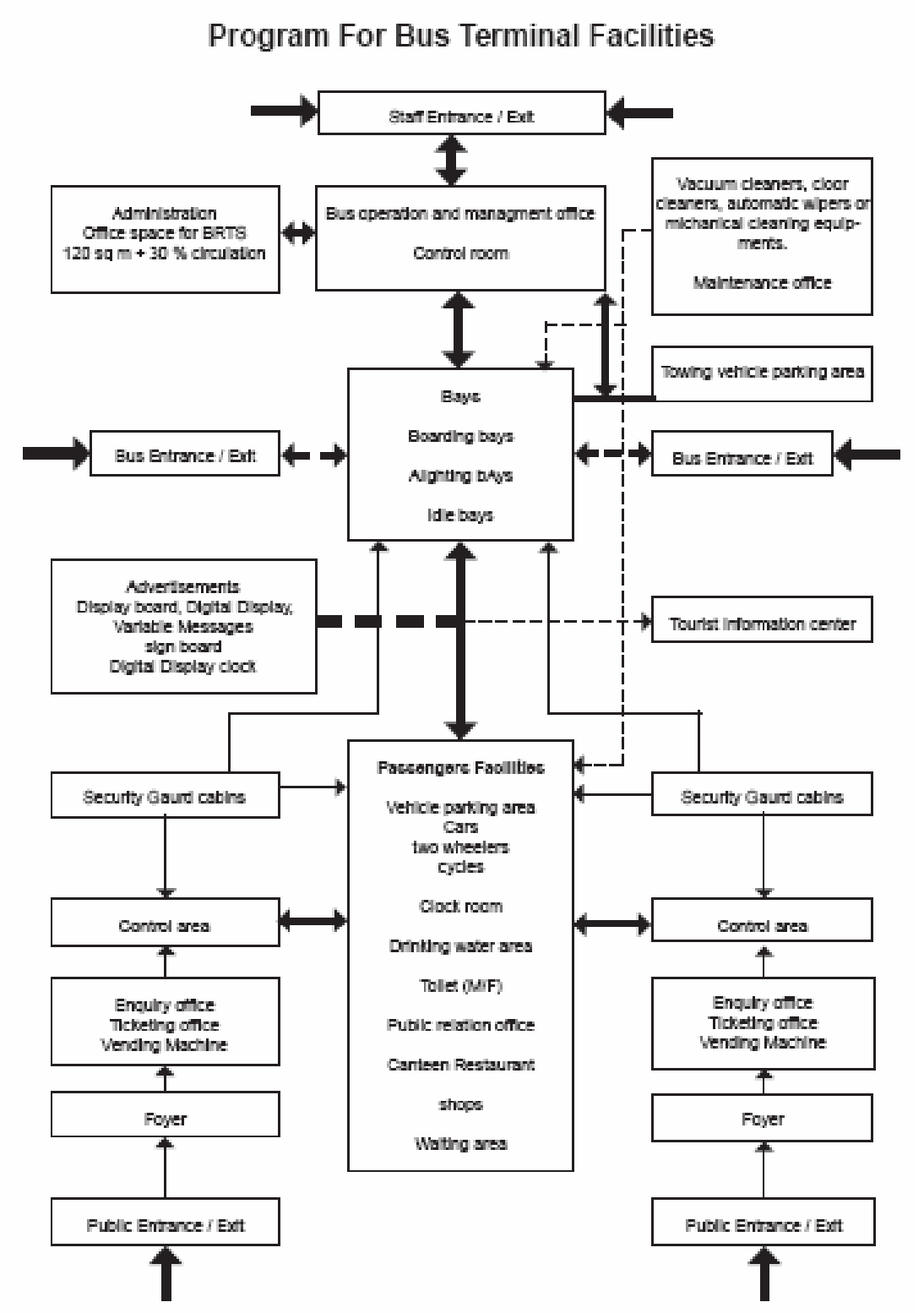


Figure 4-3: Inter-relation of Activities in a Terminal Design

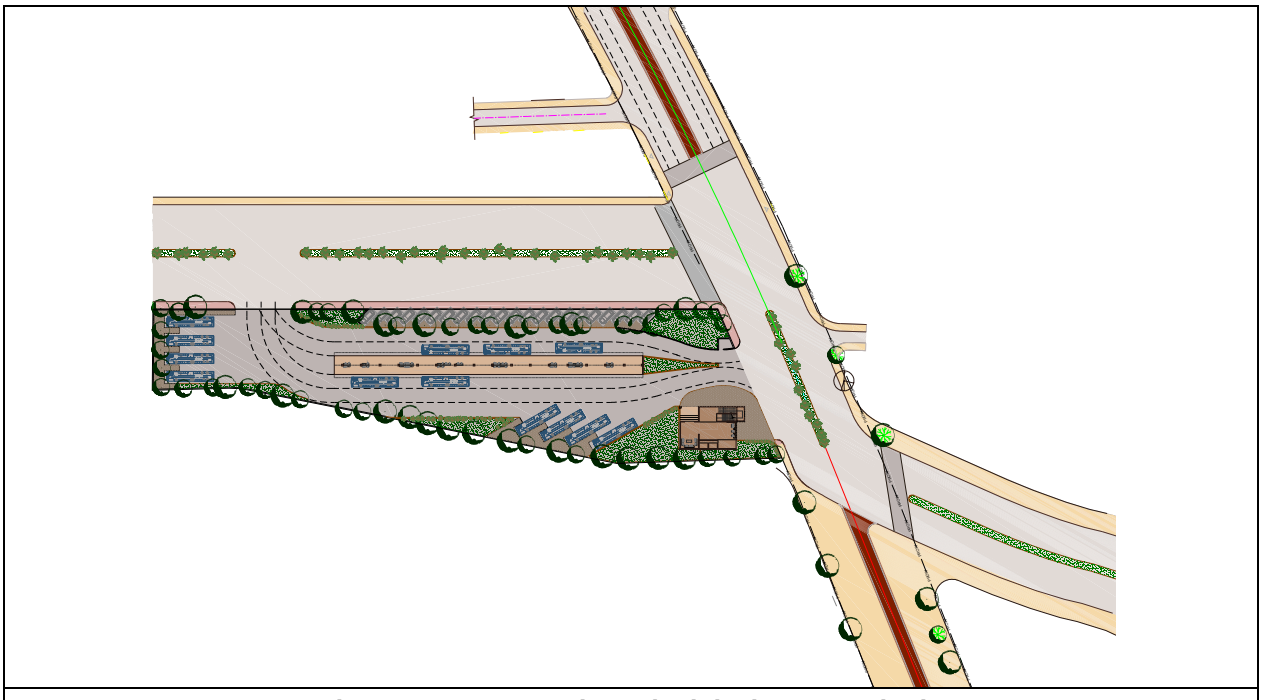
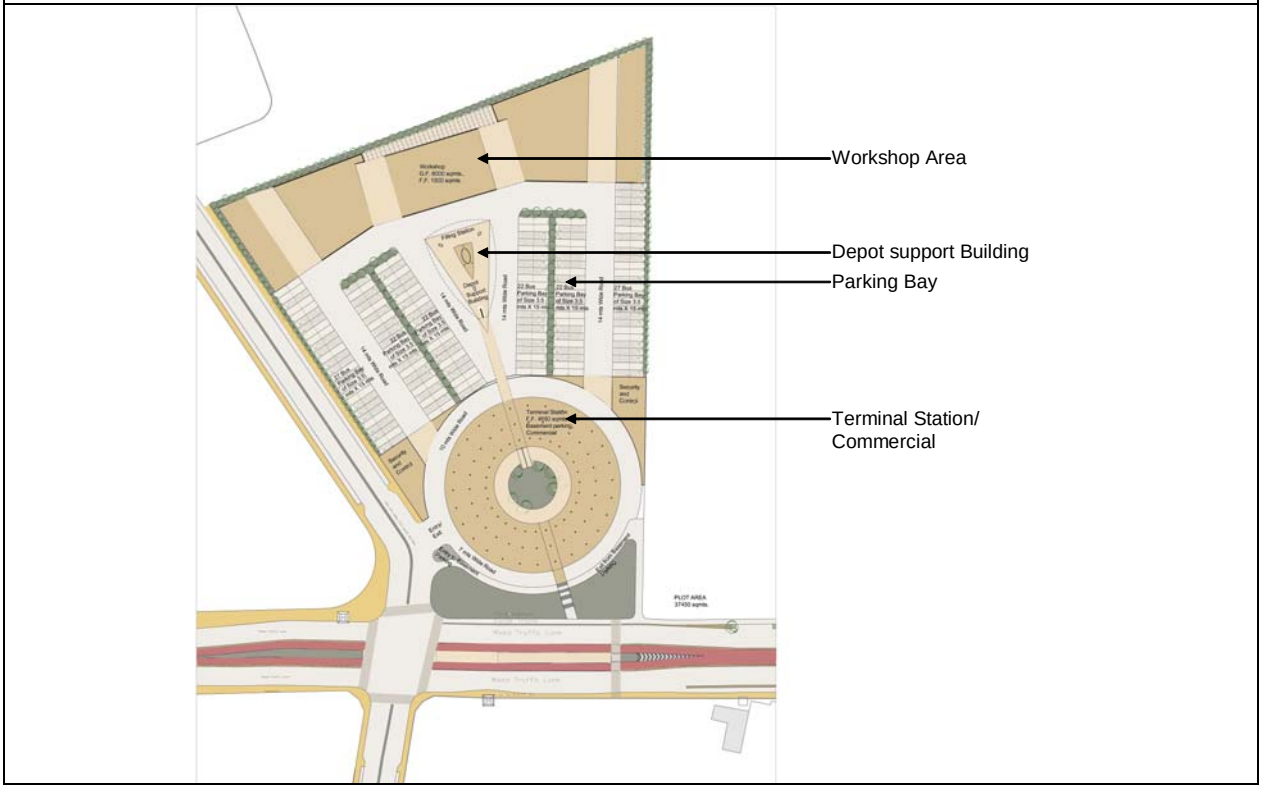


Figure 4-4: Proposed terminal design at Kankaria



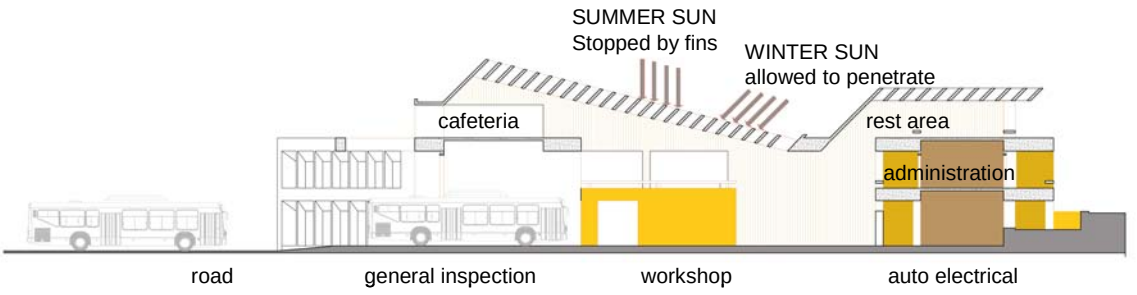
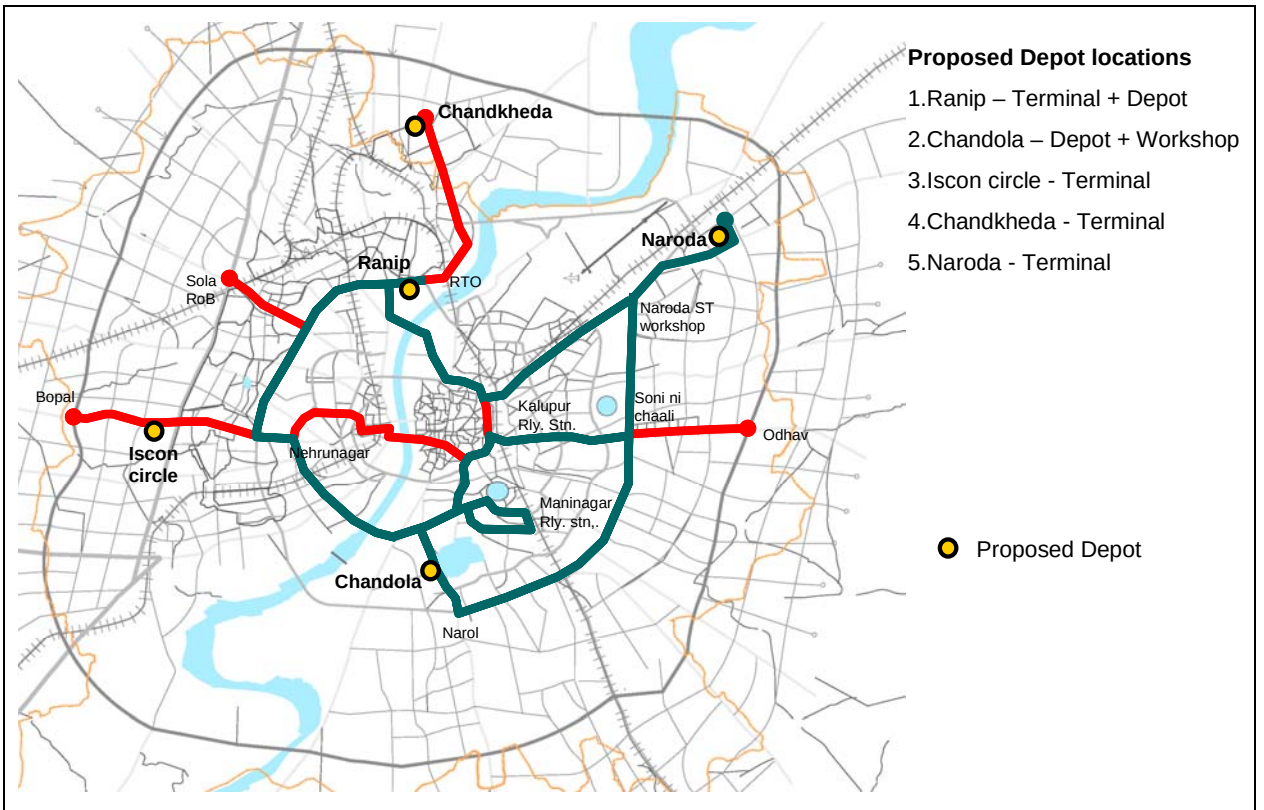


Figure 4-5: Proposed terminal design at Ranip

Overall, for phase 1 and 2, five depots and workshops are planned, with each depot on an average holding 50-60 buses initially and expanding to 80-100 buses finally. Each location will be handed over to a private operator. Private operator may have to provide day time parking facilities to other operators as part of a mutual understanding.

Workshops will be state of the art facilities with at least 10 maintenance pits, washing and cleaning yards and CNG stations.



Map 4-3: Proposed Depots and Workshops

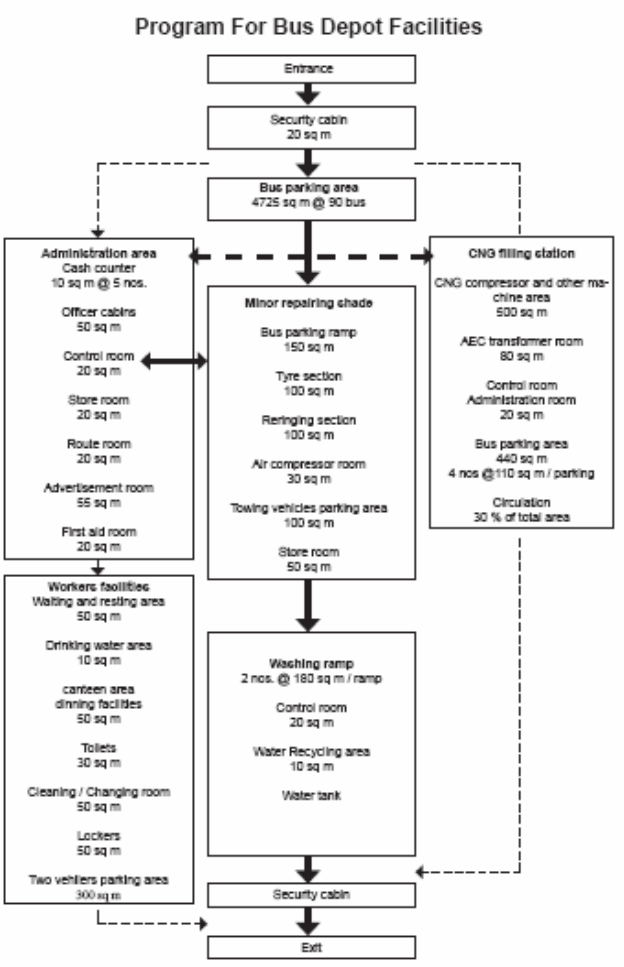


Figure 4-6: Inter-relation of Activities in a Depot and Workshop Design

4.5 VEHICLE TECHNOLOGY

A 12 meter bus with a capacity of 90 has been chosen. The floor height of the bus is 900 mm. Bus operator has been selected and orders for first fifty buses have been placed. Prototype bus is under construction. The selected diesel bus shall be energy efficient, environmentally friendly, safe and secured for transportation of passengers besides the following main attributes amongst others:

1) Passenger comfort
2) Ergonomically designed driver's work area
3) Ease of repair and maintenance
4) Aesthetically designed interiors and exteriors
5) Ease of boarding and alighting for all passengers
6) Ease of accessibility to persons with disabilities

4.6 ITS APPLICATIONS

ITS applications include following four types of applications.

- Operations Control
- Ticketing Systems

- Public Information System
- Area Traffic Control systems

4.6.1 Operations Control

A key component of bus operations is the ability to track and control the bus fleet. This way, bus timing can be adhered to providing dependable service to passengers. Passenger service is further enhanced by providing real time information regarding bus operations. It is proposed to use IT as a means to do automatic vehicle location system (AVLS). AVLS has three important components

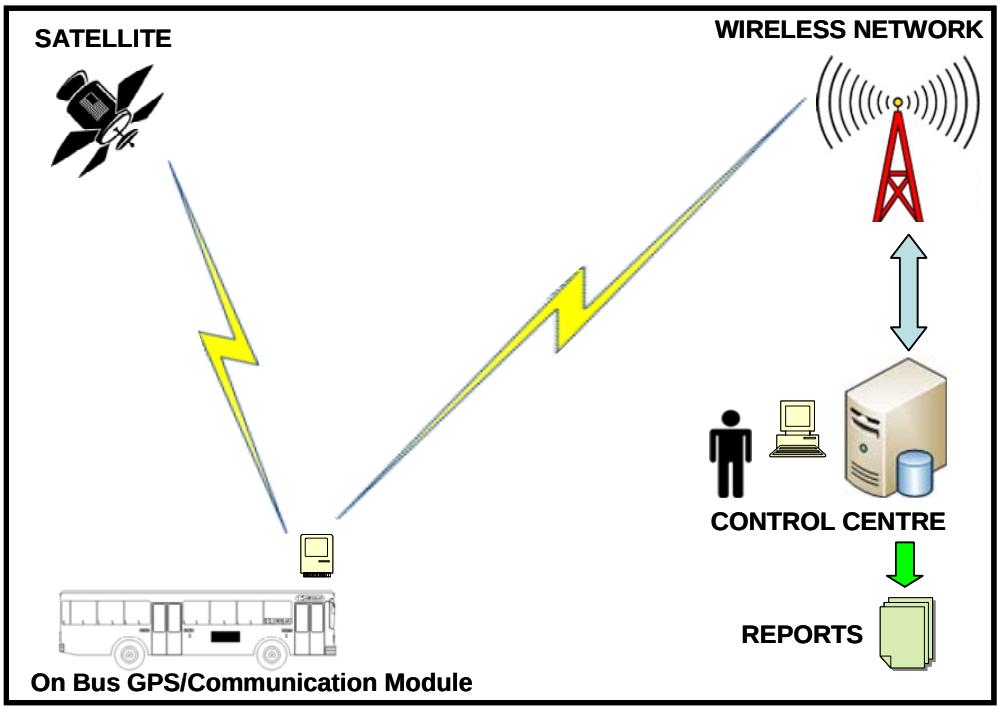
- Location of each bus in operations
- Control of buses using text and audio commands via a communication system
- Passenger information system inside the buses and at bus stops and terminals using the bus location data

Location of bus and accurate data pertaining to the kilometres logged in by each bus is a necessary requirement since all payments to buses are based on them operating the required number of kilometres as per the schedule provided by the Operations Department of Janmarg. In case of deviation from the operations schedule, the bus operator gets penalised.

4.6.2 Location of buses and control

Securely fixed inside the bus on the dashboard shall be an integrated module for

- Location using GPS (Global Positioning System)
- GPRS (General Packet Radio Service) or EV-DO (Evolution-Data Optimized) for transmission of location data to the central control centre
- GSM (Global System for Mobile communications) or CDMA (Code division multiple access) technology for emergency voice communication



The system architecture will involve using VPN (Virtual Private Network) on a wireless communication service provider network to collect data via the service provider server to the Central Control Centre server. Security protocol would involve 128 bit encryption to protect data while being transmitted. The flow chart above shows the transmission of data.

The central control centre would be operated by Janmarg. This centre is responsible for monitoring the bus operations in real time. Location and speed information received from the bus module will be mapped on a GIS network map. The software shall be capable of flashing alert messages on the control centre computer terminals in case buses are not able to maintain their location as per the assigned schedule. Bus drivers shall be first sent a text alert message and followed up by voice communication by the Control Centre executive monitoring the given route on which the bus operates.

4.6.3 Passenger information system

Passenger information system shall have three components

- Inside bus - Next station arrival information in audio-visual format. The onboard announcement system will have its own database of routes and stops. Based on the route that it is operating on, it will directly receive location information from the onboard GPS module to derive the next stop and announce accordingly.
- At stations and terminals – Next bus route and expected time of arrival information. The location information is received by the Central Control Centre as described earlier. This information is sent on VPN on wireless communication network. Stations and terminals have displays with a reception only decoder module which decodes information pertaining to routes expected to arrive at the said location and the expected time of arrival.
- Outside the bus – Bus route and destination stop information

4.6.4 Ticketing system

Once fully operational, the system is being envisaged as a Trunk and Feeder system with fully off board ticketing option. During the initial period, off-board and onboard ticketing options are proposed. Details of fare policy nad integration are discussed in the section below.

4.7 FARE POLICY

4.7.1 Factors Determining Fare policy

Public transport fare policy is defined by these critical factors.

1) Fare should be such that the system is accessible to the majority of the population, a large proportion of which falls in the lower to middle income category.
2) The fare should be high enough to keep the system in good financial health and preferably run with its own revenue.
3) Fare should not be so high that the passengers have an alternative mode which appears to be cheaper than public transit.
4) Check for fraud to the extent that the leakage plugged is more than the cost of checking leakage.

The main guiding principal is to use technology to reduce human error and use human resources to enhance user convenience and to detect revenue leakage. Automatic fare collection system (AFCS) is a step towards achieving this. Janmarg proposes to convert the system to full off-board fare collection, preferably with near universal use of CSC by the end of Phase 1 and 2.

4.7.2 Fare collection

Fare collection is the activity of collecting revenue and validating the journey media. Commonly available ticketing media types are

1) Pre-printed paper tickets
2) Electronically printed paper tickets
3) Magnetic stripe paper tickets
4) Magnetic cards
5) Contact-less Smart cards

Pre-printed tickets: They are the most commonly used media in Indian cities where the tickets are sold by a conductor inside the bus. Fare collection and ticket dispensing is very quick. Fare is distance based and quantum of fare is calculated by the conductor for each Origin-Destination pair of bus stops.

Main advantages are

1) Quick dispensing of tickets without lag for printing requirement. (6sec/ticket)
2) Very cheap media.

3) Duplication of media is not easy since the conductor dispenses the tickets on boarding and knows the series number of each fare denomination.
4) Simple for passengers to deal with.

Principal disadvantages are

1) Revenue data by fare type is not available till the end of the day and that too only in handwritten format. Conversion of this data into digital form takes dedicated manpower and time. Errors in coding also occur.
2) Conductors are expected to note down sales by fare type on a paper form at the end of each stop. There is no means of checking whether this data is correct or not. Conductor liability is limited to depositing the fare collected based on the number of tickets sold of each denomination.
3) There is not enough time for conductors to note down this data in case of heavy flow of passengers where the primary duty is to dispense tickets and collect money.
4) Checking of fare evasion by mobile inspection squads takes a lot of time since ready data of passengers on bus is not available. Instead, inspectors have to check ticket of each passenger. Origin/destination of passenger is assessed by punch mark made by conductor which may have errors.
5) Verification is purely visual with minimal security features.
6) Conductor has to remember the fare for each Origin-Destination pair of bus stops.

Electronic paper tickets: An important alternative to pre-printed tickets is to print paper tickets electronically at the time of boarding. This can happen both off board (before boarding bus) as well as onboard (after boarding). Since the media is simple paper, security is low but visual verification can be very quick.

Main advantages are

- Media is very cheap
- Electronic Handheld ticketing machines are relatively inexpensive (cost of operations under Rs.0.10/ticket)
- E-machines hold information in digital format of each ticket sold.
- The information can be transmitted on near real time basis to a central control centre using wireless technology.
- Mobile inspection squads can quickly compare passengers on bus and tickets sold to check leakage/ ticket-less travel.
- Highly dependable revenue data in digital format can be compiled at the central data centre entire system at the end of day's operations. Such data is very useful for operations planning can be used to quickly modify bus operations.
- Simple for passengers to deal with.
- Can work independent of system IT network being up 100% of the time without any impedance.

Principal disadvantages are

- Ticketing is slightly slower than simple pre-printed ticket (8 sec/ticket). This can slow down operations at very high demand bus stops where a large number of passengers board a bus.
- Requires conductor training for fast and efficient use of the machine.

Magnetic-stripe paper ticket: Magnetic-stripe tickets are electronic paper tickets which have a magnetic band on it to store data.

Main advantages are

- Can be dispensed by both off-board or on-board ticketing machines.
- It is useful when money has to be stored on the ticket for multiple trips or transfers if validation machines exist on all buses. (even on non-BRT buses)

Principal disadvantages are

- Media is more expensive than simple paper ticket but not as expensive as smart cards.
- Data security is not as strong as smart cards.
- Can be corrupted easily and do not have a very long life.
- Since the data is stored on a magnetic strip, the ticket has to be physically swiped for the electronic reader to verify the data.

Contact-less smart cards (CSC): Smart cards typically used have a chip in them which has small memory space. This chip can store multiple data types like passenger ID (in case of passes or concession fares) or have money value (when used like an e-purse) for multiple journeys. It is powered when brought into close proximity (but contact-less) of an electronic reader which powers the card chip. They have many useful features but come with a large price tag (<Rs.50 per card).

They can be very effectively used for long term concession tickets like student passes or seasonal travel pass (for a month or above) where the price of the card can be offset in the purchase amount. They are also useful when passengers use it as an e-purse where a large value is stored on the card. This allows the cost of the card to be offset in the initial purchase and users can be given discounts. The added advantage of smart cards is that variable discounts can be given with relative ease because the fare does not have to be round figures anymore (which is necessary for sale of single journey tickets where only multiples of rupee can be used for ease of transaction)

Smart cards cannot work in isolation and need large scale infrastructure and very carefully structured software which is the backbone of the high security features that they offer. It necessitates near 100% uptime of the entire system. In its absence, smart cards cannot function.

Separation of fare collection and journey validation has the advantage that the cost per vending individual ticket reduces dramatically. This should be read though with the catch that such reduction comes at the cost of large investment in infrastructure, secure software, and maintenance of such a system. Additionally, it should be noted that the advantage of

separating fare collection and validation can also turn into a disadvantage since validation can occur only if the entire system's IT network is up and running at all times.

The table below summarizes the characteristics of each fare media type.

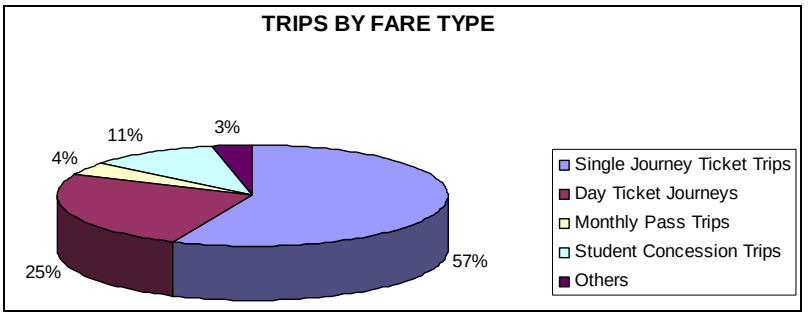
MEDIA TYPE ⇨ ⇩ FEATURES	Pre-printed tickets	Electronic paper tickets	Magnetic-stripe paper ticket	Smart card /smart token
Cost of media	Very cheap	Cheap	Medium cost	High
Cost of infrastructure	Very cheap	Medium	High	High
Revenue data collection/ compilation	Takes additional manpower and time (< 1 week)	Real time / End of day	Real time / End of day	Real time / End of day
Verification	Takes time	Quick	Quick	Quick
Security	Low	Medium	Medium	High
Data security	-	-	Medium	High
Onboard fare collection	Yes	Yes	Yes	Yes
Off-board fare collection	Not possible for distance based fare (high fraud)	Difficult for distance based fare for Transfers	Possible for distance based fare and transfers	Possible for distance based fare and transfers

4.7.3 Existing fare structure

Ahmedabad Municipal Corporation wants to use the opportunity of BRT implementation to integrate the fare structure of BRT and AMTS bus services. This would be beneficial to all public transport users.

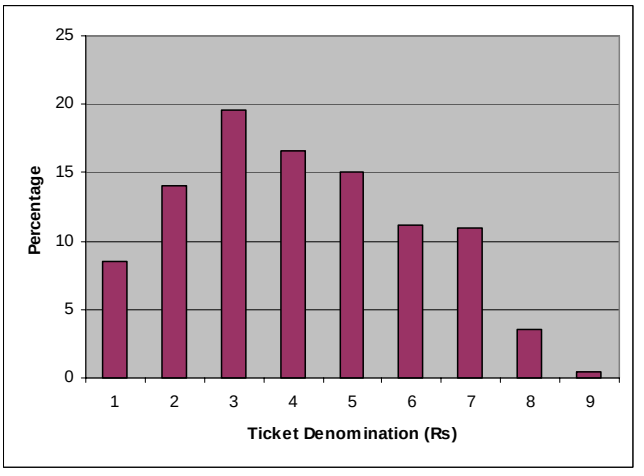
In Ahmedabad Municipal Transportation System, fares can be classified in 3 main categories:

- Distance based single journey ticket - Starting fare is Rs.1 and goes up to Rs.9. These tickets are dispensed onboard the bus by a conductor.
- Period ticket - Day pass is available for Rs.20 which allows unlimited travel on all routes of AMTS for a day. This pass is available to students and senior citizens for a 50% discount. These tickets are dispensed onboard the bus by a conductor.
- Concessionary pass – Monthly prepaid passes are given to general passengers who wish to avail a 50% discount to travel on chosen pre-registered roundtrip sector (origin-destination pair) compared to the cost of what regular daily tickets would cost for the same roundtrip if bought separately. Students get a term pass for Rs.150/semester. In addition, all police personnel get to travel for free on AMTS network for a annual payment made by police department to AMTS.

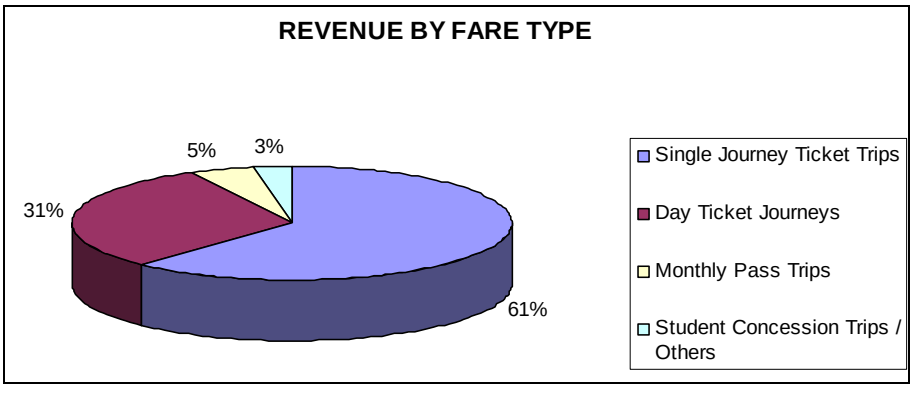


25% of single sector journeys are made using daily pass (8% people buy a full day ticket for unlimited travel and make, on an average 4 trips/day). Another 4.3% of passengers have seasonal pass (monthly). Other forms of concession passes, majority of which are student passes (for a semester) form 14% of the ridership.

Present revenue figures show that average fare per single journey is 4.20 rupees while average fare per complete trip in one direction is 5.50 rupees. Transfer survey done in the month of Feb'08 shows that a little under 17% of bus passengers perform at least two or more trips to reach their destination.



Distribution of trips based on fare denomination is shown in the graph above. Average trip length is well under 8km. 42% of these trips are under 5km in length. It is worth noting that nearly 60% of trips are made by riders who presently prefer to buy single journey tickets even though a Day Pass is available fairly cheap (Rs.20/day for unlimited travel). Any fare structure should take into account these statistics not to loose out on passenger ridership.



To retain all these passengers on public transit, it is important that both AMTS and BRT honour these multi trip passes. These two public transit regulators/fare managers will also

share revenue generated from such sources which, as of today, account for 39% of the total revenue.

Passengers are very fare sensitive. Fare sensitivity is derived in the form of fare elasticity, defined as Percentage change in demand for a given percentage change in fare.

$$\text{Fare Elasticity} = \frac{\text{Percentage Change in Demand}}{\text{Percentage change in fare}}$$

There are a number of factors that influence fare elasticity.

- Quantum of fare changes – the higher the change in fare, the less likely it is that passengers will be retained.
- Competition from other modes – Strong competition from other bus operators (existing bus service) and from other modes of transport (like shared autos, motorcycles) will make passengers more sensitive to fare changes.
- Journey purpose – travellers commuting to work or school tend to be less sensitive to fare changes, whilst leisure travellers are more sensitive.
- Distance – passengers will be more sensitive to changes in fare if they are only travelling short distances since cheap alternatives exist which can take them to destination quickly.
- Peak vs Off Peak – passengers tend to be less sensitive during peak periods of travel, compared with off-peak periods of travel.
- Income levels –higher income passengers are less likely to be sensitive to fare changes compared with those with low income.
- Quality of Service – Passengers may be less sensitive to fare changes if the quality of service is high.

The average value of waiting time of bus/IPTS passengers in Ahmedabad, converted into rupees, is eight rupees per hour. Even though this seems to be low, it is sufficient for other modes to attract passengers away from buses. The two principal competitors to bus transit are

1) Shared autos/Chakkdas
2) Motorcycles

A 15 minute wait for a bus for a short single stage trip (no transfers) would be equivalent of Rs.2. What this means is that passengers are willing to take a quicker mode like a shared auto even if it is two rupees more expensive than a bus trip of the same distance. The average trip distance is 6.2 km for single journey. At current average speed of bus of 18.6 kmph, this translates into a journey time of 20 minutes. Average speed of autos is marginally higher resulting in a similar trip time but with very little waiting time. This is the reason why a lot of short journey trips are catered to by shared autos as of today. It is estimated that close to 350,000 daily trips are made by 3-seat and 7-seat shared autos in Ahmedabad. In percentage terms, this is more than a third of the total trips made on some form of public transit (Bus + IPTS). Shared autos are an important competitor to buses on certain sections.

They form the only mode of transport in a few parts of town. Their importance should not be undermined. They play an important role in providing public transit to many people.

In the physical design of important bus station locations and at terminals, appropriate parking has been provided for Auto rickshaws for quick transfer of passengers from BRT to auto which can then serve as feeder services. At the same time it is necessary to control the usage of shared autos on important arterial roads where they compete with buses. Bus services (both BRT and AMTS) will be augmented on these sections to offset the reduced capacity provided by IPTS.

4.7.4 Proposed fare collection system

General Characteristics & Architecture of AFCS

The AFCS architecture should comply with the following important conditions:

- Flexibility - The system should be adaptable to changing commercial practices.
- Open Architecture - The system should be open to allow interoperability with general-purpose software and have facility to Export data files to nominated and agreed applications
- Workflow Integration Approach - The system will adapt workflow management techniques.
- Distributed Application - The system will support functionally distributed computing, allowing distributed applications across different locations.
- Simplicity - The overall application will be developed keeping in mind simplicity as the key, so as to enable easy maintenance and operation of the application by the end user.
- Manageability - The AFC application will cater for easy manageability by the system administrator.
- Scalability - AFCS will be deployed across all the Bus Stations and bus fleet of the BRTS, to accommodate future requirements of expansions and newer applications, the AFCS will be scalable at a modular level. Servers should be able to scale up or scale out depending on future requirements by CPU or Memory or add-on servers using clustering technology. The recommended products should be proven in the field to scale well in order to meet large enterprise requirements. Key components such as personal computers, servers, application servers and network should be of modular design to ensure scalability of the system.
- Reliability - System behaviour will be consistent and optimized to avoid malfunctioning in the form of server crashes, under unavoidable circumstances the system will be built to recover to the original status with out harmful data loses. Solution will be implemented with appropriate technology to ensure system reliability.
- Availability - High availability will be achieved through system level redundancy including the communication networks.
- Stability and Robustness - System behaviour shall be consistent even under high stress / over use, wrong use, etc. Load balancers shall be an active component of the solution so as to share the load and thereby, ensuring stable operation.

- User Friendliness - Intuitive User Interface design features shall ensure customer satisfaction and retention to the service.
- Interoperability - AFC shall support standards based data exchange, which would make it easier to integrate with compatible, nominated and agreed third party software.

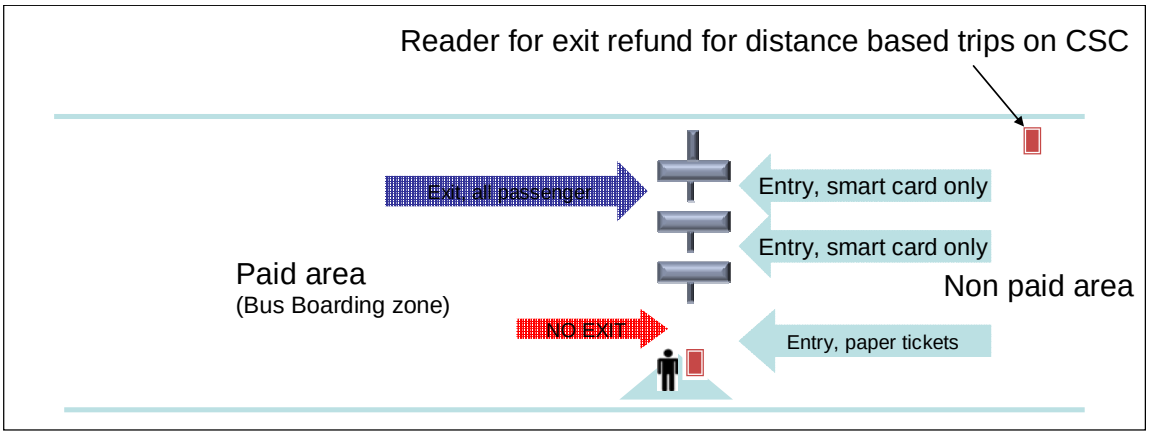
As discussed in the section on fare media types, seen in the light of choice of fare type (single trip ticket, day ticket and concession passes of various types) at present on AMTS, we can safely say that more than a third of the trips are made by those who can directly benefit from the usage of CSC. These categories are

- Students and other concession holders
- Monthly pass holders
- Day ticket passengers

CSC has definitive advantages for providing various forms of discounted travel even for single trip, especially when associated with transfers. It is necessary though that such discount be built in by selling large denomination cards on initial purchase and giving ongoing discounts for recharge so that the passengers retain their card.

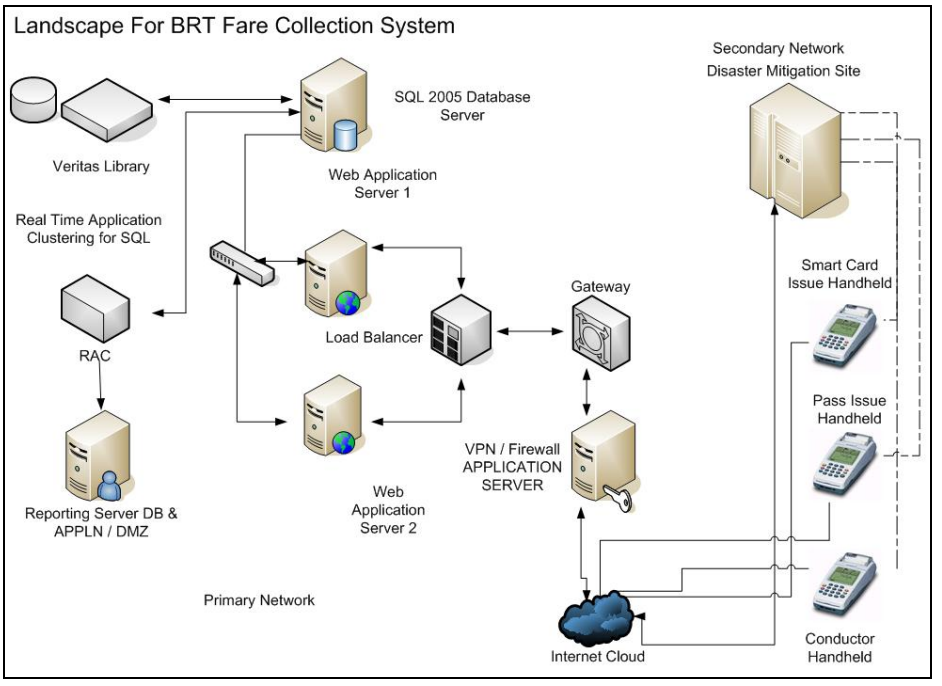
It is important to note that not every person shall benefit from the use of CSC, especially those who presently buy tickets on a daily basis for short trips and find it prohibitively expensive to buy a smart card with high value to start with. So, alternative in the form of electronic paper ticket shall be provided for such people for single travel at a premium to discourage the use of paper tickets and enhance CSC usage.

Expressions of Interest for AFCS have been received from 9 firms, 3 of which have been short listed for the bidding process.



At the start of operations, all buses will be equipped with onboard ticketing machines operated by fare collection personnel. This is required since at the start of operations, BRT buses will ply on the route network as given in the operations plan. Since certain sections of the segregated corridor shall be still under construction but passengers will have destinations on such portions, it is necessary that the BRT buses ply on such sections as well. This necessitates onboard ticketing facilities on the bus at the start of operations. When the entire Phase 1 and 2 corridors are constructed, the system will function as a closed system and access only the median BRT stations. At this stage, all ticket validation will be

done off-board. All BRT stations will have off-board ticketing facilities and the requisite network connection for validation of CSC and personnel to dispense electronic paper tickets.



5 INSTITUTIONAL STRUCTURE AND BUSINESS MODEL

5.1 INSTITUTIONAL STRUCTURE

The ultimate sustainability of the BRT & AMTS system depends as much on its software (regulatory structure, management and business model) as on its hardware (infrastructure and rolling stock). A good institutional structure should

- Maximise the quality of service to the end user and sustain it over the long term
- Minimise the cost of such service over a long term
- Maximise public benefit from public sector investment
- Maximise opportunities for private investment to cash in on private sector enterprise

With these core objectives, the principal components of the institutional structure are

- Regulatory environment in which private sector operates the system with strong public oversight in the interest of the citizens
- Cost sharing using a PPP model
- Multiple operators chosen through bidding process to encourage competition but limited to such numbers that provides low cost of operations
- Remove competition for passengers on street by making payments to operator based on kilometres operated and quality of service parameters. There should be no route contracts, exclusive or competing.
- Independent fare collection and vehicle kilometre monitoring contract to distribute revenue in a transparent manner.

To manage such a system, it is necessary to have a special body dedicated to manage the system.

- Ahmedabad Janmarg Ltd. (AJL), a company of AMC has been created under the Company Act. The organisation is responsible for managing BRTS operations in Ahmedbad.
- The AMTS will continue to manage regular services, termed as ‘complimentary services’.

The principal stakeholders of this AJL company are

- Ahmedabad Municipal Corporation
- Ahmedabad Urban Development Authority
- Government of Gujarat

5.1.1 Institutional Structure

The board of SPV consists of the following directors:

Chairman

Municipal Commissioner, AMC.

Directors

Hon. Mayor
Chairman Standing Committee
Leader of Opposition Party
Dy. Commissioner (BRTS), AMC
Chairman, AMTS
Additional Commissioner of Police (traffic)
Chairman/CEO, AUDA
Director, Urban Transport, MOUD, Government of India
One Member of Legislative Assembly representing AMC area
Principal Secretary or his representative, Urban Development Department
Principal Secretary or his representative, Department of Finance
Two urban transport specialists
Two directors from private sector (With contribution to capital)

The next step of action is to actualize the SPV. This means to bring in staff to hold key positions in the company and then employ the staff for management of the BRT system. It is important that the scope of the SPV be not diluted by assigning other tasks but to keep its objectives clear towards management, promotion and long term sustainability of BRT in Ahmedabad. AMTS and AJL will coordinate the operations.

5.1.2 Functions

The main function of the Janmarg is to maximize the quality of transit service at the minimum possible cost. It is the responsibility of the SPV to administer the implementation of special exclusive infrastructure of the system and the long term operations, which according to the physical and technological conditions in the operations of the system can be carried out to promote and to benefit the public mass transit service, in coordination with the competent authorities and within a strong legal framework.

In the fulfilment of the activities described above, SPV will try to contribute in the improvement of the physical infrastructure of the city, to improve its competitive capacity in tourist, commercial and services matters and to induce a new culture in the users of the transit service.

Janmarg Ltd will sign all contracts with operators and any service provider in fulfilment of its objective of providing high quality public transit services in the city and its surroundings. Additionally it will be able to acquire, to use, to limit, to give or to take in renting or to another title all kind of properties, and to alienate them when for reasons of necessity or convenience it is advisable; to take money in mutual, to give in guarantee its property and to conduct all the operations of credit that allow it to obtain the necessary funds and other assets for the development of the SPV; to acquire patents, commercial names, brands and other rights of industrial or intellectual property and to acquire or to give concessions for its operation, and in general, to celebrate or to execute all kind of contracts, acts or operations over its property, that they keep relation to aim with the development of its legal object, rights and obligations.

In addition to others described in general way, the important function of Janmarg Ltd would be

- Signing the contracts with private Bus Operators and Service provider for Automatic Fare Collection System, Operations Scheduling, Automatic Vehicle location and Control Technology.
- Planning routes, frequencies, schedules and operational kilometres based on demand data collected on ongoing basis.
- Supervising and controlling the operation of the Bus Companies and Collector.
- Calculating the Technical Fare and presenting studies about Public Fare to the authority to keep financial situation transparent.
- Compile information about BRT operations and financials
- In charge of the maintenance, cleanness and security of the stations.

In general, Janmarg will have a range of responsibilities, with technical autonomy within the local transportation political policy, including:

- Policy-making and setting standards for the corridors.
- Planning and design.
- Project implementation.
- Contracting.
- Operational management.
- Financial management.
- Administration.
- Marketing.

5.1.3 SPV Management

Janmarg will have various departments to manage its key responsibilities. The principal departments are

- **Operations management** – Like arms and legs, this department will manage day to day management of bus operations. This department shall be the largest in terms of manpower. It will manage the Central Control Centre, perform quality control checks on bus fleet and infrastructure, and oversee fare collection activities at terminals and in the system in general. This department also advises the Administration and Finance department regarding payments to be made to bus operators and all other external contractors. They will liaise directly with the bus operators, fare collection agency, infrastructure maintenance agencies and all other groups involved with operations.
- **Planning -** Planning department is akin to the heart of the system. It will work in the area of demand management. Its role will be to conduct passenger surveys, compile and analyse data pertaining to passenger demand, not just on the BRT system but in the whole city on other relevant modes. It will plan medium to long term changes in operations. It will assess possible extension to the system, when required, and take necessary approvals from relevant authorities. Fare structure, fare incentives, economic and business model are areas that it shall study and develop for the operations management group to implement.

- **Marketing and communications –** As the name suggests, this group looks at marketing the identity of BRT. It will manage advertising revenue accounts, handle public relations, prepare promotional material for the media and publish press releases, and conduct user satisfaction surveys.
- **Administration and finance –** It shall be responsible for making all payments based on the information it receives from the operations management cell. It will also be responsible for internal administration and HR management.

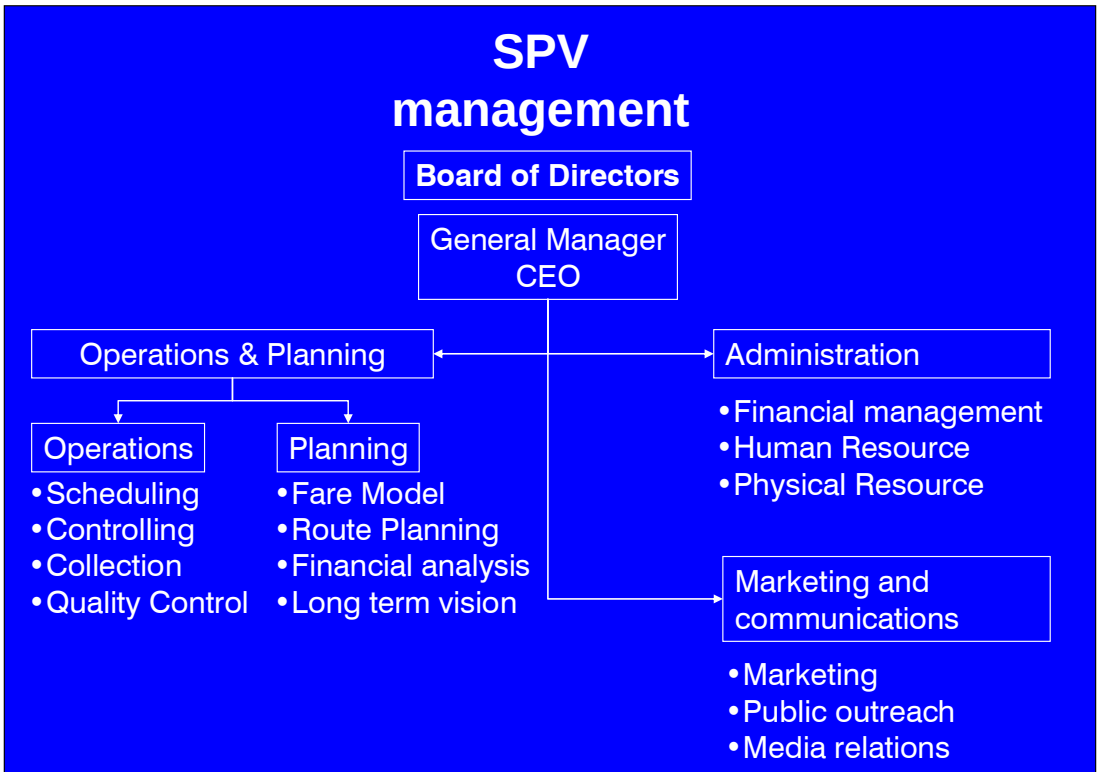


Figure 5-1: SPV Management

The figure above shows the basic structure of departments and delegation of power within Janmarg. General Manager/CEO heads the organization, manages it, and reports to the Board of Governors, the advisory body at the top. Under the CEO are department heads (Director). Operations and planning departments have a lot to co-ordinate with each other and therefore have been joined under one head called Operations and Planning.

5.2 BUSINESS MODEL

Clarity through delineation of responsibilities and rights forms the framework of a sustainable business model. Based on the core objectives of the institutional structure, the principal tenet of which is 'Regulatory environment in which private sector operates the system with strong public oversight in the interest of the citizens', the business model has three principal constituents

- Regulator
- Bus operator
- Fare collection agency

There would be 5-7 bus operators each with a fleet ranging from 70-100 buses. The main terms and conditions under which the bus operator will function and be paid for are

Bus Procurement and Operations: Bus procurement will be through private participation. Workshop space will be provided by AMC, where the private operator is expected to procure all machinery required to maintain buses. The following pints describe the operations structuring:

- There will be no route licenses and exclusive right to operate in any given part of the city. The contract is deemed to be a service contract where the bus operator agrees to purchase the agreed number of buses and operate them as per the schedule provided by Janmarg which shall be modified from time to time.
- There are no daily guarantees or individual bus guarantee for the number of operated kilometres. Janmarg solely provides a guarantee of an average of 62500 km/bus/year spread over the operator's fleet.
- The term of the contract is for 750,000km/bus spread over the operator's fleet.
- Janmarg me require an operator to put in service part of the fleet or entire fleet such that the average kilometres operated per bus is more than 62500/year.
- Cost of bus, maintenance equipment, all operations cost including fuel, all maintenance cost including tyres and spare parts, will be borne by the operator.
- Operator will be paid as per the number of kilometres scheduled and operated by him. Such rate shall be the criteria of bidding over and above clearing the minimum technical capability criteria.
- Number of passengers on any given bus has no implications on the rate per kilometre payable to the operator.
- Rate per kilometre shall be revised on an annual basis as per a pre-defined equation which takes into account fuel cost increase and other inflation indicators.
- In case the operator is unable to perform as per the schedule provided to him, or does not follow the minimum quality of service criteria such a cleanliness of bus, traffic infractions, speeding etc, he shall be fined in terms of kilometres payable.
- There is no deemed right to advertise inside or outside the bus, or anywhere at the operator maintenance facility. Advertising revenue to the extent of additional cost of maintenance of the bus shall be paid by Janmarg to the operator.

Fare Collection Contract: Fare collection contract will again be a service contract where the AFCS agency brings in the equipment, maintains the equipment and manages the back office operations. They will also set up the Financial Management System (FMS) for all accounting and payment functions and train the Administration and Finance department staff of the SPV in using the software. The fare collection agency shall be paid on a monthly basis

Fund Management: There are two funds envisaged to be created as part of Janmarg operations.

- **Main Fund:** Receive moneys from fare box collections, advertisement revenue, parking fees, terminal commercial revenue
- **Contingency Fund:** Fund is received from Urban Transport Fund.

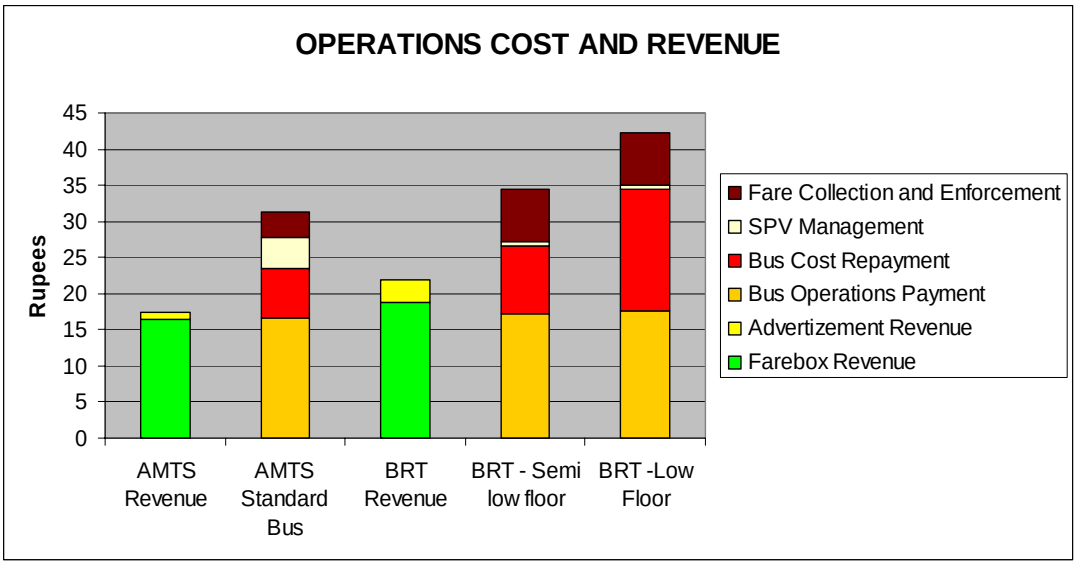
The business structure and fund flow structure is such that all payments get made only through the main account. In case of deficit in the main account if revenue is less than the expenses, then the required money will come out of the contingency fund.

Inputs into contingency fund come from two sources. If the revenue in a certain period is more than the operations cost, then the surplus is transferred into the contingency fund. On the other hand in the revenue is less than the expenses, then the deficit is transferred from the contingency fund into the Main fund to make the necessary payments. As per the contracts given to the Bus operators, fare collection agency and other subcontractors (e.g, maintenance of stations and terminals), Janmarg is bound to make payments to the said parties as long as the agencies are operating as per the terms and conditions of the contract.

Since financial calculations show that payments to bus operators, fare collection agency, infrastructure maintenance and system management cost, in short the entire cost of ongoing bus operations are more than the total revenue through fare box collection, advertising revenue an other sources, it necessitates a viability gap fund to make up for the deficit.

The graph below shows the break-up of the cost of operations (excluding infrastructure but including rolling stock) into its principal components. The comparison shows three types of buses.

1) BRT Low floor (380mm above ground) CNG bus
2) BRT Semi Low floor (650mm above ground) Diesel Euro III bus
3) Standard floor (1100mm above ground) CNG bus



The revenue figures should be seen as representative of a period by which BRT operations have stabilized and passengers are used to the new system. No fare increase or change is assumed. BRT system ridership is based on integration of BRT feeder and BRT trunk services such that a passenger who boards on the BRT system has to pay the base fare only once while he continues to pay the distance based fare corresponding to the length of travel on the each sector (trunk or feeder).

As discussed in the chapter on fare, fare elasticity is high in the presence of alternative modes. Any fare increase should also take these steps.

- Have a clear policy regarding usage of shared autos and restriction of shared autos along the BRT corridor to avoid competition.
- Create a parking policy for the entire city to make private vehicle users pay for parking to put the cost of transport by private vehicles into perspective.
- Provide frequent and reliable services so passengers can depend on them

These steps can help in modal shift but at the same time, absence of any action along with fare increase will see a reduction in total number of passengers as well as net revenue.

It is also desirable that the fare policy remains the same across all public transit systems. This requires that AMTS and BRT have a common fare collection system with revenue sharing mechanism. From existing levels, if the system were to break even purely through increase in fare box revenue, fare will have to be increased by 125% (operations with low floor CNG bus). Even though the importance of quality of service should not be undermined in estimation of modal shift and increase in ridership, anecdotal evidence suggests that quantum of fare and savings in time are larger factors in mode choice. This is based on the socio-economic conditions of the spectrum of population which currently uses public transit.

An increase of fare up to 30% is conceivable to increase the revenue. None the less, it is necessary that there be alternate sources of income, direct or otherwise, to make up for the difference between Cost of Operations and Fare box revenue. It is suggested that part of this be recovered through development of commercial space at the bus terminals and depots of the BRT system. Other suggested options for indirect sources of revenue are

- Parking fee
- Fuel surcharge
- Percentage of Local taxes

A Urban Transport Fund (UTF) shall be created which has pre-allocated revenue sources (such as above). This fund cannot be utilized for any other purpose other than managing the deficit of public transit operations as well as improving and maintaining all associated infrastructure.

Nearly 60% of bus operations cost (excluding cost of bus) is fuel. Reduction in fuel expense can happen through

- Reduction dead kilometres (non revenue generating operated kilometres) through efficient operations, variation in frequencies in peak and off peak hours, and appropriate depot location and mid day bus parking facilities.
- Direct purchase of fuel from CNG/Oil companies through contracted terms
- Waiver of taxes applied on such fuel since it is utilised for the purpose of public transit

In addition, it should be noted that 26% of the cost of bus is paid as taxes/excise duty to various state and central government bodies. If these duties/taxes are waived, then the cost of operations can come down by 11% in case of Low Floor CNG Buses or 25% in case of Semi Low Floor Diesel Buses.

6 PROPOSED PROJECT COMPONENTS

The proposed project is broadly based on the city's mobility plan and is aimed at adding value to the activities funded under JNNURM and the Municipal/ State Budget. The components can be categorised in terms of:

I. Investment Support
- (i) ITS for integration of Janmarg (BRTS) and AMTS
- (ii) Control Centre Development (Physical development excluding land)

II Capacity Building and Technical Assistance
- (i) TA for preparation of TOD plan
- (ii) TA for preparation of Bicycle Plan and a design of a Bicycle Rental Scheme
- (iii) Training for planning unit in BRT's organization

III. Project Implementation Support
- (i) Establishment of Monitoring and Evaluation System
- (ii) Project Preparation & Implementation

6.1 INVESTMENT SUPPORT (PROJECT COSTS)

As per the original plan, the IT applications were primarily aimed at Janmarg and with the expansion of the scope and the need for integration of service providers, it was decided to expand the service to AMTS.. The integration of Janmarg, AMTS and Feeder Service will essentially mean creating a central IT infrastructure which allows all the three entities to work independently while the IT system allows functional process integration. The individual entities need to have seamless integration of processes by creating identical IT platforms which has high degree of interoperability with consistent fail-over systems.

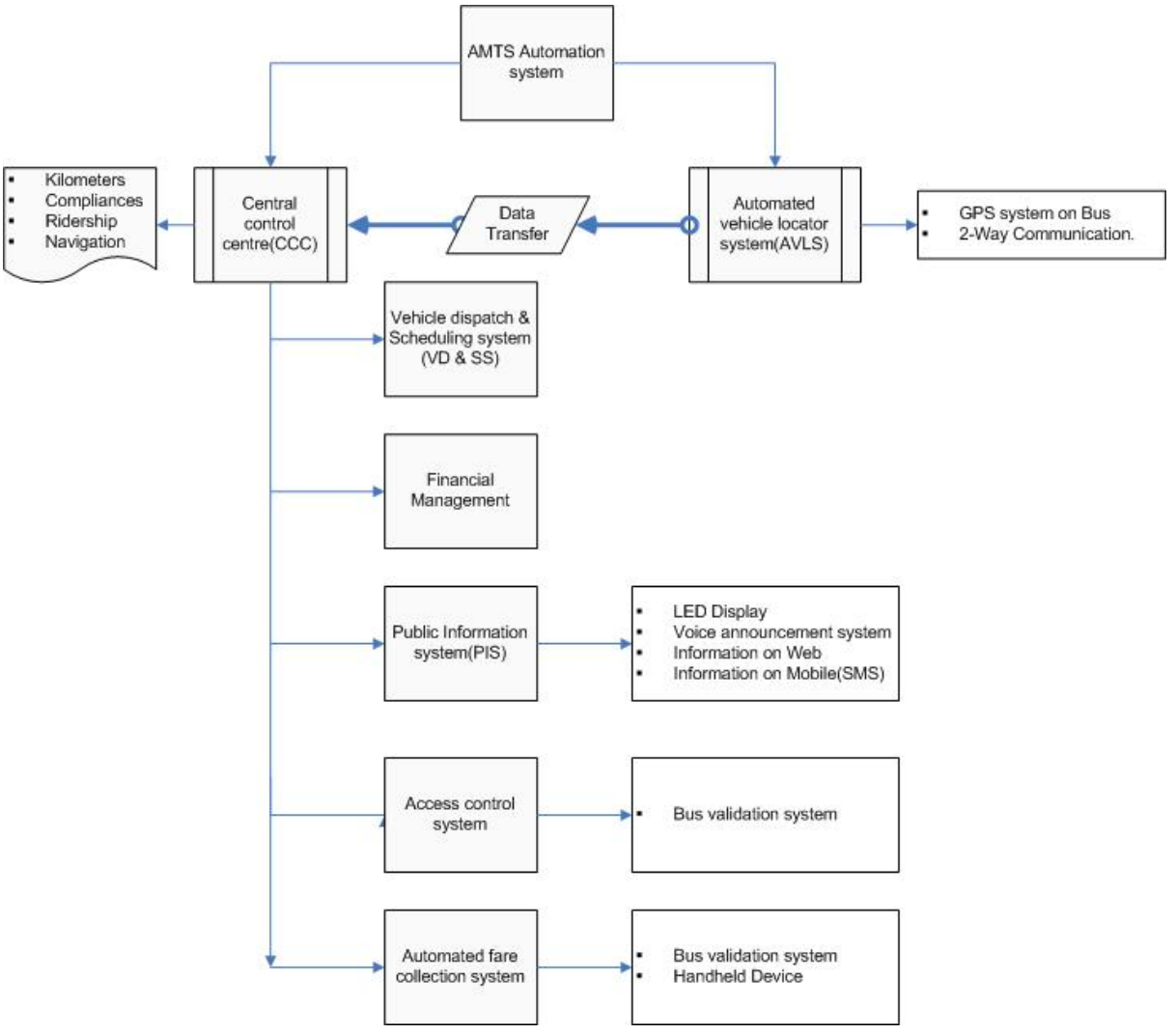
Sub Components: Upgradation of AMTS operations to Automated System will require retrofitting the old buses with some equipments and facilities.

- AMTS operation will be an open-loop system with provision for on-board ticketing / Swipe card in the bus itself.
- Hand held devices will be provided o conductors for ticketing
- 2-way communication with bus driver by SMS displayed on a large driver console.

The proposed AMTS automation System will have 2 major components namely:

1. Central Control Center (CCC)
2. Automated Vehicle Locator System (AVLS)

Both these system will work separately but in tandem, so that data will be transferred from AVLS periodically to CCC, which would in turn generate MIS reports using the data.



CENTRAL CONTROL SYSTEM (CCC)

This system will predominantly take care of:

1. Vehicle dispatch & scheduling system
2. Financial management
3. Public Information System
4. Access Control System
5. auto fare collection

Auto vehicle locater system

This will take care of the followings:

1. A GPS system will be installed in the buses, which will give location of the bus at a given point of time.
2. A 2-way communication system will be installed in the bus to pass on instructions to bus driver. For example, a message may be sent to him informing him on the crowded/ jammed state of a road, calling for diversion to an alternate route. Such messages will be displayed on a large-screen driver console.
3. Passengers will have increased convenience in travel as the PIS system shall automatically update Estimated Arrival Time (ETA) of the bus.

Automated Vehicle Dispatch and Scheduling System (VD&SS):

This system would take into account fleet strength and no. of routes and create best-fit between them for generating optimal revenues. The system will work on automatic route scheduling mode based on Ridership, Peak Rush, Peak Hours etc.

At the end of the day, the buses will be shifted to Depots allotted to different operators, where the buses will undergo a stringent maintenance and upkeep routine.

Notes:

- There will PIS displays in AMTS sheltered bus-stops
- At major AMTS stops, there will be voice announcements periodically.

Automated Fare Collection System

This will be comprised of:

1. Bus-validation system
2. Hand-held ticketing device with the conductor

ITS components needed for integration of Janmarg and AMTS are as follows:

Sr. No	ITS Component for AMTS Integration	Total Units	Total Cost
1	**Central Control Centre Software**	**1**	**15000000**
	Central Fare Collection System		
	Passenger Information System		
	Management System		
	Operations Management System		
	Vehicle Prioritization System		
2	**Disaster Recovery Centre Hardware**	**1**	**7500000**
	Application Server		
	Database Servers		
	Security Infrastructure		
	Load Balancers		
	VPN Systems		
	Backup System		
	Network Elements		
3	**Central Control Centre Hardware**	**1**	**7500000**
	Application Server		
	Database Servers		
	Security Infrastructure		
	Load Balancers		
	VPN Systems		
	Backup System		
	Network Elements		
4	**Bus Stop**		
	Station Display Unit with GSM	**560**	**5600000**
5	Communication cost – Control centre	**1**	**1400000**

Sr. No	ITS Component for AMTS Integration	Total Units	Total Cost
6	Communication cost per bus per annum	**750**	**2250000**
7	Communication Cost for PIS on Bus Stations	**560**	**1700000**
8	System maintenance Cost per annum	**1**	**5340000**
		Total cost	**406270000**

6.2 CAPACITY BUILDING AND TECHNICAL ASSISTANCE

The proposed TA component consists of three elements. They are:

(i) TA for preparation of TOD plan
(ii) TA for preparation of Bicycle Plan and a design of a Bicycle Rental Scheme
(iii) Training for planning unit in BRT's organization

Detailed TOR is given below.

6.2.1 Transit Oriented Development

The scope of the first TA is to:

- redefine the transit oriented development of Ahmedabad;
- examine various planning options and related development control requirements;
- impact of development on the network and other services and
- examine options of using the proposed TOD measures such as additional FSI etc, as a source to finance part of urban transport expansion in the city.

Box 6.1
TERMS OF REFERENCE-I
PREPARATION OF TOD PLAN FOR AHMEDABAD

1. The objectives

The overall objectives of the TA are to define a transit oriented development policy for Ahmedabad and define development control tools that would help the city raise resources for infrastructure and transport sector investments.

2. The Scope of work

Specific spoke of work includes:

- Review existing land use, densities and transit oriented development policies along the proposed BRT alignment, major routes of AMTS and the proposed Metro Rail
- Review existing development control regulations of AMC and AUDA
- Review the parking policies and notifications of AMC
- Assess the population carrying capacity in the influence zone of the corridor and the impact on network and services
- Estimate the cost of upgrading services in line with the proposed TOD framework
- Define the transit oriented development policy and framework for Ahmedabad;
- Define the planning option and related development control requirements;
- Based on the best option, estimate revenue potential of the TOD policy and define the

tools and the rates of charge for each development regulation measure. This could be in terms of additional FSI or a TDR based approach.

The overall process should be based on extensive consultation with the stakeholders.

2.1 Surveys, Assessment and Outputs

Assessment and Outputs

Physical surveys on a sample basis covering a variety of uses such as residential (Low and High density development), commercial (small retails, large establishments, offices, trading/ warehousing etc) and Industrial and institutional) to assess:

- extent of use of land including variations with DCR;
- parking arrangements;
- need for additional FSI, willingness to pay charge for additional FSI and
- expected use and market potential.

In case of alternate models of implementing the DOT related land use and zoning, define areas of application of proposed tools (Such as TDR's) and the implication of such an arrangement on proposed location.

Based on input from AMC, assess the current capacity of the service systems and implications of proposed FSI on cost of expansion of services.

Development Control Regulations

Review exiting DCR and related regulations and policies and define modifications required based on proposed development policy.

Institutional Framework Define the institutional arrangement required to implement the proposed arrangements including regulatory arrangements

Economic Analysis: Carry out an economic analysis of the implications of the proposed policy and related mechanisms and

Financing Plan: based on costs of the proposed of network expansion and environmental service improvements along the transport network or other areas as envisaged through the policy, assess the returns of such as an action through appropriate pricing of additional FSI or other development control measures

3. Deliverables

1. Consultants should submit 5 copies of all interim submissions and 10 copies of the Final Report.

1.1 **Inception Report:** The inception report is to include approach and methodology to carry out project in a systematic manner to achieve the objectives outlined for project..

1.2 **Project Area Assessment and Draft Policy:** This report will present the situation analysis of development and the issues and constraints with existing DCR, proposed options and next steps of the assessment.,.

1.3 **Interim Report:** The draft TOD policy and its implications of development options envisaged inclusive of an initial economic and financial analysis.

1.4 **Draft Final Report:** Draft final report will include all aspect of the project on the policy, the actions, the rates, the financial and implementation plan of the proposed action including legislative changes required

1.5 **Final Report:** Based on the comments received, if any, on the draft final report the consultant will submit the final report on the project.

4. Other Deliverables

Two soft and hard copies of Surveys, Land use, Base Map of the project area, and all final drawings of the interventions areas will be submitted by the consultant two after the final report.

5. Study Team

The team will be lead by an Urban Planner with at least 15 years experience in design of urban land policies or in related areas such as Master Plan preparation. The other members would include:

Economic Analyst: Masters in Economics with at least 15years experience in economic analysis of policy actions, preferably in the urban sector, more importantly linked to land.

Financial Analyst: Masters in Finance/ CA/ ICWA with at least 15years experience in analysis of urban sector projects.

Municipal Engineer: Masters in Civil/ Public Health Engineering with at least 15ears experience in design of basic environmental services projects.

6. Time frame:

The overall time frame for the project will be six months.

7. Payment and Deliverable Schedule:

Deliverable	***Percentage of Fees***
1. Mobilisation, Submission of Detailed Work Plan	*20*
2. Project Area Assessment and Draft Policy	*20*
3. Submission of Concept Report/ Interim Report	*20*
4. Submission of Draft Final Report	*10*
Sub-Total	***70***
5. Approval of the Draft Final Report by State Govt.	*10*
6. Approval of the project by GOI	*20*
Total	***100***

8. Review Team

i. Municipal Commissioner
ii. Director, Urban Transport, MOUD, GOI
iii. Director, JANMARG
iv. Transport Manager, AMTS
v. Deputy Commissioner/City Planner, Town Planning
vi. Chief Town Planner, Government of Gujarat
vii. Chief Planner, AUDA
viii. Nominee, CEPT

6.2.2 Bicycle Plan

The scope of the TA are in terms of:

- More specifically within the old city of Ahmedabad,
    a. design a bicycle plan along the major arteries
    b. design specifications,
    c. investment requirements
    d. operational guidelines and
- design a bicycle rental scheme inclusive of:
    a. regulatory requirements,
    b. concession documents and
    c. operational plan including a rental scheme primarily to be owned and operated by the private sector or the communities.

Box 6.2

TERMS OF REFERNCE FOR FORMULATION OF A BICYCLE PLAN AND A RENTAL SCHEME

1. The Objectives:

The objective of this exercise is to evolve a bicycle plan along the BRT and priority AMTS network for the city and more specifically for the old city and define a bicycle rental scheme.

2. Scope of Work

The scope work includes:

d. Review the feasibility of a bicycle plan for the city specially along the BRT and other major arteries where AMTS operates its services
e. Based on feasibility, evolve the design specifications for cycle tracks or other arrangements to facilitate cycles,
f. Define the costs of providing the services
g. Evolve operational guidelines for design, maintenance and regulation of the proposed system
h. Assess relocation required if any and assess the costs of relocation based on available resettlement frameworks
i. To operationalize the system, design a bicycle rental scheme inclusive of:
    i. regulatory requirements and
    ii. bid and concession documents for the proposed rental arrangements

While designing the rental scheme, the focus should also examine feasibility of a community owned and operated systems as well as the possible private sector operation. The design of the rental scheme will also draw on international best practices in design and maintenance of bicycle facilities and rental schemes.

3. Surveys, Assessment and Outputs

Assessment and Outputs

While drawings of BRT will be made available, consultants will need to carry out physical surveys on Non BRT alignments. PLEASE ADD THE PHYSICAL SURVEYS ….

For the design of the rental scheme, a market demand assessment and willingness to pay survey will need to be conducted covering around 1000 passengers/ potential users.

4. Deliverables

Consultants should submit 5 copies of all interim submissions and 10 copies of the Final Report.

Inception Report: The inception report is to include approach and methodology to carry out project in a systematic manner to achieve the objectives outlined for project.

Initial Concepts and Survey findings: This report, based on situation analysis, present the outline concept plans for physical expansion, the rental scheme and preliminary feasibility of the concept. The report should also include the findings of the market demand and willingness to pay surveys.

Interim Report: Based on feedback from the client on the second submission,

(i) complete the design and specifications for the proposed facility;
(ii) indicative phasing of the program including basis of selection of priority stretches
(iii) Issues that need to be addressed as part of implementation- in terms of physical, social and institutional issues
(iv) The business plan for the rental scheme including location plan for the facilities
(v) The draft bid and concession document
(vi) Management arrangements for the proposed facility

Draft Final Report: Draft final report will include all aspect of the project on the policy, the actions, the rates, the financial and implementation plan of the proposed action including legislative changes required

Final Report: Based on the comments received, if any, on the draft final report the consultant will submit the final report on the project.

5. Other Deliverables

Two soft and hard copies of Surveys, Land use and all final drawings of the interventions areas will be submitted by the consultant with the final report.

6. Study Team

The team will be lead by a Transport Planner/ with at least 15 years experience in design of urban traffic projects, experience in design of cycle based facilities would be an advantage. The other members would include:

Economic Analyst: Masters in Economics with at least 15years experience in economic analysis of policy actions, preferably in the urban transport sector, more importantly linked to land.

Financial Analyst: Masters in Finance/ Business Administration/ CA/ ICWA with at least 15 years experience in analysis of urban Transport projects and in preparation of business plan for public / micro enterprises.

Market Research Specialist: Masters in Business Administration with at least 15 years experience in the areas of Market research and feasibility studies for small business.

Social Development Specialist: Masters in Planning, Sociology, economics with at least 15 years experience in social assessment and design of rehabilitation packages. Should be conversant with Bank/ ADB resettlement policies.

7. Time frame:

The overall time frame for the project will be six months.

8. Payment and Deliverable Schedule:

Deliverable	***Percentage of Fees***
1. Mobilisation, Submission of Detailed Work Plan	*20*
2. Initial Concepts and Survey findings	*20*
3. Submission of Interim Report	*20*
4. Submission of Draft Final Report	*10*
Sub-Total	***70***
5. Approval of the Draft Final Report by State Govt.	*10*
6. Approval of the project by GOI	*20*
Total	***100***

9. Review Team

i. Municipal Commissioner
ii. Director, Urban Transport, MOUD, GOI
iii. Director, JANMARG
iv. Transport Manager, AMTS
v. Institute of Urban Transport
vi. Nominee, CEPT

6.2.3 Training for AMTS & BRTS

The scope of the TA will include:

- Training Needs Assessment for operational and management staff of BRT and AMTS;
- Design of learning events and knowledge management activities, content, costs of programs and delivery arrangements;
- Delivery methods for each event;
- Short list of agencies to deliver the programs and
- Equipment needs for programs to be conducted in-house

Detailed terms of reference are annexed to this chapter.

Box 6.3

TERMS OF REFERNCE III

PREPARATION OF TRAINING PLAN FOR BRT

1. The objectives

The objectives of the TA are to design a training plan for the Bus based transport system of the city of Ahmedabad.

2. Scope of Work:

The scope of the TA will include:

I. Assessment of Training Needs for operational and management staff of BRT and AMTS- the focus being on operational and managerial skills inclusive of IT applications;
II. Design of learning events and knowledge management activities, content, costs

and number of programs and delivery arrangements. The indicative structure of learning events are as follows"

(i) Basic training programs;
(ii) Seminars/ workshops/ Conferences
(iii) Short term and long term technical training programs;
(iv) Advanced degree programs wherever required
(v) Exposure visits to similar projects;
(vi) Rotation of staff in the office of the management unit and
(vii) Hands-on Training as part of design and supervision of projects.

III. Delivery methods for each event- should be a combination of class room sessions, exposure visits to national and international best practices, hands on / on the job training;

IV. Short list of agencies to deliver the programs and a procurement plan

V. Design of a training cell within AMC or define alternate training management arrangement. In either case define the structure and skill requirement for management of program delivery and in case of outsourcing- define the TOR, Evaluation procedure, and bidding procedures. Use of existing institutions should also be explored in terms of management of the program, and

VI. Equipment and other infrastructure needs for programs to be conducted in-house

3. The Design process

I. Within the sector development / reform agenda: Use structured questionnaires to interview and solicit demands for specific knowledge and skill inputs by senior officials and staff of the – GoI, GoG and AMC,

II. With the BRT/AMTS -level reform agenda and investment possibilities as a framework: Use structured questionnaires to identify knowledge and skill gaps which inhibit reforms and investments interview from at least 20 % of the staff of various categories within the bus companies.

III. Review the training plan, progress to date and on-going training activities in the State conducted through various institutions, Identify content and personnel coverage and forthcoming events with a view to eliminate duplication fill gaps if any and avoid information overload.

IV. Based on steps 1 to 3, conduct an exploratory survey to prepare an inventory of suitable Gujarat-based, national and select international institutions (via desk survey) which can be contracted under the project to become capacity enhancement providers.

4. Output:

Formulate Training Plan which:

I. comprehensively addresses all knowledge and skill requirements identified above and which incorporates relevant aspects of World Bank environmental and social safeguards;

II. uses appropriate adult learning mechanisms (including but not limited to: lecture-based training, on-the-job mentoring, pairing between peers, linking with issue-specific champions, structured site visits etc.) for the full range of participants;

III. identifies capacity enhancement institutions within Gujarat and in other states which could anchor specific capacity enhancement activities;

IV. outlines a roll-out plan (Project Implementation Plan) for all activities;

V. Staffing and Capacity enhancement plan for proposed arrangements, and;

VI. offers a reasonable best estimate of resources (time and financial) likely to be required to implement the strategy.

5. Assessment Team

The team responsible for the design of the Plan are:

I. Team Leader: Senior professional (at least ten years experience) with a demonstrated background in transport/ urban sector reform processes in India (central and/or multi-state experience) and with active involvement in urban sector capacity enhancement activities. Essential- Masters degree in urban/ transport planning.

II. Urban Transport engineer (International): advanced degree in transportation or traffic engineering with around 15 years experience in design, implementation and management of BRT infrastructure. Should have designed/ implemented technical and managerial capacity building

III. Two Research Associates: Urban/ Transport / HR sector professionals with experience in participatory field work and data analysis. Fluency in Kannada and English is essential; and

6. Time Frame

The assessment should be completed within Five months of award.

7. Payment and Deliverable Schedule:

Deliverable	***Percentage of Fees***
1. Mobilisation, Submission of Detailed Work Plan	*20*
2.Training Needs Assessment Report	*20*
3. Submission of Interim Report-TA Plan, costs – delivery arrangements and management arrangements	*20*
4. Submission of Draft Final Report	*10*
Sub-Total	***70***
5. Approval of the Draft Final Report by State Govt.	*10*
6. Approval of the project by GOI	*20*
Total	***100***

8. Review Team

i. Municipal Commissioner
ii. Director, Urban Transport, MOUD, GOI
iii. Director, JANMARG
iv. Transport Manager, AMTS
v. Institute of Urban Transport

Nominee, CEPT

6.3 COMPONENT III- PROJECT IMPLEMENTATION SUPPORT

(i) Establishment of Monitoring and Evaluation System
(ii) Project Preparation & Implementation

The detailed terms of reference is presented below.

Box 6.4
TERMS OF REFERENCE
FOR
MONITORING AND EVALUATION AND PROJECT IMPLEMENTATION

1.0 The Objectives

The objectives of this assignment are to prepare Monitoring and evaluation frameworks and coordination of IT integration and capacity building activities.

2.0 Scope of Work

This component has two parts.

Part A will focus on design of an M&E framework and operationalization of the M&E activities for the first year. This will focus on monitoring of IT integration as well as the performance of the City Bus operations. The broad scope will include:

The specific scope of work includes:

i. Preparation of M&E formats in consultation
- review progress of work,
- perform technical review of issues relating to
  - traffic engineering arrangements
  - Transport Planning mechanisms including multi-modal integration
  - Infrastructure
  - construction
  - quality
  - standards
  - site management
  - related infrastructure issues

- review performance of bus operations in terms of the following areas but not restricted to these themes:
  - Standards Bus operational performance
  - Service quality
  - Management issues
  - Maintenance issues
  - Safety and Accidents
- Based on discussions with AMC conduct periodic service quality assessment through passenger and operators survey
- Report progress and issues in implementation of BRT infrastructure and notes on thematic and cross cutting issue
-

Part B:

For implementation of the project, AMC intends inducting IT consultants and Institutional Development Consultant. The scope of work of the IT consultant would include:

- Design the proposed system integration arrangements

- Define specifications
- Prepare bid documents and procurement plan
- Support AMC in evaluation and
- Oversee operationalization of the integration plan.

The Institutional development Consultant role will be in terms of:

- Coordinate with AMC and Consultants
- Review the outputs
- Finalize training plan
- Support in operationalizing the plan
- Conduct programs for a year and transfer management skills to Janmarg/AMTS staff

The specific scope of work includes:

- review performance of bus operations in terms of the following areas but not restricted to these themes:
  - Standards Bus operational performance
  - Service quality
  - Management issues
  - Maintenance issues
  - Safety and Accidents

- Based on discussions with AMC conduct periodic service quality assessment through passenger and operators survey
- Report progress and issues in implementation of BRT infrastructure and notes on thematic and cross cutting issue
- Support AMC in preparation of news letter for circulation based on the findings

ii. based on the above reviews contribute to, design and implement a capacity building plan for AMTS & BRT on various themes relating to design, implementation and management of AMTS & BRT systems.

3.0 CONSULTANT TEAM

The team for **Part A** consists of two specialists:

i. Urban Transport engineer (International): advanced degree in transportation or traffic engineering with around 15 years experience in design, implementation and management of BRT infrastructure. Should have designed/ implemented at least one BRT program of scale in a city of at least 1 million population. Experience in M&E will be an advantage
ii. Bus Operations Specialist: advanced degree in mechanical engineering with around 15 years experience in management of bus operations in a city of at least 1 million population. Exposure to M&E methods and skills in capacity building will be an advantage.

The Team for **Part B** will consist of an IT specialist and an Institutional Development specialist.

i. The IT specialist should have an advanced degree in electronics and communication and have at least 15 years of experience in design and implementation of IT systems in the transport sector. Experience in a Bus sassed system would be preferable.
ii. The Institutional specialist, should have an advanced degree in planning/ management/ economics and conversant with in project/ program monitoring and evaluation. Should have fifteen years of experience in M&E preferably in the transport sector.

4.0 REVIEW AND ADVISORY

The review and advisory team will consist of:

i. Municipal Commissioner
ii. Director, Urban Transport, MOUD, GOI

iii. Director, JANMARG
iv. Transport Manager, AMTS
v. Institute of Urban Transport
vi. Nominee, CEPT

Delivery and Payment Schedule

M&E

REPORT	CONTENTS	DAYS FROM START	% OF COST
Inception	Methodology Review arrangements Monitoring formats (SOW i)	30	10
Interim	Review of BRT/AMTS capacity Technical and Operational Review Reports Modified Monitoring format based in review above *Workshop*	90	30
Interim	▪ Monitoring Report I (for one quarter) ▪ Passenger Opinion and Operators Surveys *M&E Workshop*	120	30
Draft		180	20
Final		10 Days from receipt of Comments	10

IT Consultant

Activity	Time from start Weeks	% of Cost
Design report on system integration arrangements	8	15
Draft specifications and Bid Documents including implementation and procurement plan	20	15
Evaluation Report	30	20
System Implementation- Monthly Reports		50

Activity	Time Frame Weeks	% of Cost
Finalise TOR for TA Needs	3	10
Evaluation Report	10	10
Review the outputs	15	10
Finalize training plan	23	10
Support in operationalizing the plan	30	10
Conduct programs for a year and transfer management skills to Janmarg/AMTS staff		50

6.4 EXPECTED OUTCOMES

The expected outcomes of the proposed investments will be a larger shift from private and individual modes to BRT and AMTS systems. The specific outcomes are:

(i) The proposed IT based first stage integration of AMTS and BRT will

a. facilitate seamless movement of passengers and

b. enable design of an efficient hub and spoke operation in the medium term.

(ii) The second stage of integration of modes will be:

a. by way of the proposed bicycle plan which will overcome parking constraints and

b. enable free movement from the bicycle to the bus and vice versa.

(iii) The skill upgradation of the staff will result in improved management of public transport and transit arrangements in the city.

6.5 ESTIMATED COST

The total project cost has been estimated to be 9.356 Crores. The details have been given in table below.

Table: 3 Estimated Project Costs

Components	***Costs***	
Investment Support	***Rs. Crores***	***$ Million***
▪ ITS for integration of Janmarg (BRTS) and AMTS	4.1	1.0
▪ Control centre Development (Physical development excluding land)	4.0	1.0
Capacity Building and Technical Assistance		
▪ TA for preparation of transit oriented development (TOD) plan	1.0	0.2
▪ Training for planning unit in BRT's organization & AMTS & associated agencies	1.5	0.4
▪ Design of Bicycle Plan, Bike infrastructure, Bicycle Rental Scheme	6.0	1.5
Project Implementation Support		
▪ Establishment of Monitoring and Evaluation System	0.8	0.2
▪ Project Preparation & Implementation	1.1	0.2
Total	**18.5**	**4.5**

6.6 BENEFITS AND IMPACTS

6.6.1 Social and Environment

Likely environmental and social impacts of the proposed project components are following:

The proposed projects will not any have any social impacts, rather the proposed bicycle plan would help access to livelihood for the local communities along the transit system. It is expected that 40% households will benefit from the proposed action.

The proposed bus technology and advancements will form the basis of expansion of the fleet and AMTS is committed to phase old busses and promote fuel efficient and emission control technologies. The proposed cycle arrangements will reduce dependence on two wheelers, one of the major contributors to the pollution load in the city.

6.6.2 Economic Analysis

Non-monetary Benefits

- Enhanced Passenger safety: Stringent maintenance and upkeep schedule will be followed for buses
- Enhanced passenger satisfaction with AMTS and BRT services with seamless movement which would reduce the delays in ticketing and waiting time for conections

Monetary Benefits

- Savings in Stationery;
- Elimination of pilferage in revenues to the extent of 15-20%
- Reduction in number of buses required due to optimization of routes and fleet (from 750 to 530)
- Reduction in about 500 staff involved in accounting and reporting at the administrative office and bus terminals and their redeployment in other management functions

6.6.3 Fiscal

The expected cost of IT as an additional cost./km is of the order of Rs 0.16 and will not be a burden on the overall operations. However, the fiscal benefits to AMC would be substantial with a marginal reduction in bus staff ratio. The non monetary benefits are substantial.

Integration of JanMarg system with AMTS and Feeder System

		Without IT System	With IT System				
Sr No	Details	FY0809	FY0910	FY1011	FY1112	FY1213	FY1314
1	IT- Capital Investment Deppriciation cost	-	7,320,000.00	7,320,000.00	7,320,000.00	7,320,000.00	7,320,000.00
	No.of Bus	750.00	750.00	750.00	750.00	750.00	750.00
	No.of station	560.00	560.00	560.00	560.00	560.00	560.00
	Passengers foot print per year	292,000,000.00	292,000,000.00	292,000,000.00	292,000,000.00	292,000,000.00	292,000,000.00
	Revenue Per Footprint	3.90	3.90	3.90	3.90	3.90	3.90
	Travel KMs in a year	54,750,000.00	49,275,000.00	46,811,250.00	44,470,687.50	42,247,153.13	40,134,795.47
2	Gross Yearly revenue(Rs)	1,138,800,000.00	1,138,800,000.00	1,138,800,000.00	1,138,800,000.00	1,138,800,000.00	1,138,800,000.00
3	IT- Recurring Cost per year	-	5,330,000.00	10,670,000.00	10,670,000.00	10,670,000.00	10,670,000.00
4	Admin Staff Cost	120,000,000.00	108,000,000.00	97,200,000.00	87,480,000.00	78,732,000.00	70,858,800.00
5	Pilferage %	15%	-	-	-	-	-
	Pilferage Amount in a year	170,820,000.00	-	-	-	-	-
6	Net Yearly revenue(Rs)	847,980,000.00	1,025,470,000.00	1,030,930,000.00	1,040,650,000.00	1,049,398,000.00	1,057,271,200.00
7	Revenue(Rs Per KM)	15.49	20.81	22.02	23.40	24.84	26.34
	IT- Capital Cost (Rs per KM Travel)	-	0.15	0.16	0.16	0.17	0.18
8	Net Revenue(Rs Per KM)	15.49	20.66	21.87	23.24	24.67	26.16
	% Rise in Revenue(Rs Per KM)	-	133%	141%	150%	159%	169%

Assumptions for Calculations

1	Investment Depreciation Taken as 20% Year by Year for next 5 Yrs.
2	No.of Bus kept same for 5 Years
3	No.of Stations kept same for 5 years
4	No.of foot print kept same for 5 years
5	Ticket Charges per footprint kept same for 5 years

6.7 PHASING

In terms of phasing, all activities except bicycle rental scheme are proposed in phase -1. Bicycle rental scheme which will also have a component of PPP, has been slated to be undertaken as phase-2 as the plan for the same will be prepared during year-1.

6.8 INSTITUTIONAL ARRANGEMENTS FOR PROJECT IMPLEMENTATION

Ahmedabad Municipal Corporation will implement the proposed project. Similarly, Ahmedabad Municipal Transport Service, (AMTS) a body of AMC, will be drawn to assist in implementing the bus component of the project. The project will be developed and implemented under the overall guidance and control of the Municipal Commissioner, Ahmedabad. Overall executive control of the project implementation will be with the AMC-JnNURM Mission. The PIU has been established by AMC as below.

Project implementation unit of AMC

1. Mr. Chirag Panchal - Assistant manager, BRTS & Project manager, GEF
2. Mr. Nimeshbhai Patel - Officer, Information technology
3. Mr. Jaswantbhai Shah – Officer, Finance officer
4. Ms. Shilpaben R. Patel – Social development officer
5. Mr. Nitinkumar B. Solanki – Procurement officer
6. Ms. Dhartiben A. Acharya – Environment officer
7. Mr. Murlisinh Vaghela – HRD officer

ANNEX: FINANCIAL PROPOSAL

1.1 ITS Investment Proposal

Sr No	ITS Component for AMTS Integration	Units	Unit Rate	Total Investment
1	Central Control Centre Software	1	15,000,000.00	15,000,000.00
	Central fire collection system			
	Passenger information system			
	Management system			
	Operations Management System			
	Vehicle Prioritization system			
2	Disaster Recovery Centre Hardware	1	7,500,000.00	7,500,000.00
	Application server			
	Database servers			
	Security infrastructure			
	Load balancer			
	VPN System			
	Back up system			
	Network elements			
3	Central control centre Hardware	1	7,500,000.00	7,500,000.00
	Application server			
	Database servers			
	Security infrastructure			
	Load balancer			
	VPN System			
	Back up system			
	Network elements			
4	Bus stations			
	560			
	No.of Bus			
	750			
	Station display unit with GSM	560	10,000.00	5,600,000.00
11	Software license for Control centre	1	1,000,000.00	1,000,000.00
	Grand Total			36,600,000.00

1.2 O&M Costs

Sr No	ITS Component for AMTS Integration	Units	Unit Rate	Recurring cost
1	Bus stations			
	560			
	No.of Bus			
	750			
	Communication cost -Control centre	1	1,400,000.00	1,400,000.00
	Communication cost-Per year	750	3,000.00	2,250,000.00
	Communication cost for PIS on Bus stations	560	3,000.00	1,680,000.00
	System Maint.Cost per year	1	5,340,000.00	5,340,000.00
	Grand Total			10,670,000.00

Revenue Assumptions

Sr No	Details of Head	Units
1	No of Bus	750.00
	Passengers foot print per day	800,000.00
	Passengers foot print per year	292,000,000.00
	Revenue Per Footprint	3.90
	Yearly revenue	1,138,800,000.00
	Per Bus Per Day - KMs	200.00
	Travel KM for all Bus - Yearly	54,750,000.00
	Revenue Per KM	20.80