

CHAPTER – 2

TRAFFIC DEMAND ANALYSIS

2.1 Introduction

The following steps are involved in traffic demand analysis towards estimation of ridership on Mass Rapid Transit System:

Preparation of Database: Involves collection of secondary data (studies done earlier, census data, Master Plan, land use parameters etc) and primary surveys (traffic and travel surveys).

Development of Transport Demand Models: The process consists of development of formulae (or models), enabling forecast of travel demand.

Estimation of Land use Parameters: Land use parameters (viz., population, employment) are to be estimated for the horizon years in order to assess the future travel demand.

Formulation & Evaluation of Alternative MRTS Networks: Various alternative alignments for MRTS corridor are to be identified and passenger loading on each alternative is estimated. The alternative having better ridership and engineering feasibility is recommended for implementation.

2.2 Database For The Study

The literature available with different organizations/ planning agencies has been reviewed with an objective to understand the growth of the sub-areas within the Study Area along with their traffic and travel characteristics. A review of all the earlier study reports related to the Study Area was also taken up.

Census data available for various wards has been reviewed in order to carry out household travel survey. The sample size and distribution of samples over the Study Area to carry out the household travel survey is based on the zonal population and distribution of zonal households. Additional details like major activity centers in each traffic zone have been collected to assess the trip generation/attraction potential of each zone.

The transport network maps of the Study Area and land-use proposals have been studied in depth to assess the scope and requirement of future transport infrastructure. All the data available with various Government departments relating to traffic and travel characteristics have been collected and compiled for use in the Study.

The primary surveys include Road Network Inventory, Speed and Delay Survey, Traffic Volume Surveys, Origin and Destination Survey, Bus and

Shared Auto Passenger Survey, Rail Terminal Survey and Household Travel Surveys.

The traffic volume data has been compiled both in terms of vehicles and passengers. Origin-Destination (O-D) matrices for public and private transport for various trip purposes are prepared for base year and projected for various horizon years.

Planning parameters consisting of population, employment and number of resident workers for the zone system for the base year (2003) and for the horizon years (2010, 2025 & 2035) have been quantified. A road network map with all roads of 12 m and above ROW for the base year 2003 was developed and integrated with traffic zone system.

2.3 Traffic Zone System

The Study Area was divided into a total of 197 zones (186 internal and 11 external). The 186 internal zones consist of Ahmedabad Municipal Corporation (AMC) area, Area of Ahmedabad Development Authority (AUDA) and Gandhinagar. The zones are divided in such a way that the population is homogeneous within a zone. The zone size has been kept sufficiently small so as to have better sensitivity to the Transport Demand Model.

The traffic zone system map for the Study Area is presented as **Figure 2.1**.

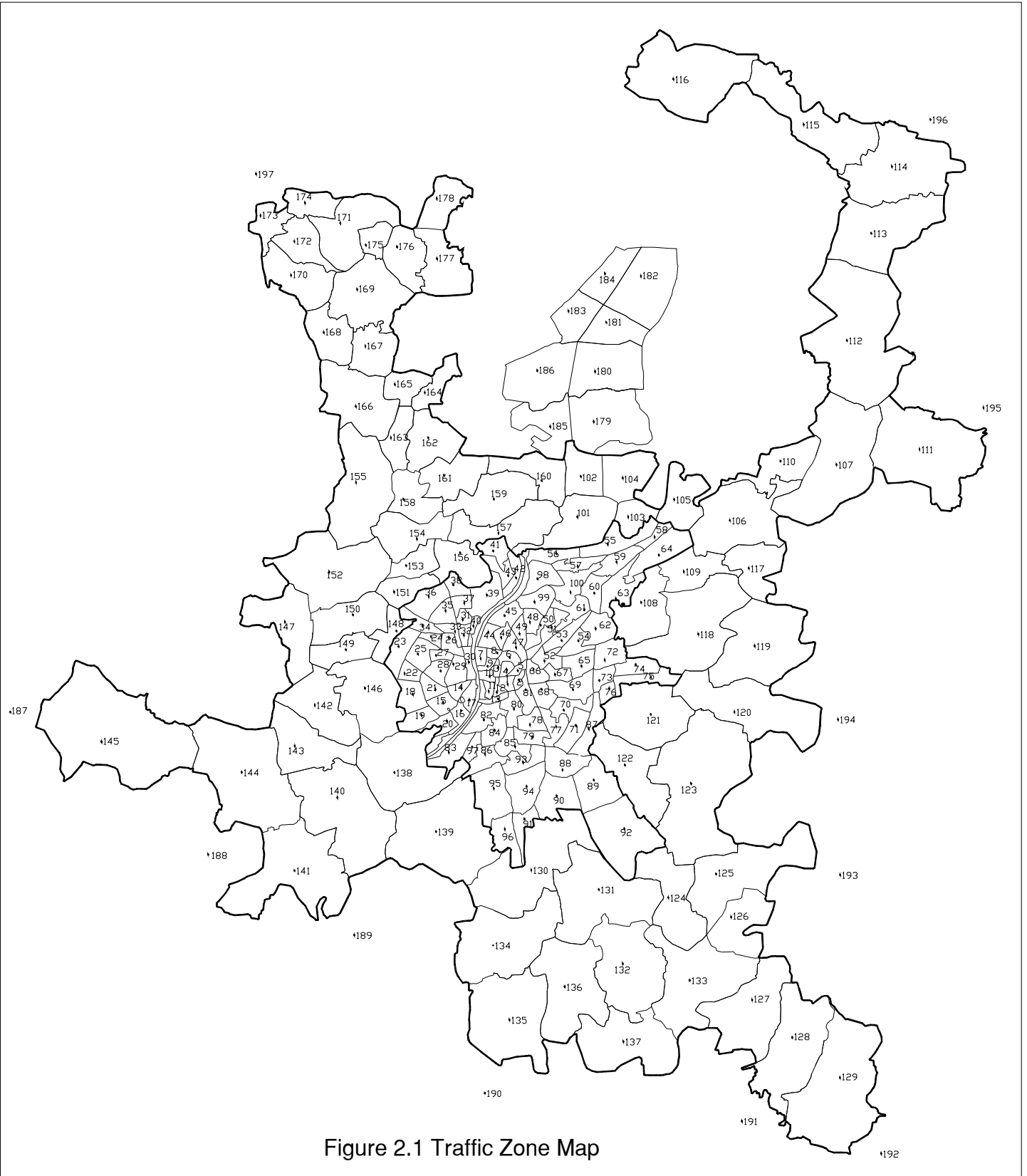


Figure 2.1 Traffic Zone Map

2.4 Primary Surveys and Analysis

2.4.1 The following primary traffic and travel surveys have been conducted as a part of the study:

- i) Road Network Inventory and Speed & Delay Surveys
- ii) Traffic Volume Counts
- iii) Public Transport Passengers' Surveys
- iv) Household Travel Surveys

2.4.2 Road Network Inventory and Speed & Delay Surveys

Road network inventory has been carried out along all arterials and major roads totaling to 1042 km. Of which 41% of the road network is having 4 or more lanes of carriageway and about 48% is having 2-lane of carriageway. About 5% of the Study Area roads are provided with footpath on both sides and 15% of road length has footpath on one side.

Speed and delay survey has been conducted using moving car method during peak and off-peak periods. For private vehicles, during peak period about 71% road network is having journey speed of less than or equal to 30 Km/h and for public vehicles during peak period about 95% of the road network is having journey speed of less than or equal to 30 Km/h.

The distribution of the road length by journey speed during peak and off-peak periods for private and public transport is presented in **Table 2.1**.

Table 2.1 Distribution of Road Length by Journey Speed

SI No	Journey Speed (Kmph)	Private Veh.		Public Tpt.	
		Peak Period	Off-Peak Period	Peak Period	Off-Peak Period
1	<= 10	1.92 %	0.89 %	3.94 %	1.54 %
2	11 - 20	10.66 %	9.23 %	39.46 %	10.94 %
3	21 - 30	58.67 %	29.14 %	51.66 %	47.87 %
4	> 30	28.76 %	60.74 %	4.94 %	39.65 %
	Total	100.0%	100.0%	100.0%	100.0%

2.4.3 Traffic Volume Counts

Classified traffic volume count survey has been conducted at the selected mid-block locations, Outer Cordon Location and Screen Line Locations. The survey helps in assessing the existing traffic characteristics as well as to validate the transport demand model.

Classified traffic volume counts have been taken on an average weekday for 16 hour duration to quantify the volume of traffic moving along the various road sections in the Study Area. The survey locations were selected in such a way that would cover entire Study Area and assist in understanding the traffic pattern in the Study Area.

a) Mid-Block Traffic Counts

Mid-block traffic counts were conducted at 33 locations in the Study Area. The locations were chosen in such a way that combination of some of the mid-blocks would act as screen line also.

It was observed that traffic at different locations varies from 10511 PCUs (Thaltej Village Road) to 64045 PCUs (K.G. Road, Near Delhi Darwaja) on a normal working day. At different mid-block locations peak hour traffic varies from 8.37% S.G. Highway (Near Karnawati Club) to 10.85% (Ashram Road, Near Fateh Pur) of the total daily traffic and A summary of traffic characteristics at mid-blocks is presented in **Table 2.2**.

Table 2.2 Summary of Traffic Characteristics at Mid-Block Locations

Loc. No.	Name of Location	Veh.	PCUs	Peak Hr. Traffic (PCUs)	% Peak Hour Share/ Factor
1	Ashram Road (Near Fateh Pur)	45281	35896	3893	10.85
2	Ashram Road (Near V.S. Hospital)	88343	62760	6012	9.58
3	Ashram Road (Near Sanyash Ashram)	57528	42391	3680	8.68
4	Ashram Road (Near Usman Pura)	41048	31990	3268	10.22
5	Naya Wadaj Road	40972	28357	2661	9.38
6	R.T.O Office (Near Subhash Circle)	77999	55322	5561	10.05
7	Relief Road (Near Rewadi Bazar)	61380	40167	4006	9.97
8	Relief Road (Near Rupam Cinema)	39923	26713	2710	10.14
9	Relief Road (Near Relief Cinema)	67097	41750	4334	10.38
10	Gandhi Road (Near State Bank of Patiala)	18729	12479	1215	9.73
11	Gandhi Road (Near Teen Darwaja)	36290	22928	1999	8.72
12	K.G. Road (Near Daryapur Darwaja)	78917	56218	5454	9.70
13	K.G. Road (Near Delhi Darwaja)	96115	64045	5458	8.52
14	Navrang Pura Road (Near Railway Xing)	41619	28580	3061	10.71

Loc. No.	Name of Location	Veh.	PCUs	Peak Hr. Traffic (PCUs)	% Peak Hour Share/ Factor
15	Navrang Pura Terminal	20205	15332	1490	9.72
16	Gujarat University Road (Near H.L.Commerce College)	54268	35451	3769	10.63
17	Manav Mandir Marg (Near Suchitra Apt)	52830	36388	3623	9.96
18	Akashwani Kendra (Near Gandhi Bridge)	100634	63586	5768	9.07
19	Rajiv Kaka Road (Near Usman Pura)	17693	13788	1227	8.90
20	Mangal Das Road (Near Pinnacle Hotel)	63160	40476	3924	9.69
21	Mangal Das Road (Near Parimal Society)	36644	25561	2295	8.98
22	Vikram Sara Bhai Road (C.N. Vidhyalaya)	111039	72117	7716	10.70
23	Vikram Sarabhai Marg (Near L Colony)	35574	23893	2215	9.27
24	Vikram Sarabhai Marg (Near IIM)	41269	27148	2925	10.77
25	Netaji Road (Near Paldi Bus Terminal)	47104	33269	3264	9.81
26	C.G. Road	30742	20281	2144	10.57
27	120 Circular Road	25026	17702	1741	9.83
28	132 Ring Road (Near Jivraj Park Bus Stop)	32046	25542	2464	9.65
29	132 Ring Road (Near Mem Ngr Bus Stop)	49607	31963	3354	10.49
30	S.G. Highway (Near Karnawati Club)	35352	47864	4004	8.37
31	Bopal Road (Near ISCON Temple)	23047	16972	1777	10.47
32	Thaltej Villege Road	14670	10511	1104	10.50
33	S.G. Highway (Near New High Court)	30500	37622	3414	9.07

b) Outer Cordon Surveys

The outer cordon survey has been conducted at 11 locations along all the major roads radiating from the Study Area. The volume and composition of inter city traffic entering and leaving the Study Area is recorded at these locations for 16 hour duration on an average working day.

It was observed that the traffic at different locations varies between 3431 PCUs to 25041 PCUs. The maximum daily traffic is observed on Mehsana Highway, followed by Rajkot Highway and Baroda Highway. The peak hour traffic varies from 7.98% to 9.74% of the total daily traffic at various locations. The daily passenger trips varies from 8184 (Borsad Highway) to 72948 (Rajkot Highway). The summary of the traffic characteristics at outer cordon locations is presented in **Table 2.3**.

Table 2.3 Traffic Characteristics at Outer Cordons

Loc. No.	Name of Location	Veh.	PCUs	Peak Hr. Traffic (PCUs)	% Peak Hour Share/Factor	Daily Pass. Trips
1	Viramgaon Highway	11837	15127	1235	8.16	35745
2	Rajkot Highway	17164	24748	2116	8.55	72948
3	Dholka Highway	4670	6204	604	9.74	18553
4	Baroda Highway	11042	20484	1731	8.45	40094
5	Borsad Highway	2609	3431	307	8.95	8184
6	Nadiad Highway	4058	5045	443	8.77	17136
7	Vadodra Express Highway	2986	3759	363	9.64	12989
8	Kapadwanj Highway	6058	7594	704	9.27	23671
9	Modasa Highway	6293	7698	620	8.05	19966
10	Himmat Nagar Highway	7779	12014	1063	8.85	28162
11	Mehsana Highway	15907	25041	1997	7.98	56982

c) Traffic Volume Counts at Screen Line Location

Traffic volume counts at 7 screen line points have been carried out as part of the presented Study. The intensity of the traffic at screen line locations is presented in **Table 2.4**. It can be observed that Gandhi Bridge carries the maximum daily traffic with an approach volume of about 154,290 vehicles (93,938 PCUs) followed by the Nehru Bridge with daily (16 hourly) approach volume of 1,04,937 vehicles (68,531 PCUs).

Table 2.4 Intensity of Traffic at Screen Line Location

Sl. No.	Location	Total Veh.	Total PCUs	Peak Hour Traffic	Peak Hour Factor
1	Vasana Bridge	34478	47674	5585	11.71
2	Sardar Bridge	101381	72901	6673	9.15
3	Ellis Bridge	88975	59740	7391	12.37
4	Nehru Bridge	104937	68531	6226	9.08
5	Gandhi Bridge	154290	93938	9109	9.70
6	Subhash Bridge	80662	54269	4979	9.17
7	Indira Bridge	23938	20472	1990	9.72

2.4.4 Public Transport Passengers' Survey

In order to assess the public transport passenger's characteristics in the Study Area, two different types of surveys related to bus and other public modes such as shared auto, tempo and rail were carried out at selected locations. Bus Stop survey covered bus passenger origin-destination interviews with boarding passenger count at 309 bus stops and 8 Terminals along the proposed Metro Corridor and its influence area. The boarding passengers were interviewed at random, with a sample size of about 10%.

Shared auto passengers' boarding count was also carried out at 309 locations. Rail passenger boarding count and OD surveys were carried out at 15 stations. All surveys were conducted for 16 hour duration (from 6 AM to 10 PM)

a) Bus and Shared Auto Passengers Survey

The boarding and alighting counts of passengers was carried out at 15 minutes interval for a period of 16 hrs. Income Tax office bus stop has the maximum volume of boarding passengers (about 2700), Laldarwaja Terminal has the maximum volume of boarding passengers (about 35000) and for shared autos, the maximum boarding of passenger takes place near Kalupur Terminal. Bus and Shared Autorickshaw boarding along the proposed corridor is presented in **Table 2.5**

Table 2.5 Bus and Shared Auto Rickshaw Passengers' Boarding

Sl. No.	Mode	Total Passengers Boarding
1	Bus	134425
2	Auto Rickshaw	62763
	Total	197188

b) Rail Passengers' Survey

Rail passengers' boarding and alighting counts and origin–destination surveys were conducted at 15 railway stations. The maximum passenger traffic (boarding & alighting) is observed at Kalapur station (71715 numbers) and the minimum passenger traffic (boarding & alighting) is observed at Gandhi Nagar Station (275 numbers).

2.4.5 Household Travel Survey

The objective of the survey conducted at the residences of the Study Area population was to collect the socio - economic characteristics of the households and trip information of the individual members.

The Household travel cum opinion survey for a sample of about 5247 households has been carried out as a part of the Study, to get the information spread over the entire Study Area. These households have been drawn from all the Traffic Zones by random sampling basis. Stratification of the sample was done to cover various income groups.

The following outputs are derived from the analysis of the household travel survey.

- Distribution of the households according to household size and vehicle ownership.
- Distribution of the individuals by their income, occupation, education and expenditure on transport
- Distribution of trips by mode and purpose
- Distribution of trips by trip length

Some of the above outputs / findings are detailed in the following paragraphs.

a) Households by Size

Distribution of households according to the family size is presented in **Table 2.6**. The table indicates that only 5.53% of the households comprise of 1 or 2 members. About 5% of the households belong to the category of large households, with over 8 persons per household. The majority i.e., 79% of households have between 3 to 6 persons in the family.

Table 2.6 Households by Size

Sl. No.	Household Size	Number of Households	Percentage
1	Up to 2	290	5.53
2	3-4	2075	39.55
3	5-6	2053	39.13
4	7-8	568	10.83
5	>8	261	4.97
	Total	5247	100.0

b) Distribution of Households by Monthly Income

The distribution of sampled households according to their monthly income ranges is presented in **Table 2.7**. About 43% of household have monthly income less than or equal to Rs. 5000 and another 34% have income between Rs. 5001 – 10,000 per month. The percentage of households having monthly income more than Rs. 20,000 is observed to be only 5%. The average monthly household income per month is reported to be about Rs. 7760.

Table 2.7 Distribution of Household According to Monthly Income

Sl No	Income Group	Number of Individuals in Sampled Households	Percentage
1	<=Rs 5000	2232	42.54
2	Rs 5001 – Rs 10000	1790	34.11
3	Rs 10001 - Rs 15000	625	11.91
4	Rs 15001 – 20000	303	5.77
5	>Rs 20000	276	5.26
6	No Response	21	0.40
	Total	5247	100.0

c) Modal Split

Separate Origin-Destination matrices for various modes have been developed from household travel data and used in the modeling process. The distribution of trips according to mode of travel is given in **Table 2.8**. About 38% of the trips are walk trips. The trips performed by 2-Wheelers are about 25% whereas about 15% trips are made by bus, autorickshaw and shared autorickshaw. The trips performed by trains are about 5%.

The per capita trip rate (PCTR) including walk is 1.16, and it is 0.72 excluding walk. The PCTR for motorized trips is 0.52.

Table 2.8 Modal Split – 2004

Sl. No.	Mode	No of Trips	Percentage
1	2-Wheeler	1681867	25.29
2	Car	165207	2.48
3	Shared Auto Rick.	381356	5.73
4	Autorickshaw	169019	2.54
5	Bus	561254	8.44
6	Train	20043	0.30
7	Cycle	1169732	17.59
8	Walk	2501356	37.62
	Total	6649834	100.0

d) Purposewise Distribution of Trips

Table 2.9 presents the purpose wise distribution of the trips. About 28% of the trips are performed for work and business purpose put together, where as 19% trips are for education and 5% for other purposes which include shopping, social, health and recreation. About 48% trips are return trips.

Table 2.9 Distribution of Trips by Purpose

SI No	Purpose	No of Trips	Percentage
1	Work	1223971	18.41
2	Business	616557	9.27
3	Education	1249221	18.79
4	Others	303372	4.56
6	Return Work	1177454	17.71
7	Return Business	592519	8.91
8	Return Education	1214181	18.26
9	Return Others	272560	4.10
	Total	6667160	100.0

2.4.6 Land use Parameters

One of the important aspects of traffic demand modeling exercise is the estimation of base year and horizon year land use parameters. The land use parameters for the year 2010, 2025 & 2035 are worked out by Louis Berger Report of 2000 in various zones of the Study Area.

The population of Study Area in the year 2003 was about 57.25 lakh. Out of which 37.37 lakh population reside in Ahmedabad Municipal Corporation (AMC) area, 17.64 lakh in Ahmedabad Urban Development Area (AUDA) and about 2.25 lakh in Gandhi Urban Development Area(GUDA).

The zone wise distribution of population & employment for the years 2003, 2010, 2025 & 2035 are presented in **Table 2.10**.

Table 2.10 Zone wise Population and Employment for the Years 2003, 2010, 2025 & 2035

Zone No.	POPULATION				EMPLOYMENT			
	2003	2010	2025	2035	2003	2010	2025	2035
1	34316	34316	34316	34316	38115	41525	46023	49099
2	20154	20154	20154	20154	15947	19084	22546	24935
3	10412	10703	10703	10703	29619	31126	32978	34195
4	18128	21405	21405	21405	8362	10425	12846	14580
5	33891	36057	36057	36057	17666	21947	25877	28471
6	62989	62989	62989	62989	12487	13839	18212	21928
7	31329	31329	31329	31329	4646	4697	6091	7325
8	31329	31329	31329	31329	14049	15831	18407	20251
9	25808	25808	25808	25808	8410	10518	13482	15735
10	16130	16130	16130	16130	36620	39192	41381	42722
11	22582	22582	22582	22582	3560	4684	7114	9325
12	39912	39912	39912	39912	19082	19840	23656	26717
13	26609	26609	26609	26609	20493	23338	26844	29276
14	20813	27267	27962	28470	9644	10155	10297	10344
15	25547	33110	33955	34572	7577	7720	7772	7794
16	17351	21424	21971	22370	6943	7030	7068	7086
17	15086	15581	15979	16269	10049	10692	10834	10868
18	21536	25206	27016	28388	1910	2361	2605	2735
19	26358	28356	30392	31936	9858	10103	10241	10314
20	56939	56939	56939	56939	5804	5919	6098	6216
21	22241	27687	29064	30089	16077	16109	16249	16346
22	8643	12412	13029	13488	3422	3541	3612	3651
23	16578	23868	25055	25938	781	1189	1375	1461
24	12463	15276	16035	16601	2296	2364	2446	2499
25	10902	16231	17038	17639	4413	4667	4800	4869
26	20496	26638	26860	27019	12592	12849	12896	12904
27	3223	4296	4332	4358	5052	5058	5061	5062

Zone No.	POPULATION				EMPLOYMENT			
	2003	2010	2025	2035	2003	2010	2025	2035
28	17644	21481	21660	21789	9755	11037	11245	11253
29	13480	21482	21661	21790	35283	35517	35562	35570
30	9535	12030	12129	12201	46269	46621	46681	46688
31	18677	20622	21081	21415	6303	6366	6411	6437
32	21533	23200	23716	24092	8830	9400	9534	9569
33	20485	24059	24595	24985	3528	3626	3690	3727
34	14600	18044	18446	18738	2020	2155	2213	2241
35	47467	54611	58603	61631	14070	14214	14340	14415
36	38837	44682	47947	50425	5532	5652	5757	5820
37	40019	52221	55680	58290	9720	9904	10082	10191
38	33275	46309	49376	51691	3858	4089	4253	4348
39	36770	47294	50538	52990	8091	8183	8278	8338
40	39834	51235	54749	57406	7619	8097	8503	8751
41	48472	63548	66707	69060	19733	20665	21239	21557
42	9583	9929	10423	10791	4532	5157	5301	5335
43	19574	25816	27100	28056	3935	4012	4058	4084
44	73584	100820	105834	109567	23857	24441	24827	25045
45	45389	59805	62779	64993	14885	15241	15523	15689
46	11425	15467	16236	16808	5388	5469	5524	5555
47	19337	27841	29225	30255	16968	17251	17416	17506
48	27770	40481	42494	43993	12091	12560	12821	12960
49	44553	60721	63741	65989	7016	7250	7425	7527
50	61156	103112	108239	112057	14628	15533	16109	16433
51	88547	110749	116256	120357	19009	19330	19598	19758
52	77313	109222	114653	118697	24459	25396	25998	26336
53	72679	96116	100895	104454	19069	19507	19822	20004
54	13976	20565	21588	22349	17484	17690	17818	17889
55	11117	12786	13422	13895	1077	1286	1375	1416
56	24692	24692	24692	24692	218	512	670	744
57	29154	29834	31317	32422	5210	5531	5719	5821
58	14339	15982	16776	17368	3800	4035	4131	4175
59	21471	21471	21471	21471	7518	7739	7845	7898
60	91952	91952	91952	91952	7183	7477	7677	7791
61	75232	75232	75232	75232	4357	4539	4663	4734
62	129168	129168	129168	129168	29122	30282	31072	31522
63	67221	71580	75140	77790	14149	14771	15262	15555
64	28917	33440	35103	36342	34730	35178	35434	35571
65	91113	95474	100221	103756	44873	45299	45582	45742
66	35266	42008	44097	45653	63278	63339	63548	63692
67	44905	63013	66146	68479	8736	9467	9862	10071
68	74477	104640	109843	113717	20568	21970	22841	23327
69	78392	103876	109041	112887	30987	31909	32510	32848
70	82237	110749	116256	120357	30684	30961	31218	31374
71	103408	106931	112248	116207	13318	13976	14359	14566
72	54296	54296	54296	54296	4618	5083	5331	5461
73	66360	66360	66360	66360	8346	9092	9489	9698

Zone No.	POPULATION				EMPLOYMENT			
	2003	2010	2025	2035	2003	2010	2025	2035
74	40451	40451	40451	40451	12258	12492	12648	12736
75	18097	18097	18097	18097	11342	11445	11513	11552
76	47903	47903	48284	48558	12818	12913	12977	13013
77	76578	106167	111446	115377	9080	9715	10137	10378
78	27834	34707	36432	37717	2773	2987	3101	3161
79	63740	73752	77419	80150	29740	30246	30636	30865
80	59542	78915	82839	85761	21955	22332	22571	22703
81	14503	17323	18185	18826	10998	11025	11074	11106
82	76366	98761	103671	107327	8108	8941	9485	9796
83	2183	2824	2964	3069	118	138	151	158
84	55005	55005	57733	59763	15088	15436	15668	15800
85	44006	44006	46187	47811	6132	6277	6375	6430
86	11001	11001	11547	11953	1568	1617	1650	1669
87	67080	67080	67080	67080	17298	17865	18242	18456
88	54883	54883	54883	54883	3358	3617	3788	3886
89	12171	12171	12171	12171	29499	29553	29591	29612
90	42601	42601	42601	42601	10573	10812	10977	11071
91	24343	24343	24343	24343	1388	1641	1814	1915
92	30429	30429	30429	30429	1710	1813	1883	1924
93	68416	68416	70322	71716	11829	13074	13889	14355
94	17104	17104	17581	17929	25928	26492	26865	27075
95	28508	28508	29301	29882	4341	5140	5661	5961
96	12171	12171	12171	12171	789	893	964	1006
97	4134	5347	5612	5810	1411	1438	1456	1466
98	25477	28642	30066	31127	3727	3860	3951	4003
99	25477	28642	30066	31127	615	719	790	832
100	45518	51174	53718	55613	10443	11338	11952	12307
101	6359	13641	20634	27730	3568	5056	7182	8907
102	4242	6764	13393	21816	899	1368	2609	3964
103	10530	15563	26057	37654	3386	4641	7096	9305
104	294	318	2252	9116	821	1008	2391	4339
105	2630	2905	11031	28611	738	929	2377	4543
106	16990	21890	27974	33330	4115	6631	10551	14004
107	9625	9870	10221	10480	4807	5929	7340	8368
108	10094	15437	34148	60207	2631	3752	7162	10961
109	3509	5186	13372	26306	798	1267	3336	6355
110	3247	3658	4358	4938	633	831	1133	1374
111	41035	48086	63448	77343	13814	18502	26955	34231
112	10565	11030	11856	12483	2670	3399	4438	5240
113	5815	6318	7067	7655	1823	2312	2973	3473
114	7850	9020	11110	12894	2656	3689	5425	6911
115	5228	5877	7000	7932	2270	2864	3688	4314
116	10515	11158	11993	12627	2960	3749	4767	5524
117	4849	5544	10328	16108	1328	1848	3156	4470
118	16991	21951	38012	56266	4356	6134	10791	15601
119	13713	16594	22603	28187	2918	3871	5518	6906

Zone No.	POPULATION				EMPLOYMENT			
	2003	2010	2025	2035	2003	2010	2025	2035
120	24316	31452	45702	59683	7695	10749	16591	21863
121	40616	53498	92641	137132	6730	10092	19460	29844
122	26865	34986	60585	89680	5449	8376	16691	26140
123	13853	15703	23773	31968	3447	4701	8316	12107
124	9565	10910	15681	20320	3123	4085	6118	7944
125	8634	9537	10963	12110	2269	2864	3677	4294
126	3426	3937	4849	5628	1639	2072	2690	3163
127	11221	12774	15496	17789	3598	4809	6754	8357
128	41628	49747	65673	80084	9090	12509	18548	23787
129	20228	23462	44509	70321	8116	10624	19144	28365
130	12818	14253	36811	72497	5836	7463	16521	28420
131	8856	9402	10807	11938	3881	4855	6281	7379
132	6790	7046	9075	10873	2245	2815	4077	5192
133	9004	10760	14197	17306	1923	2786	4414	5903
134	8004	8758	9913	10831	4283	5362	6792	7859
135	15883	19356	56852	122740	6241	8670	19875	34761
136	6942	8796	12860	16867	2424	3195	4560	5716
137	7375	7816	10313	12571	2834	3597	5028	6233
138	9097	13446	21855	30920	1728	3292	6758	10577
139	20519	24253	43682	66501	6143	8530	16741	26206
140	12008	14814	34326	62560	4328	5622	8780	11754
141	5695	6430	7733	8823	1403	1871	2615	3226
142	32504	51831	89754	132858	6044	12724	28190	46118
143	31590	50372	87228	129120	14275	22476	40358	58531
144	13730	16460	34766	59306	3375	4595	10742	19092
145	30735	36017	40897	44782	12979	16292	20425	23454
146	175005	239582	267856	290073	26065	36244	48998	58762
147	6599	8391	30719	77621	1743	2672	9631	23041
148	91606	122152	166486	207698	37628	49022	64122	75611
149	49854	85704	113085	137850	8386	14870	24858	33844
150	56243	96689	179062	278078	10026	17038	31474	46222
151	120832	175216	195894	212142	21835	33112	44095	51856
152	50720	109768	223697	371968	8414	22838	58162	102418
153	60044	80630	92683	102380	11339	15009	19313	22471
154	100986	129644	173511	213668	9599	21551	43398	65884
155	7194	10890	20584	32435	2305	3348	5969	8682
156	101972	119496	137357	151728	21728	28736	40181	49617
157	89800	115830	155678	192286	11643	18542	31748	44456
158	5194	6980	10400	13828	1295	2014	3272	4424
159	62034	84925	119996	153605	11265	17988	30076	41394
160	5253	7073	21383	47126	1771	2843	9628	21925
161	4810	6351	17126	34785	1488	2150	5407	10061
162	5646	6616	8729	10641	1757	2414	3644	4735
163	3317	4203	5545	6759	1337	1976	3051	3999
164	3307	4528	7329	10338	474	700	1204	1704
165	1538	1550	9125	32370	402	491	1168	2124

Zone No.	POPULATION				EMPLOYMENT			
	2003	2010	2025	2035	2003	2010	2025	2035
166	3279	3481	3733	3924	1136	1427	1803	2082
167	2320	2464	2642	2777	659	831	1055	1221
168	3874	4452	5484	6364	790	1025	1383	1668
169	13598	19000	27584	36000	2171	3207	5043	6697
170	6598	7004	7511	7895	1189	1571	2097	2505
171	43280	63391	89915	115416	22171	30840	44296	55470
172	54859	54859	54859	54859	17713	31313	41390	47665
173	2016	2362	3011	3582	518	769	1235	1663
174	1703	1881	2162	2388	490	653	900	1099
175	4246	5813	9733	14064	722	1156	2237	3417
176	2559	2940	3621	4203	273	404	639	851
177	6022	6394	6856	7207	2761	3408	4219	4809
178	1579	1677	1798	1890	460	568	702	800
179	8680	11883	39710	94008	2903	4025	10737	20930
180	134	1100	14121	87425	240	463	4652	22617
181	23763	27520	44546	62837	30109	37498	50238	60539
182	50862	69630	108957	150022	17334	24950	40516	55193
183	33017	39457	63868	90092	4178	5936	10920	16283
184	95421	130631	204412	281454	27742	41976	72275	102142
185	10416	13197	27926	47703	3511	4967	10499	17297
186	2248	9679	20481	34985	575	2499	6896	12255
Total	5724927	7020643	8446668	10125421	1803494	2102284	2637401	3180483

Source: Louise Berger Study - 2000

2.5 Demand Modeling and Forecast

2.5.1 General

The transportation study process consists of development of formulae (or models), enabling forecast of travel demand, and development of alternative strategies for handling this demand. It is not just one model, but a series of inter-linked and inter-related models of varying levels of complexity, dealing with different facets of travel demand. Through these models, the transportation study process as a whole is checked and calibrated before it is used for future travel predictions.

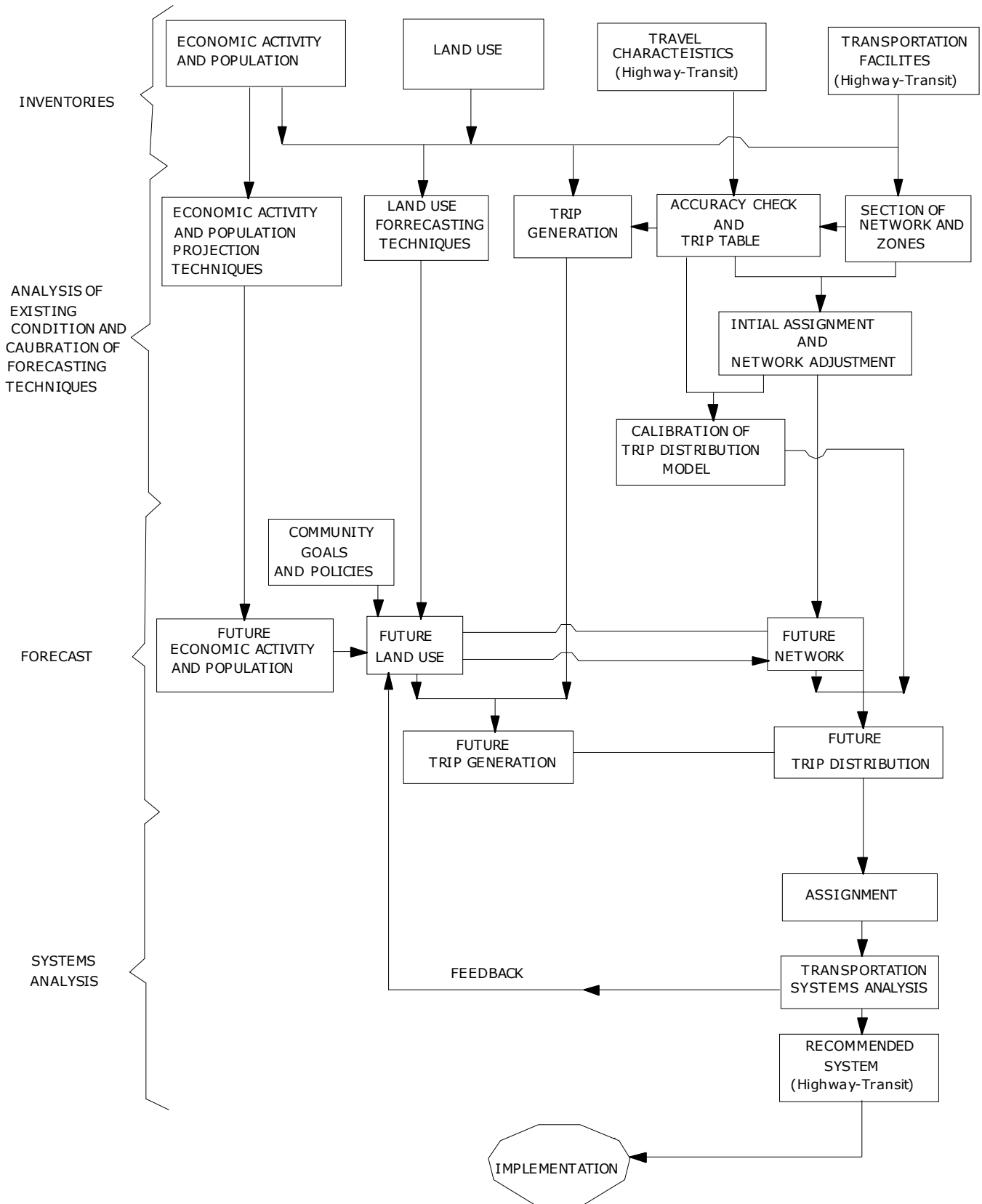
In the present study, a four-stage transport demand model has been developed for estimating future travel demand. The normal and easily available planning variables at traffic zone levels such as population and employment have been made use of in transport demand analysis.

The four stages of transportation planning process are:

- **Trip-end prediction or trip generation and attractions** – the determination of the number of person trips leaving a zone irrespective of destination and the number of trips attracted to a zone, irrespective of origin.
- **Trip distribution** – the linking of the trip origins (generation) with their destinations (attraction)
- **Modal split** – the separation of trip by public transport modes or by private modes.
- **Assignment** – the allocation of trips between a pair of zones to the most likely route(s) on the network.

The details of urban transport planning process as adopted for the Study are shown in **Figure 2.2**.

Figure 2.2 Elements of Urban Transportation Planning Process



2.5.2 Trip Generation

Home Based Work Trips

The trip generation sub-model for home based one-way work trips produced/attracted from/to a zone by all modes (mass, fast and slow) is developed and presented in Table 2.11. The independent variable for trip production is the zonal population, whereas for the purpose of attraction, the independent variable is the employment in each zone.

Table 2.11 Trip Generation Sub-Models For Home Based One-Way Work Trips – 2003

Dependent Variable	Independent Variable	Constant Co-efficient	Regression Co-efficient (Trip Rate)	(R ²) Co-efficient of Determination
(Y)	(X)	(a)	(b)	
<i>Trip Production</i>				
All Modes	Population	-61.9426	0.323506	0.97
<i>Trip Attraction</i>				
All Modes	Employment	1639.07	0.851493	0.57

Home-Based Education Trips

Summary of regression analysis for home-based one-way education trips produced/attracted from/to a zone by different modes is given in **Table 2.12**. The independent variables used are zonal population and zonal school enrolment respectively.

Table 2.12 Trip Generation Sub-Models For Home Based One-Way Education Trips – 2003

Dependent Variable	Independent Variable	Constant Co-efficient	Regression Co-efficient (Trip Rate)	(R ²) Co-efficient of Determination
(Y)	(X)	(a)	(b)	
<i>Trip Production</i>				
All Modes	Population	-218.28	0.225299	0.94

Home-Based Other Trips

Summary of regression analysis for one-way home-based other purpose trips produced/attracted from/to a zone are presented in **Table 2.13**.

Table 2.13 Trip Generation Sub-Models For Home Based One-Way Other Trips – 2003

Dependent Variable	Independent Variable	Constant Co-efficient	Regression Co-efficient (Trip Rate)	(R ²) Co-efficient of Determination
(Y)	(X)	(a)	(b)	
<i>Trip Production</i>				
All Modes	Population	192.5665	0.046735	0.44
<i>Trip Attraction</i>				
All Modes	Employment	5066.982	2.960293	0.32

Home-Based Total Trips

Summary of regression analysis for one-way home-based total trips produced/attracted from/to a zone are presented in **Table 2.14**.

Table 2.14 Trip Generation Sub-Models for Home Based One-Way Total Trips – 2003

Dependent Variable	Independent Variable	Constant Co-efficient	Regression Co-efficient (Trip Rate)	(R ²) Co-efficient of Determination
(Y)	(X)	(a)	(b)	
<i>Trip Production</i>				
All Modes	Population	5456.395	0.984282	0.78
<i>Trip Attraction</i>				
All Modes	Employment	2113.579	0.415655	0.58

2.5.3 Trip Distribution

The gravity model formulation has been used for developing the synthetic O-D matrix for the intra-city trips. The formulation of Gravity model used is as under:

$$T_{ij}^n = P_i^n [A_j^n \exp(-a^n C_{ij}^m) / \sum A_j^n \exp(-a^n C_{ij}^m)]$$

Where

T_{ij}^n = The number of trips produced in zone I and attracted to zone j for nth purpose (work, education, other)

P_i^n = The total number of trips produced in zone I for nth purpose

A_j^n = The total number of trips attracted to zone j for nth purpose

a^n = Parameter calibrated for base year for nth purpose

C_{ij}^m = Travel time between pair of zones I & j by mode m

Gravity Model – Calibration Process

The sequence of activities involved in the calibration of Gravity Model is shown in **Figure 2.3** Only the home based trips for purposes (work, education, other and total), which have been simulated for comparison with the observed flows.

The calibrated values of Gravity Model parameter for home-based trips for various purposes are presented in **Table 2.15** where W, E, O denote parameters for work, education and other purposes respectively.

Calibration process included comparison of observed and simulated mean trip lengths as well as shapes of the trip length frequency distribution.

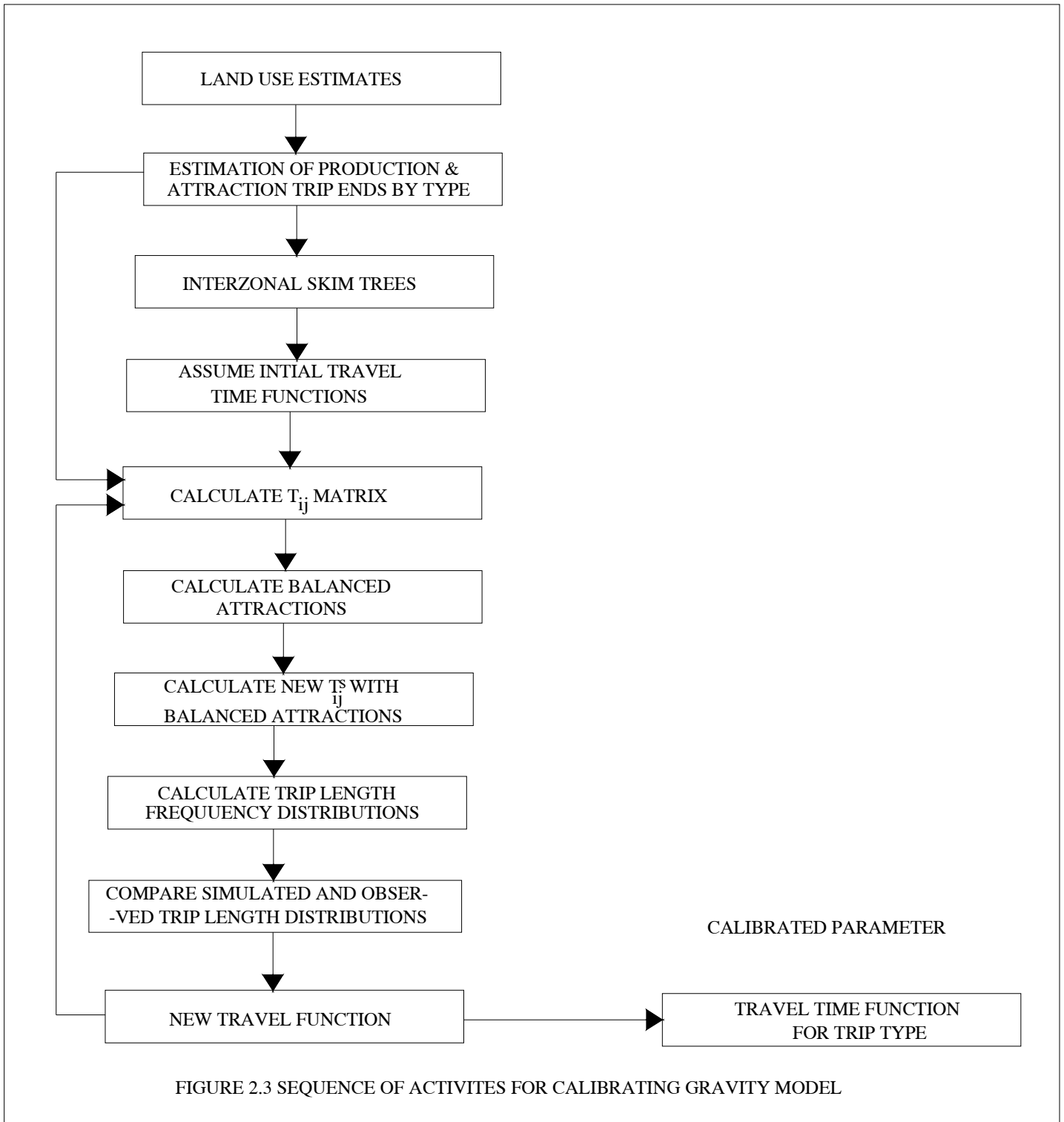
Table 2.15 Calibrated Gravity Model Parameters

Trip Purpose	Parameter	Parameter Value	Mean Trip Length
Work	W	0.048	34.20
Education	E	0.069	27.88
Other	O	0.054	30.47
Total		0.4165	32.16

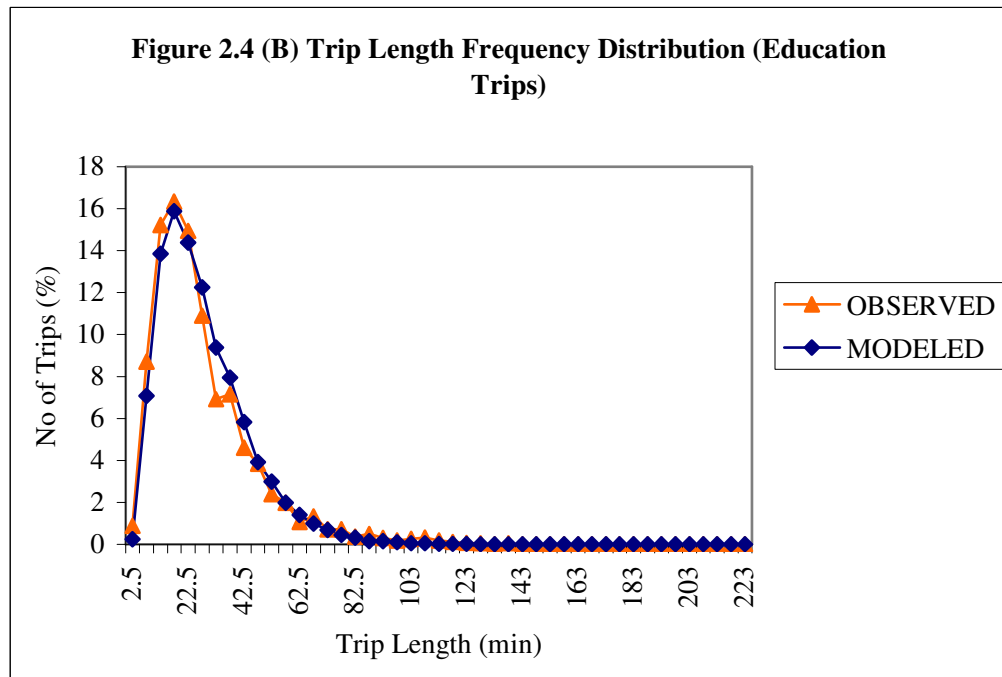
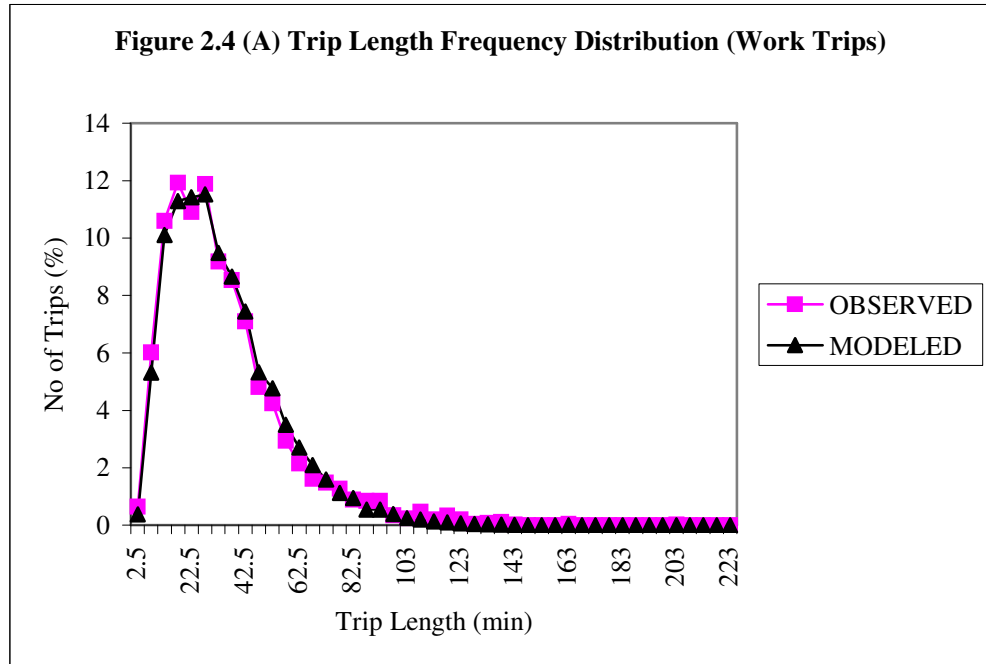
The observed trip length frequency distributions for different purposes (work, education and other) were obtained from the 2003 Household Travel Survey data. For simulated trip length frequency distributions, the parameter values (negative exponential) were varied until the simulated and observed trip length frequency distributions for each purpose exhibited the following.

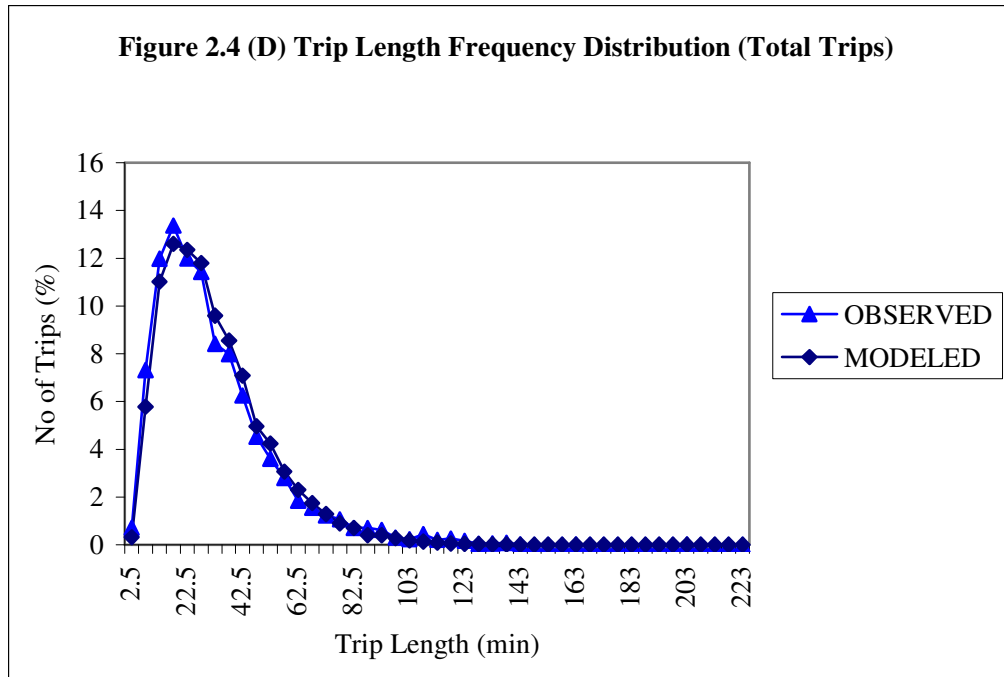
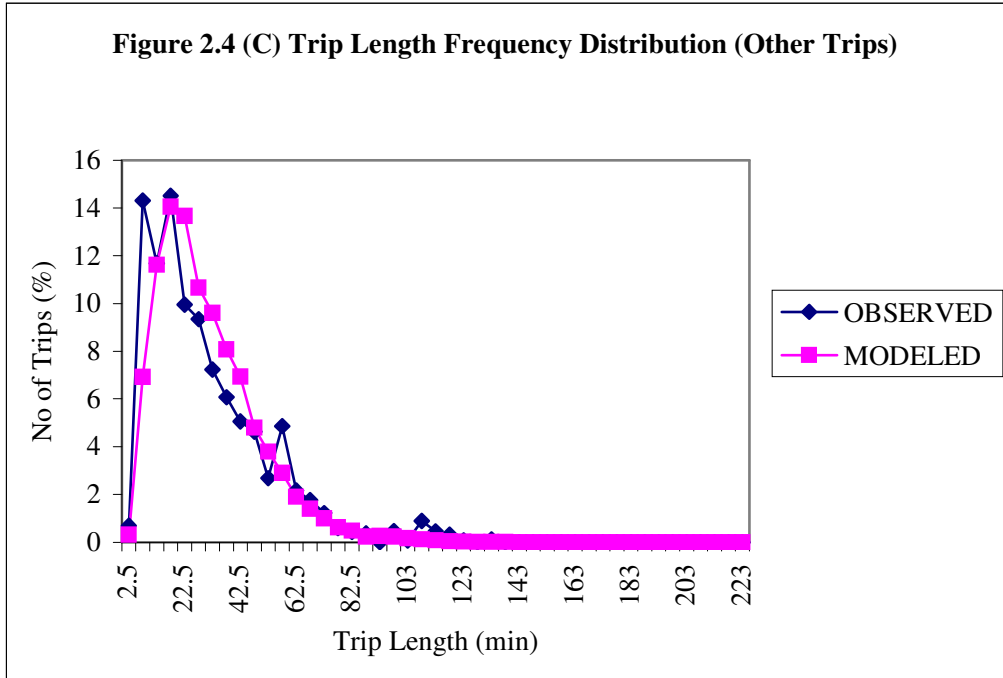
- The shape and position of both curves relatively close to each other when compared visually.
- The difference between mean trip lengths was within 3 percent variation

The calibration procedure developed by Bureau of Public Roads was used, which adjusts the measure of attraction used in the Gravity Model. Eight such iterations of attraction trip and balancing procedure were carried out for each trip purpose separately.



A comparison of observed and simulated trip length frequency for work, education, other and total trips is presented in **Figure 2.4 A to 2.4 D**.





The measure of deterrence is the perceived inter-zonal generalized cost – this is what the traveler unconsciously thinks it costs him to travel from one place to another. For each pair of zones, generalized cost for a public transport trip or by any other mode is determined. For any inter-zonal trip, the cost between each of the two zone centroids and between them and the appropriate actual network nodes is added to establish the least cost journey through the whole network between the zones. For example, for a trip including one or more public transport links and walk links thereto, the public transport generalized cost would be made up of:

- a) Cost of walking time to bus stop (from notional centroid link)
- b) Cost of waiting time at bus stop
- c) Cost of traveling time on bus
- d) Bus fare
- e) Cost of interchange waiting time – where appropriate
- f) Further c) and d) – where appropriate
- g) Cost of walking time from bus stop to destination (by notional centroid link).

In a somewhat similar way, generalized cost for other modes is determined. The least-cost journey from any zone to another is determined by a tree building process. Separate least-cost journey trees are built for public transport trips and for trips by other modes.

For the purpose of analysis in this study, C_{ij} values, which should normally be based on Generalized Cost, have been taken only in terms of travel time. Travel time matrices have been computed and ‘skim trees’ built representing shortest travel paths between each pair of zones taking road congestion into consideration.

2.5.4 Modal Split

The household travel survey carried out in 2003 shows a less modal split in favour of public transport. The lower modal split in favour of public transport system shows the deficiency in public Transport system and also the non-availability of public transport system in major routes of the city. The reduction in fleet size of AMTS bus services is also one of the major reason for lower public transport share.

A good mass transport system expected to increase a higher modal split in favour of public transport in the year 2010, 2025 and 2035.

2.5.5 Trip Assignment

For the purpose of this study, Capacity restrained assignment technique has been followed. In this method of assignment, private and public transport trip matrices are loaded onto their respective networks, using an incremental assignment method. The trip matrices are assigned to the shortest paths generated successively after assignment of small lots each of 10% increment of the trips matrices. The incremental assignment proceeds by updating the private and public transport networks using the speed flow relationships of the links until 100% of the two matrices are assigned.

The assignment is largely controlled by alternative paths, which are built by the shortest path algorithm through the network. There is simultaneous building of shortest paths for the two networks (mass transport and private trips), and rules adopted are:

1. The paths are not allowed to be built through the zone centroids, other than the origin and the destination end.
2. Due to the type of signal phasing adopted for intersections, the right turning traffic has to wait for a few seconds more than the straight moving traffic. Also, as the right turners have to follow a curved and longer path through the intersection, a penalty of 30 seconds is adopted for such assignment.

The road network is assigned the road capacity based on the available lane widths. The types of roads and their capacities are given in **Table 2.16**

Table 2.16 Types of Roads and Their Capacities

Road Type	Capacity in PCU's per Hour*
2-Lane Divided	2000
4-Lane Divided	4000
6-Lane Divided	6000

It has been assumed that roads have a given capacity, while the existing rail network has unlimited capacity.

In addition to the capacity values, the speed flow relationships of the three types of links are required for modifying the speeds for each incremental loading. A mathematical model was developed for each link type. These mathematical modes are as follows

2-Lane Divided

$$S = S_f(1.0 - 0.57 (V/C)^{30})$$

4-Lane Divided

$$S = S_f(1.0 - 0.63 (V/C)^{27})$$

6-Lane Divided

$$S = S_f(1.0 - 0.60 (V/C)^{25})$$

Where

S	=	Speed in kmph
S _f	=	Free flow speed in kmph
V	=	Assigned volume in PCU's
C	=	Capacity of road link in PCU's

The initial free flow speeds taken for the assignment of public and private modes are summarised in **Table 2.17**

Table 2.17 Free Flow Speeds

Mode	Free Flow Speed in kmph*		
	2-Lane	4-Lane	6-Lane
Public Transport	15	20	25
Private Transport	30	35	40

The results from the incremental assignments, which are in terms of person trips, have to be converted to PCU's for updating the link speeds. As the occupancy levels of the private modes are drastically different from the road-based public transport modes, separate passenger to PCU conversion factors have been derived for the two types of travel. For this purpose, the city has been divided into two regions - each having a different mix of traffic characteristics. The factors used for the two regions are given in **Table 2.18**

The roads are also used by goods vehicles and other slow moving vehicles. The capacity comparison and speed modifications must take movement of these vehicles and mixed traffic conditions into account. Thus, after the person trips are converted to vehicles trips in terms of PCUs, the goods factors is used to incorporate the mixed flow conditions because of goods and the slow moving vehicles.

Table 2.18 PCU Conversion Factors

Region	PCU Conversion Factors		
	Pub. Vehicles	Pvt. Vehicles	Goods
AMC Area	0.067579	0.415010	1.20
Rest of AMC Area	0.067108	0.360208	1.23

In the assignment process, the link speeds get modified by appropriate modeling of speed flow relationships. As the volume-capacity ratio increases towards 1.0, the link speed decreases fast to a residual value of about 10 to 15 kmph. In case of further loading of the link (which is possible in absence of alternate paths) beyond volume/capacity ratio of 1.0, the speeds may get negative.

Accordingly, to control the speed to a non-negative residual value, the lowest bound for public and private mode speeds is taken as 5.0 and 10.0 kmph respectively.

The base year assigned trips were compared with the ground counts of selected arterials to establish the validity of models as stated earlier for working out horizon year (2035) transport demand forecast.

2.6 TRANSPORT DEMAND FORECAST

2.6.1 The following assumptions have been made while working out the traffic demand on the proposed Metro & Regional Rail System:

1. The basic inputs to the study i.e. the land use parameter for the year 2010, 2025 & 2035 are worked out by Louis Berger Report – 2000 presented in **Table 2.10**. The land use parameters population and Employment is available in AUDA and GUDA master plan up to the year 2011.
2. The integrated transport network includes the future road network proposals, Metro network & Regional Rail System.
3. For working out a path between an origin and destination, travel time has been considered.
4. Proper inter-modal integration facilities, including approach roads are assumed to be available at all stations of Metro and Regional Rail System.

5. Feeder services have been assumed to be available at all stations of Metro and Regional Rail System.
 6. Wherever possible, proper passenger integration has been assumed between Metro Stations and Regional Rail System.
 7. Common ticketing for Metro corridors with regional rail system.
- 2.6.2 The summary of horizon year (2010, 2025 & 2035) transport demand forecasts for study area is presented in **Table 2.19**.

Table 2.19 Summary of Transport Demand Forecast

Sl.No.	ITEM	FIGURES (Million)			
		2003	2010	2025	2035
1	Population	5.73	7.02	8.45	10.13
2	Employment	1.80	2.10	2.64	3.18
3	Per Capital Trip Rate (Excluding Walk)	0.72	0.80	0.90	1.00
4	Total Trips	4.55	6.11	8.31	10.99
5	Intra city Trips	4.15	5.62	7.61	10.13
6	Inter city Trips	0.40	0.49	0.70	0.86
7	Modal split (Public Transport for Intra city trips)	28	60	70	75
8	Peak Hour Factor	10	10	10	10
9	Peak Direction Factor	60	60	60	60

2.7 ROAD ONLY NETWORK

- 2.7.1 The road only network consists of all the roads with Right Of Way 12 m (carriageway with 2 lane) and above and covers the whole area of AMC, AUDA and Gandhi Nagar.
- 2.7.2 The origin – destination matrix for the year 2003, 2010, 2025 and 2035 assigned on road only network and shown in **Figures 2.5 to 2.8**.
- 2.7.3 The trip assignment on this network in the year 2035 shows that the following road corridors will carry out the maximum traffic more than 20000 peak hour trips. Some of these major corridors are;

- i) Vishala to Sachivalya via Vasna, Paldi, ITO, Usmanpura, Sabarmati, Moetra, Koba Circle.
- ii) Kalupur-Prem Darwaja—Shahpur Darwaja-ITO-HL Commerce College-Manav Mandir-Thaltej Village Road
- iii) 132' Ring Road From Vasna (APMC)- Jivraj Park – Shivranjani Junction – Memnagar – Manav Mandir – Naranpura – Nava Wadaj – RTO.
- iv) National Highway – 8 from Vishala – Narol – Isanpur - Khokara Mahamdabad- Rakhail – Sahijpur Bogha.
- v) Kalupur – Asarva - Sahijpur Bogha – Naroda GIDC – Naroda.
- vi) Sarkhej – Gandhinagar Highway (NH – 8C) from Sarkhej – Makarba-Vejalpur – Bodakdev – Thaltej – Sola – Oganj – Khodiyar – Adalaj – Indroda Circle.
- vii) Kalupur –Sarangpur – Jamalpur – Ellis Bridge – Ashram Road
- viii) On Baroda Highway from Jamalpur – Kankaria – Danilimda – Narol – Vatva – Jetalpur – Bareja.
- ix) Nadiad Highway from Khokara Mahamdabad – Mani Nagar – Vatva GIDC – Vinzol – Hatijan – Nandej / Barejadi – Raska - Mehmdabad



Figure 2.5 Showing Link Wise Peak Hour Passenger Trips in 2003



Figure 2.6 Showing Link Wise Peak Hour Passenger Trips in 2010



Figure 2.7 Showing Link Wise Peak Hour Passenger Trips in 2025



Figure 2.8 Showing Link Wise Peak Hour Passenger Trips in 2035

2.8 AIRPORT LINK

The airport rail link from regional rail system (and also through metro) is not justified even in the year 2035 as the daily traffic demand is too low. The current traffic demand and the projection in various years with 10% growth rate are indicated in **Table 2.20**. The shift of airport bound passengers to rail system is high in case of checking in facility in the city with direct link to airport (without any interchange).

Table 2.20 Projected Air Passengers Traffic

Year	No. of Air Passengers
2003	2500
2010	4871
2025	20350
2035	52784

2.9 IDENTIFICATION OF METRO AND REGIONAL RAIL CORRIDORS

The major transport corridors for the Metro and Regional rail system have been identified on the basis of road network assignment for the year 2035, the mass transport corridors suggested in the earlier studies carried out in the study area and review of the following corridors which are given to be examined in the scope of work.

A) Metro System

- i) Line No. 1 – Vasna – Sabarmati – Gandhinagar
- ii) Line No. 2 – Kalupur – Thaltej / Vastrapur
- iii) Line No. 3 – Extension of Metro Corridor from Vasna to Changodar
- iv) Line No. 4 – Sarkhej to Gandhinagar via NH – 8C
- v) Line No. 5 – Vasna to Sabarmati along 132 feet wide road
- vi) Line No. 6 – Corridor along Sabarmati Riverfront

B) Regional Rail System

- i) Corridor No. 1 – Barejadi – Kalupur – Sabarmati – Kalol
- ii) Corridor No. 2 – Kalupur – Naroda
- iii) Corridor No. 3 – Airport Link from Kalupur – Naroda Line
- iv) Corridor No. 4 – Development of Regional Rail system on the available ROW of Indian Railways from Vasna to Sabarmati.
- v) Corridor No. 5 – Sarkhej to Gandhinagar via NH – 8C

The following Metro and Regional Rail System Corridors were identified for the year 2035, which is considered as Full System.

A) Metro System

- 1 Chandgodar – Sarkhej – Makatpur -Vishala-Vasana –ITO – Sabarmati –Motera- Indroda – Akshardham
- 2 Kalupur – Prem Darwaja – ITO – Manav Mandir – Drive in Cinema - Thaltej
- 3 Vishala – Manav Mandir- Naranpur – RTO
- 4 Sarkhej – ISKON Temple – Thaltej – Khodiyar – Indroda Circle

B) Regional Rail System

- 1 Barajadi- Vatva – Maninagar – Kalupur –Khodiyar – Kalol.
- 2 Kalupur – Naroda.

Where as Regional Rail System corridors as suggested in the Full System are recommended for Phase – 1 on techno-economic considerations, the ridership in the year 2010 does not justify Full system of Metro corridors. Therefore the Phase – 1 of Metro Corridor has been considered where the ridership is maximum. The corridors for Metro and Regional Rail system for Phase – 1 are as follows:

A) Metro System

- 1 APMC - Vasana –Aayakar Bhavan –Sabarmati –Motera- Indroda – Akshardham
- 2 Ahmedabad – Prem Darwaja – Aayakar Bhavan – Manav Mandir – Drive in Cinema - Thaltej

B) Regional Rail System

- 1 Barajadi- Vatva – Maninagar – Kalupur –Khodiyar – Kalol Junction.
- 2 Ahmedabad – Naroda.

The four different alternatives for North – South Corridor comprise different options and have been presented in Figures 2.9 to 2.12. The summary of Transport Demand for the years 2010, 2025 & 2035 for the four alternatives is presented in Tables 2.21 to 2.23.

Figure 2.9 Alternative – 1 for North – South Metro Corridor

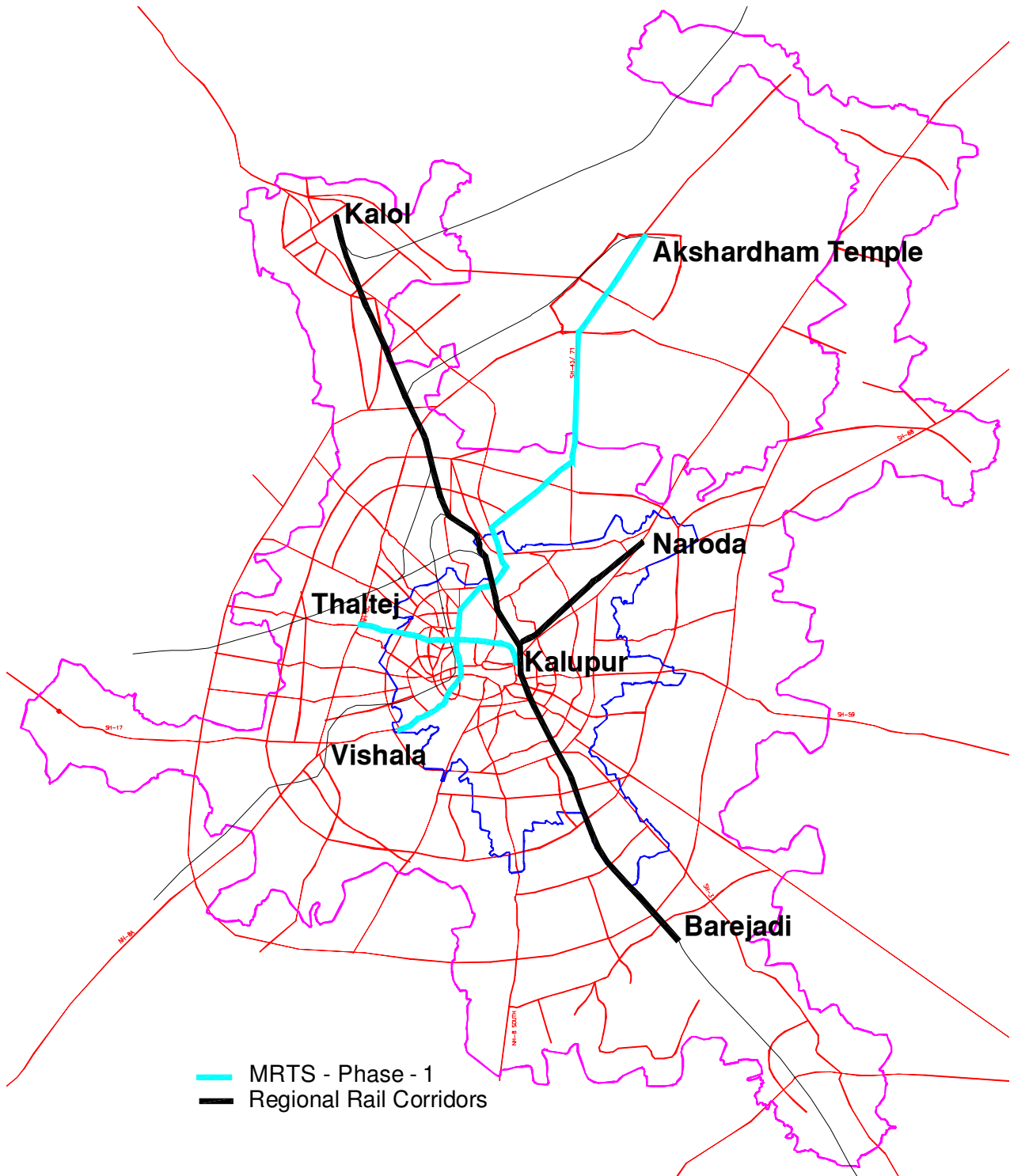


Figure 2.10 Alternative – 2 for North – South Metro Corridor

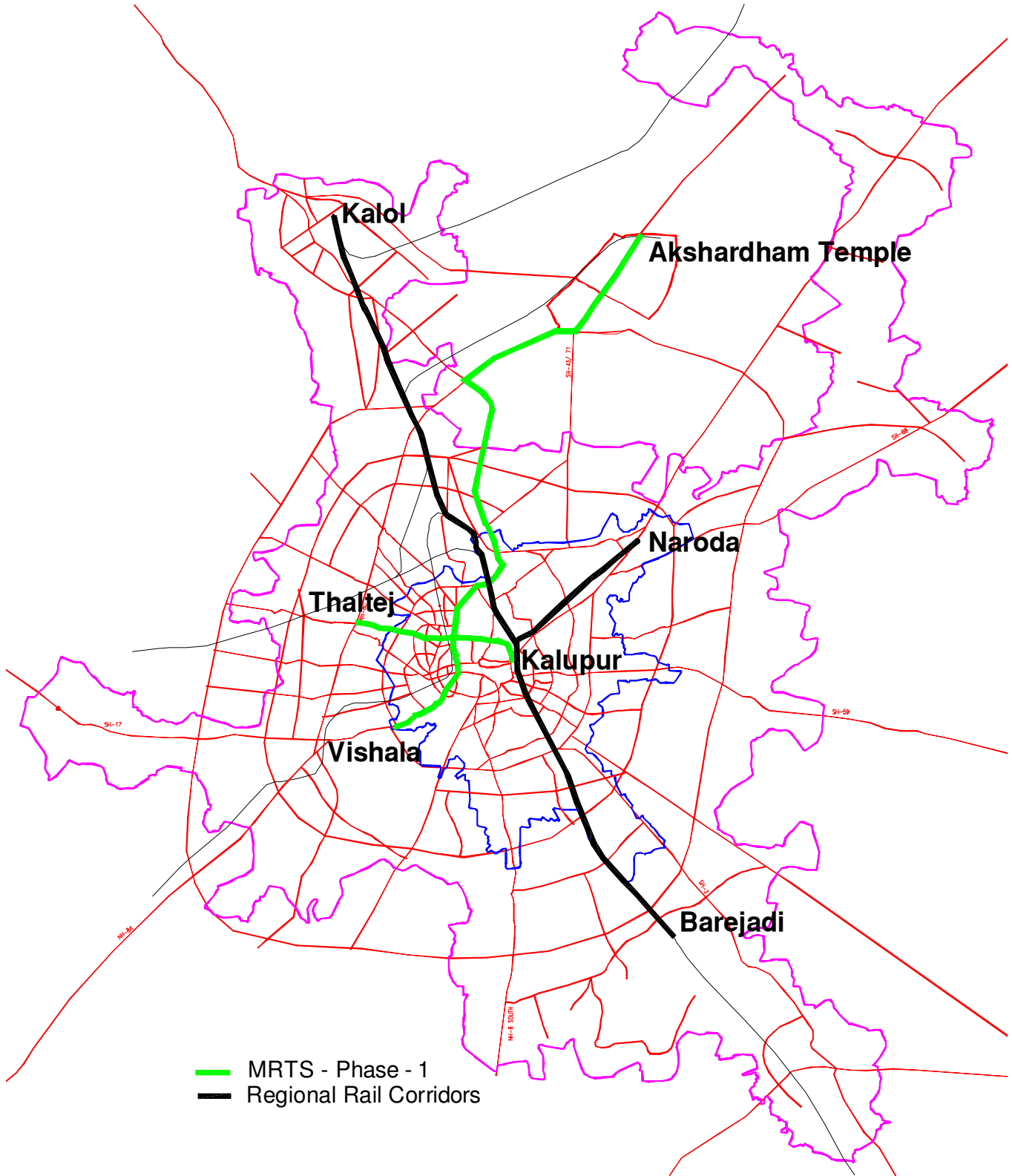
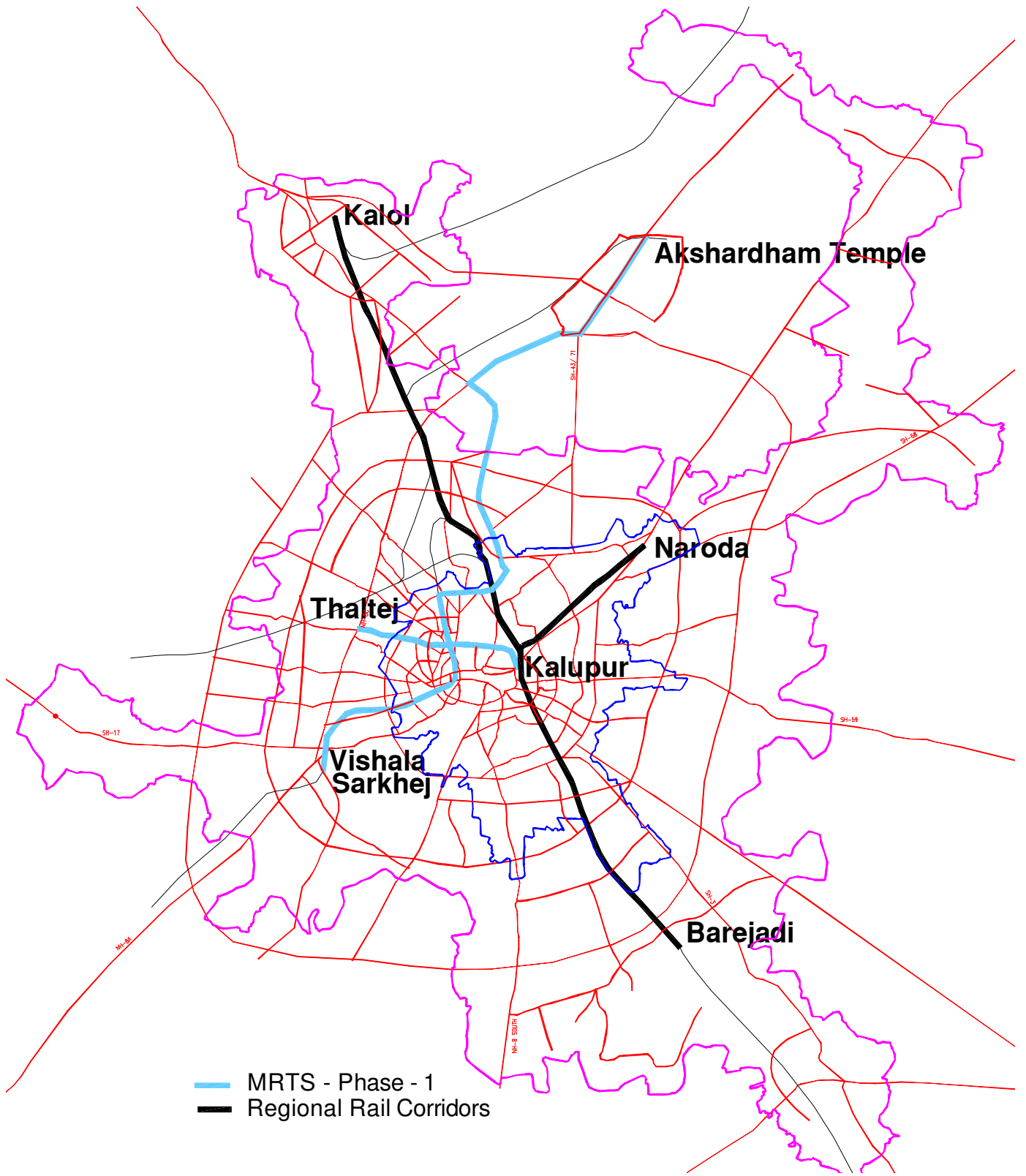


Figure 2.12 Alternative – 4 for North – South Metro Corridor



- 1) Alternative – 1: (As given above) Via Koba Circle
Vishala – Akshardham Temple (Ashram Road – SP Stadium - Motera – Koba Circle – Indroda Circle)
- 2) Alternative – 2: Via Adalaj
Vishala – Akshardham Temple (Ashram Road – SP Stadium – Adalaj – Indroda Circle)
- 3) Alternative – 3: Along Meter Gauge Railway line & via Koba Circle
Sarkhej – Akshardham Temple (Via Meter Gauge - SP Stadium – Motera - Koba Circle - Indroda Circle)
- 4) Alternative - 4: Along Meter Gauge Railway line & via Adalaj
Sarkhej – Akshardham Temple (Via Meter Gauge – SP Stadium – Adalaj - Indroda Circle)

Table 2.21 SUMMARY OF TRANSPORT DEMAND – 2010

<i>Section</i>	Length (Km)	Number of Passengers (lakh)	Pass- Km (lakh)	Pass- Km/Km (lakh)	Average Lead (km.)
Alternative I	94.67	11.30	105.01	1.11	9.29
Alternative II	100.26	10.40	101.59	1.01	9.77
Alternative III	104.18	11.24	115.28	1.11	10.26
Alternative IV	105.63	10.58	110.54	1.05	10.45

Table 2.22 SUMMARY OF TRANSPORT DEMAND – 2025

<i>Section</i>	Length (Km)	Number of Passengers (lakh)	Pass- Km (lakh)	Pass- Km/Km (lakh)	Average Lead (km.)
Alternative I	94.67	17.94	176.32	1.86	9.83
Alternative II	100.26	16.59	170.16	1.70	10.26
Alternative III	104.18	18.27	196.13	1.88	10.73
Alternative IV	105.63	17.11	188.85	1.79	11.04

Table 2.23 SUMMARY OF TRANSPORT DEMAND – 2035

Section	Length (Km)	Number of Passengers (lakh)	Pass-Km (lakh)	Pass-Km/Km. (lakh)	Average Lead (km.)
Alternative I	94.67	25.90	263.77	2.79	10.18
Alternative II	100.26	24.34	254.32	2.54	10.45
Alternative III	104.18	27.16	295.80	2.84	10.89
Alternative IV	105.63	25.30	285.11	2.70	11.27

It can be observed from the above tables that the passenger traffic is more or less same for all the alternatives. The parameter “Passenger Kms per route Km” are however higher for alternatives I & III as compared to alternatives II & IV. Thus, it is recommended to provide Mass Transit Corridor along Sabarmati – Koba Circle – Indroda Circle – Gandhinagar. This will be a shorter route to connect the twin cities of Gandhinagr and Ahmedabad.

However out of the alternatives I and III the alternative I has been selected on the basis of engineering feasibility and cost of the project.

The network options considered are: Metro for Phase1 and Full system are shown in Figure 2.13 & 2.14.

The phase 1 metro corridors are also worked out with two scenarios

Scenario 1: Metro corridors will be available without dedicated Regional Rail corridors. The Regional Rail system will be available as present without augmentation.

Scenario 2: Metro corridors will be available with dedicated Regional Rail corridors.

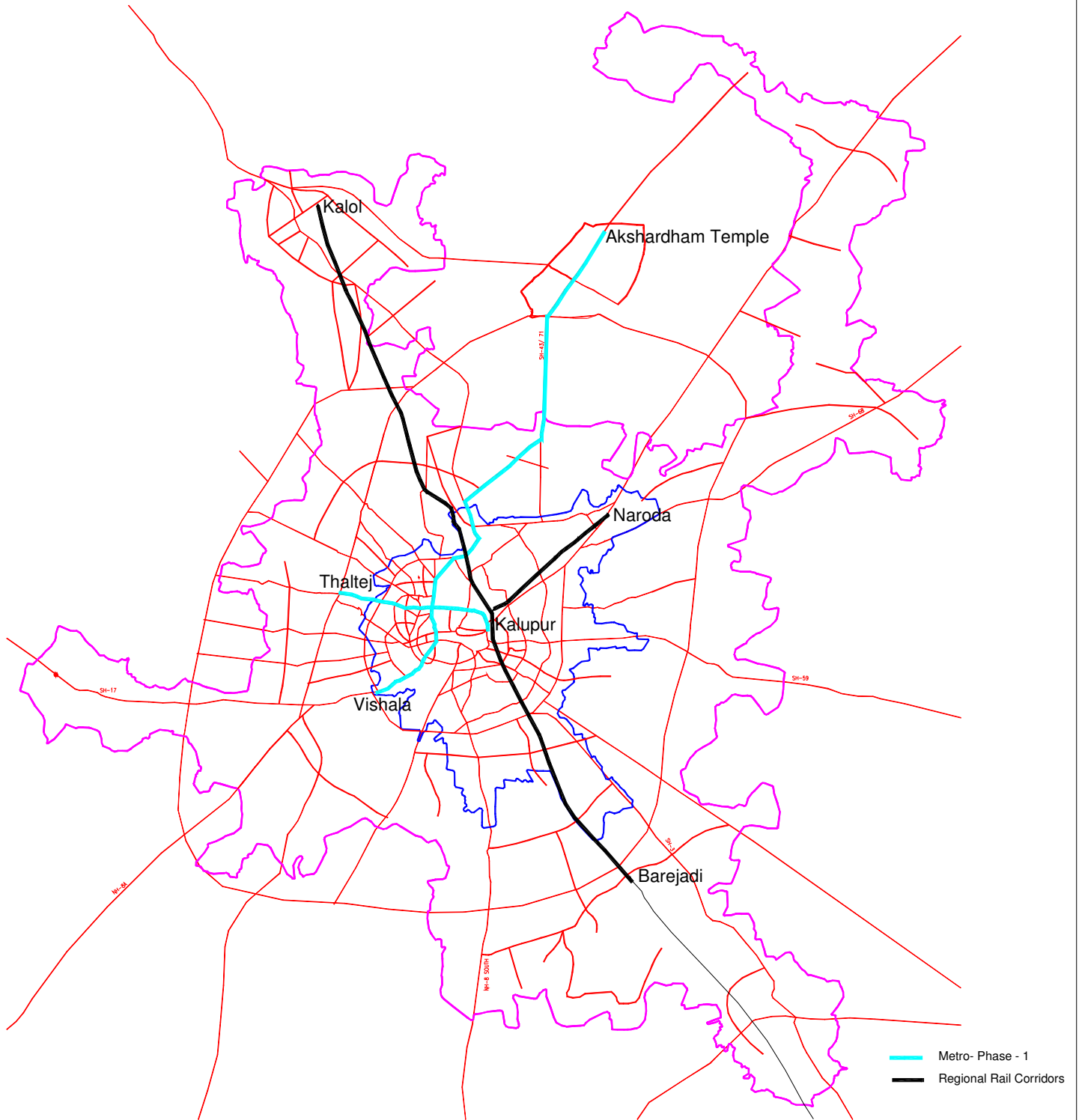


Figure 2.13 Ahmedabad Phase - 1 - MRTS and Regional Rail System

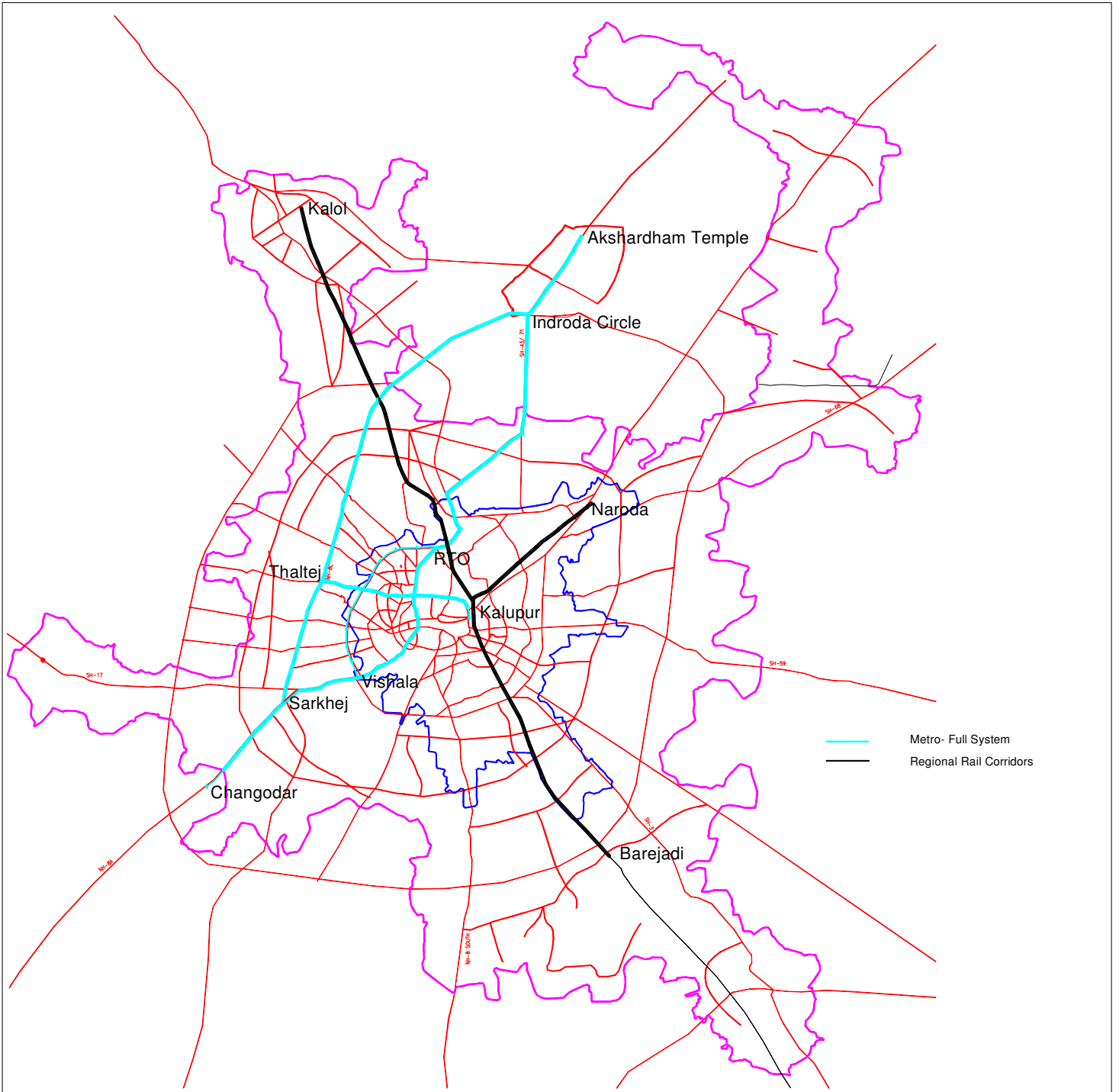


Figure 2.14 Ahmedabad - Full System - MRTS and Regional Rail

The transport demand for the two different scenarios has been worked out and summarized in the **Tables 2.24 to 2.26**. It has been observed from the tables that the no. of passengers, passenger km. and pkm/km are much more in Scenario 2 as compared to Scenario 1. This shows that the Regional Rail System is also required to make the metro system more efficient.

Table 2.24 SUMMARY OF TRANSPORT DEMAND – 2010

<i>Section</i>	Length (Km)	Number of Passengers (lakh)	Pass-Km (lakh)	Pass-Km/Km. (lakh)	Average Lead (km.)
Scenario 1	41.71	5.38	48.23	1.16	8.97
Scenario 2	41.71	6.75	56.35	1.35	8.35

Table 2.25 SUMMARY OF TRANSPORT DEMAND – 2025

<i>Section</i>	Length (Km)	Number of Passengers (lakh)	Pass-Km (lakh)	Pass-Km/Km. (lakh)	Average Lead (km.)
Scenario 1	41.71	9.24	87.44	1.87	9.46
Scenario 2	41.71	11.34	100.83	2.42	8.89

Table 2.26 SUMMARY OF TRANSPORT DEMAND – 2035

<i>Section</i>	Length (Km)	Number of Passengers (lakh)	Pass-Km (lakh)	Pass-Km/Km. (lakh)	Average Lead (km.)
Scenario 1	41.71	14.46	140.20	3.36	9.70
Scenario 2	41.71	17.10	158.28	3.79	9.26

2.10 SECTION LOADS

The trips made between two adjacent stations have been worked out for the year 2010, 2025 and 2035 for Phase 1 of Metro with Regional Rail System. The daily and PHPDT passenger trips in Metro and Regional Rail System are given in **Table 2.27 & 2.28**.

TABLE 2.27
SECTION LOADS ON METRO SYSTEM – PHASE - 1

S.NO.	FROM	TO	2010		2025		2035	
			DAILY	PHPDT	DAILY	PHPDT	DAILY	PHPDT
APMC- AKSHARDHAM								
1	APMC	VASNA	19330	1160	38868	2332	63740	3824
2	VASNA	NARAYAN NAGAR	45574	2734	70802	4248	99353	5961
3	NARAYAN NAGAR	PALDI	64644	3879	95256	5715	128627	7718
4	PALDI	MADALPUR	85503	5130	122372	7342	161422	9685
5	MADALPUR	NAVA GANDHIGRAM	95961	5758	136351	8181	178618	10717
6	NAVA GANDHIGRAM	NAVRANGPURA	120610	7237	173151	10389	229319	13759
7	NAVRANGPURA	AAYAKAR BHAVAN	174256	10455	242553	14553	314988	18899
8	AAYAKAR BHAVAN	USMANPURA	155358	9321	251829	15110	369488	22169
9	USMANPURA	VADAJ	163943	9837	264483	15869	385583	23135
10	VADAJ	GANDHI ASHRAM	157029	9422	264628	15878	392633	23558
11	GANDHI ASHRAM	SUBASH CIRCLE	150830	9050	258442	15507	387215	23233
12	SUBASH CIRCLE	SABARMATI	148842	8931	259647	15579	394248	23655
13	SABARMATI	SHANKARPURA	185482	11129	343091	20585	547248	32835
14	SHANKARPURA	ACHER	189262	11356	348996	20940	555195	33312
15	ACHER	MOTERA STADIUM	174467	10468	335123	20107	544336	32660
16	MOTERA STADIUM	MOTERA	144553	8673	293856	17631	494533	29672
17	MOTERA	AMIYAPUR	108877	6533	230006	13800	400048	24003
18	AMIYAPUR	SUGHAD	119986	7199	258571	15514	458251	27495
19	SUGHAD	NARMADA CANAL	111001	6660	242676	14561	434748	26085
20	NARMADA CANAL	KOBA CIRCLE	108997	6540	236327	14180	424329	25460
21	KOBA CIRCLE	KOBA	132405	7944	279041	16742	492231	29534
22	KOBA	POR	124681	7481	259471	15568	456783	27407
23	POR	KUDASAN	118110	7087	234078	14045	391026	23462
24	KUDASAN	DHAULA KUVA	123870	7432	255185	15311	443986	26639

S.NO.	FROM	TO	2010		2025		2035	
			DAILY	PHPDT	DAILY	PHPDT	DAILY	PHPDT
25	DHAULA KUVA	INFOCITY	119792	7188	235488	14129	368559	22114
26	INFOCITY	INDRODA CIRCLE	123662	7420	247738	14864	393739	23624
27	INDRODA CIRCLE	SECTOR7	127751	7665	263251	15795	462216	27733
28	SECTOR7	S.T.DEPOT	137102	8226	284125	17048	490127	29408
29	S.T.DEPOT	SACHIVALAY	135009	8101	282386	16943	484722	29083
30	SACHIVALAY	AKSHARDHAM	73644	4419	152652	9159	251348	15081
AHMEDABAD JUNCTION – THALTEJ								
1	AHMEDABAD JN.	PREM DARWAJA	231632	13898	314980	18899	402658	24159
2	PREM DARWAJA	DELHI DARWAJA	237139	14228	325656	19539	419955	25197
3	DELHI DARWAJA	SHAHPUR DARWAJA	231171	13870	319102	19146	413722	24823
4	SHAHPUR DARWAJA	AAYAKAR BHAVAN	226617	13597	318208	19092	418833	25130
5	AAYAKAR BHAVAN	SARDAR PATEL STADIUM	183461	11008	299837	17990	438368	26302
6	SARDAR PATEL STADIUM	COMMERCE CIRCLE	179959	10798	301385	18083	444473	26668
7	COMMERCE CIRCLE	GUJARAT UNIVERSITY	169001	10140	288781	17327	430901	25854
8	GUJARAT UNIVERSITY	GURUKUL	143886	8633	255617	15337	389864	23392
9	GURUKUL	DOORDARSHAN KENDRA	91560	5494	182633	10958	307081	18425
10	DOORDARSHAN KENDRA	THALTEJ	79230	4754	153471	9208	251846	15111

TABLE 2.28
SECTION LOADS ON REGIONAL RAIL SYSTEM – PHASE - 1

S.NO.	FROM	TO	2010		2025		2035	
			DAILY	PHPDT	DAILY	PHPDT	DAILY	PHPDT
REGIONAL RAIL CORRIDOR: BARAJADI- KALOL JUNCTION								
1	BARAJEDI	BHAIPURA	10170	610	17753	1065	25446	1527
2	BHAIPURA	GERATPUR	21408	1284	37200	2232	54799	3288
3	GERATPUR	VIVEKANAND NAGAR	26958	1617	45160	2710	64910	3895
4	VIVEKANAND NAGAR	VATVA GIDC	25718	1543	43540	2612	63060	3784
5	VATVA GIDC	VINZOL	36609	2197	62895	3774	94267	5656
6	VINZOL	VATVA	67737	4064	98641	5918	132415	7945
7	VATVA	JASHODA NAGAR	70500	4230	100970	6058	134223	8053
8	JASHODA NAGAR	DAXINI SOCIETY	154816	9289	215027	12902	278689	16721
9	DAXINI SOCIETY	MANINAGAR	169222	10153	235521	14131	305439	18326
10	MANINAGAR	KANKARIA	174851	10491	243790	14627	316329	18980
11	KANKARIA	AHMEDABAD JUNCTION	201212	12073	284077	17045	373263	22396
12	AHMEDABAD JUNCTION	SARASPUR	134912	8095	212475	12749	297421	17845
13	SARASPUR	GIRDHARNAGAR	139174	8350	219770	13186	308330	18500
14	GIRDHARNAGAR	SHAHIBAUG	141656	8499	225141	13508	316656	18999
15	SHAHIBAUG	NATIONAL MEMORIAL	137330	8240	222387	13343	316302	18978
16	NATIONAL MEMORIAL	POWER HOUSE	132532	7952	216474	12988	309720	18583
17	POWER HOUSE	SABARMATI	110827	6650	196877	11813	299968	17998
18	SABARMATI	RANIP	72492	4350	137747	8265	217311	13039
19	RANIP	KALI ROAD	75478	4529	139283	8357	216101	12966
20	KALI ROAD	D CABIN	84088	5045	159713	9583	250217	15013
21	D CABIN	CHANDKHEDA ROAD	57322	3439	107917	6475	168105	10086
22	CHANDKHEDA ROAD	TRAGAD	52501	3150	98490	5909	154287	9257
23	TRAGAD	KHORAJ	51288	3077	95382	5723	147473	8848

S.NO.	FROM	TO	2010		2025		2035	
			DAILY	PHPDT	DAILY	PHPDT	DAILY	PHPDT
24	KHORAJ	KHODIYAR	60254	3615	114599	6876	179370	10762
25	KHODIYAR	DANTALI	59569	3574	113593	6816	178170	10690
26	DANTALI	DHANEJ	58088	3485	108225	6494	162508	9750
27	DHANEJ	SAIJ SERTHA ROAD	58512	3511	110753	6645	171783	10307
28	SAIJ SERTHA ROAD	SAIJ VILLAGE	58712	3523	110697	6642	171466	10288
29	SAIJ VILLAGE	GIDC KALOL	56506	3390	106856	6411	165715	9943
30	GIDC KALOL	KALOL JUNCTION	56135	3368	106713	6403	164822	9889
AHMEDABAD JUNCTION – NARODA								
1	AHMEDABAD JN.	SARASPUR	210746	12645	285381	17123	362356	21741
2	SARASPUR	ASARVA	224158	13449	303218	18193	384204	23052
3	ASARVA	CHAMANPURA	216059	12964	291485	17489	367609	22057
4	CHAMANPURA	MEGHANI NAGAR	150324	9019	197319	11839	242965	14578
5	MEGHANI NAGAR	SAHIJPUR	133813	8029	175539	10532	216659	13000
6	SAIJPUR	SARDAR GRAM	90457	5427	116768	7006	142252	8535
7	SARDAR GRAM	KUBER NAGAR	63912	3835	80842	4851	95893	5754
8	KUBER NAGAR	NARODA	49642	2979	62167	3730	73094	4386

2.11 Corridor Loading

2.11.1 The description of no of passengers using the Phase - 1 system as follows

- A) Metro Phase - 1: The phase 1 of Metro system comprises of the following two lines

Line - 1: APMC-Vasana –Aayakar Bhavan –Sabarmati –Motera-Indroda – Akshardham along Ashram road of length of about 32 km. Consisting of 31 stations with interstation distance of 1 km. The number of passengers carried by this line is 4.16 lakh, 7.40 lakh and 11.95 lakhs in the years 2010, 2025 and 2035 respectively.

Line - 2: Ahmedabad Junction – Prem Darwaja – Aayakar Bhavan – Manav Mandir – Drive in Cinema – Thaltej of length 9.65 km. consisting of 11 stations. The number of passengers carried by this line is 2.59 lakh, 3.94 lakh and 5.15 lakhs in the years 2010, 2025 and 2035 respectively.

- B) Regional Rail System Phase – 1:

Line - 1: Barajadi- Vatva – Maninagar – Kalupur –Kodiyar – Kalol of length about 44km. The number of passengers carried by this line Phase-1 is 2.80 lakh, 4.30 lakh and 5.97 lakhs in the years 2010, 2025 and 2035 respectively.

Line - 2: Ahmedabad Junction – Naroda via Asarva and Sardargram of length 9.47 km. The number of passengers carried by this line in Phase - 1 is 1.75 lakh, 2.30 lakh and 2.83 lakhs in the years 2010, 2025 and 2035 respectively.

The expected station loads on the metro corridor and regional rail System for phase I for different horizons years is presented in **Table 2.29**.

TABLE 2.29 STATIONS LOADING ON PHASE - I

SI.No.	STATION NAME	Daily BOARDING / ALIGHTING		
		2010	2025	2035
APMC – AKSHARDHAM				
1	APMC	9700	19400	31900
2	VASNA	14800	21500	26200
3	NARAYAN NAGAR	11800	15500	18700
4	PALDI	13700	18100	22100
5	MADALPUR	7600	9900	14000
6	NAVA GANDHIGRAM	15500	22100	33400
7	NAVRANGPURA	30200	40200	60000
8	AAYAKAR BHAVAN	12500	18000	30000
9	USMANPURA	4000	5900	10500
10	VADAJ	23900	30000	45000

Sl.No.	STATION NAME	Daily BOARDING / ALIGHTING		
		2010	2025	2035
11	GANDHI ASHRAM	12900	17500	21500
12	SUBASH CIRCLE	11400	22400	29100
13	SABARMATI	8500	12700	15500
14	SHANKARPURA	1800	5800	9500
15	ACHER	16900	23200	34000
16	MOTERA STADIUM	25300	46100	60000
17	MOTERA	16600	39700	38000
18	AMIYAPUR	5200	16300	27100
19	SUGHAD	6200	15900	23000
20	NARMADA CANAL	2800	13900	32700
21	KOBA CIRCLE	13600	26700	44500
22	KOBA	3900	10400	20800
23	POR	3100	12800	30600
24	KUDASAN	2700	10800	24700
25	DHAULA KUVA	1900	13200	40700
26	INFOCITY	1800	10700	21700
27	INDRODA CIRCLE	4800	16000	45800
28	SECTOR7	32400	37400	60300
29	S.T.DEPOT	13100	29100	50000
30	SACHIVALAY	50600	82500	148000
31	AKSHARDHAM	36800	76300	125700
AHMEDABAD JUNCTION – THALTEJ				
1	AHMEDABAD JUNCTION	48800	65800	83500
2	PREM DARWAJA	21500	29800	32800
3	DELHI DARWAJA	18900	26000	30800
4	SHAHPUR DARWAJA	27000	34800	42000
5	AAYAKAR BHAVAN	19500	23300	27000
6	SARDAR PATEL STADIUM	17700	36400	39000
7	COMMERCE CIRCLE	8500	11100	15000
8	GUJARAT UNIVERSITY	13700	18500	23700
9	GURUKUL	24700	31600	43200
10	DOORDARSHAN KENDRA	12900	25400	34500
11	THALTEJ	45800	91300	153500
BARAJEDI – KALOL JUNCTION				
1	BARAJEDI	5100	8900	12700
2	BHAIPURA	5100	9000	13700
3	GERATPUR	2900	4200	7300
4	VIVEKANAND NAGAR	1500	2700	4700
5	VATVA GIDC	5900	10100	21500
6	VINZOL	14600	19400	22500
7	VATVA	6900	9300	13300
8	JASHODA NAGAR	26900	32300	41200
9	DAXINI SOCIETY	15100	20400	25300
10	MANINAGAR	24400	28700	34300
11	KANKARIA	30000	40000	47000
12	AHMEDABAD JUNCTION	20100	26300	31000
13	SARASPUR	6900	8200	11000
14	GIRDHARNAGAR	5000	7300	9300
15	SHAHIBAUG	7600	10500	13000
16	NATIONAL MEMORIAL	2100	2600	5900

Sl.No.	STATION NAME	Daily BOARDING / ALIGHTING		
		2010	2025	2035
17	POWER HOUSE	3500	5400	9300
18	SABARMATI	15700	24200	28600
19	RANIP	4900	8300	13800
20	KALI ROAD	6400	12200	16500
21	D CABIN	17400	34000	38500
22	CHANDKHEDA ROAD	3600	5100	10000
23	TRAGAD	3300	6700	12000
24	KHORAJ	5500	10800	17000
25	KHODIYAR	1800	6200	12000
26	DANTALI	1600	3700	11000
27	DHANEJ	1200	4000	8000
28	SAIJ SERTHA ROAD	2800	6200	8500
29	SAIJ VILLAGE	1600	4900	7200
30	GIDC KALOL	2500	5000	7500
31	KALOL JUNCTION	28100	53400	83400
AHMEDABAD JUNCTION – NARODA				
1	AHMEDABAD JUNCTION	15000	21000	26000
2	SARASPUR	7500	11000	16600
3	ASARVA	16500	23500	28500
4	CHAMANPURA	30800	44900	54800
5	MEGHANI NAGAR	21700	26700	32800
6	SAIJPUR	28500	36100	44400
7	SARDAR GRAM	20700	23900	29400
8	KUBER NAGAR	9500	11800	14000
9	NARODA	24800	31100	36500

2.12 Summary of Transport Demand Forecast

The summary of transport demand forecast are presented in **Table 2.30** and **Table 2.31** for the year 2010 & 2035, for the phase 1 Metro and Regional Rail corridors. It is seen that, with a network length of 94.7 km would carry 11.30 lakh & 25.90 lakh passengers per day, the passenger km carried would be 105.02 lakh & 263.77 lakhs and the intensity of utilisation (passenger km carried per km) would be 1.11 lakh & 2.79 lakh for the year 2010 and 2035 respectively.

Table 2.30 SUMMARY OF TRANSPORT DEMAND – 2010-PHASE 1

Section	Length (Km)	Number of Passengers (Lakhs)	Pass-Km (lakhs)	Pass-Km/km (lakhs).	Average Lead (km.)
A) Metro System					
Line – 1: APMC-AAYAKAR BHAVAN-SABARMATI – AKSHARDHAM	31.88	4.16	39.00	1.22	
Line – 2: AHMEDABAD JN. - AAYAKAR BHAVAN - THALTEJ	9.83	2.59	17.47	1.78	
B) Regional Rail System					
Line – 1: BAREJADI – AHMEDABAD JN. –KALOL JN.	43.49	2.80	34.39	0.79	
Line – 2: AHMEDABAD – NARODA	9.47	1.75	14.15	1.49	
TOTAL	94.67	11.30	105.02	1.11	9.29

Table 2.31 SUMMARY OF TRANSPORT DEMAND – 2035-PHASE 1

Section	Length (Km)	Number of Passengers (lakhs)	Pass-Km (lakhs)	Pass-Km/km (lakhs).	Average Lead(km.)
A) Metro System					
Line – 1: APMC-AAYAKAR BHAVAN-SABARMATI – AKSHARDHAM	31.88	11.95	119.92	3.76	
Line – 2: AHMEDABAD JN.- AAYAKAR BHAVAN - THALTEJ	9.83	5.15	38.34	3.90	
B) Regional Rail System					
Line – 1: BAREJADI – AHMEDABAD JN. –KALOL JN.	43.49	5.97	81.99	1.89	
Line – 2: AHMEDABAD – NARODA	9.47	2.83	23.52	2.48	
TOTAL	94.67	25.90	263.77	2.79	10.18